2012-2016 Paper 1

2017

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NOVEMBER 2016

(a) Find the value of $0,4 \times 0,002$,
giving the answer as a decimal fraction. [1]

(b) Simplify $\frac{2}{5}$ of $15x - 3x \times 1\frac{1}{3}$ [2]

SOLUTION

(a) Find the value of $0,4 \times 0,002$,
giving the answer as a decimal fraction. [1

$$0,4 \times 0,002 = 0,0008$$

(b) Simplify $\frac{2}{5}$ of $15x - 3x \times 1\frac{1}{3}$

$$\frac{2}{5}(15x - 3x \times 1\frac{1}{3})$$

$$= \frac{2}{5}(15x - 3x \times \frac{4}{3})$$

$$= \frac{2}{5}(15x - 4x)$$

$$= 15x \times \frac{2}{5} - 4x \times \frac{2}{5}$$

$$= 6x - 1\frac{3}{5}x$$

$$= 4\frac{2}{5}x$$

Q2

Express $2,54 \times 10^{-1}$

(a) In ordinary form. [1]

(b) as a fraction in its lowest terms. [1]

(c) as a percentage. [1]

SOLUTION

Express $2,54 \times 10^{-1}$

(a) In ordinary form. |

$= 0,254$

Express $2,54 \times 10^{-1}$

(b) as a fraction in its lowest terms.

$$= 0,254 \times \frac{1000}{1000}$$

$$= \frac{127}{500}$$

Q3

Evaluate

(a) $2^3 - 2^0$ [1]

(b) $\sqrt{1,6 \times 10^2 + 9}$ [2]

SOLUTION

Evaluate

(a) $2^3 - 2^0$ [1]

$= 2 \times 2 \times 2 - 1$

$= 8 - 1$

$= 7$

(b) $\sqrt{1,6 \times 10^2 + 9}$ [2]

$\sqrt{1,6 \times 10^2 + 9} = \sqrt{1,6 \times 100 + 9}$

$= \sqrt{160 + 9}$

$= \sqrt{169}$

$= \pm 13$

Q4

(a) Evaluate $413_5 - 34_5$, giving the answer in base 5. [1]

(b) Express 78_9 as a number in base 6. [2]

SOLUTION

(a) Evaluate $413_5 - 34_5$, giving the answer in base 5. [1]

$= 24_5$

(b) Express 78_9 as a number in base 6.

$78_9 = [7 \times 9^1 + 8 \times 9^0]_{10}$

$= [63 + 8]_{10}$

$= 71_{10}$

$71_{10} = 155_6$

Q5

(a) Factorise completely $6mn - 3n$ [1]

(b) Remove the brackets and simplify $x - 2y - 3(x - 2y)$. [2]

SOLUTION

(a) Factorise completely $6mn - 3n$ [1]

$= 3n(2m - 1)$

Q6

Solve the simultaneous equations:

$$3x - 2y = 9$$
$$4x + y = 1 \quad [3]$$

SOLUTION

$$3x - 2y = 9 \text{ eqn (i)}$$

$$4x + y = 1 \text{ eqn (ii)}$$

Multiply eqn(ii) by 2

$$2(4x + y = 1)$$

$$8x + 2y = 2$$

Add revised eqn(ii) and eqn(i)

$$3x + 8x - 2y + 2y = 9 + 2$$

$$11x = 11$$

$$\frac{11x}{11} = \frac{11}{11}$$

$$\therefore\ x = 1$$

Substitution in (ii)

4(1) + y=1

y=-3

Q7

Express

(a) $61{,}7^{\circ}$ in degrees and minutes. [1

(b) $11\,\dfrac{2}{3}$ m/s in km/h. [2]

SOLUTION

(a) 61,7° in degrees and minutes. [1]

= 61 degrees 42 minutes.

(b) $11\frac{2}{3}$ m/s in km/h.

$$= \frac{35}{3} \times \frac{60 \times 60}{1000}$$

$$= 42\text{km/h}$$

Q8

(a) Find $f(-2)$ given that $f(x) = \frac{x^2}{4} - \frac{5}{4}$ [1]

(b) Find the value of $(y+z)^x$, given that $x = 2$, $y = -2$ and $z = 5$. [2]

SOLUTION

(a) Find $f(-2)$ given that $f(x) = \frac{x^2}{4} - \frac{5}{4}$

$$f(-2) = \frac{(-2)^2}{4} - \frac{5}{4}$$

$$= \frac{4}{4} - \frac{5}{4}$$

$$= \frac{4-5}{4}$$

$$= -\frac{1}{4}$$

(b) Find the value of $(y+z)^x$, given that $x = 2$, $y = -2$ and $z = 5$.

$$= (-2+5)^2$$

$$= (3)^2$$

$$= 9$$

Q9

The interior angles of a regular polygon are 144° each.

(a) Find the number of sides of the polygon. [2]

(b) State the number of lines of symmetry of the polygon. [1]

SOLUTION

(a) Find the number of sides of the polygon. [2]

$$= \frac{360}{180^\circ - 144^\circ}$$
$$= \frac{360}{36}$$
$$= 10$$

(b) State the number of lines of symmetry of the polygon.

$$= 10$$

Q10

(a) Find the value of $3\sqrt{2} \times 5\sqrt{2}$ [1]

(b) Given that $6782 \times 65 = 440830$, find the value of

(i) $6,782 \times 0,65$ [1]

(ii) $440830 \div 6,5$ [1]

SOLUTION

(a) Find the value of $3\sqrt{2} \times 5\sqrt{2}$ [1]

$$= 3 \times \sqrt{2} \times 5 \times \sqrt{2}$$

$$= 3 \times 5 \times \sqrt{2} \times \sqrt{2}$$

$$= 15 \times 2$$

$$= 30$$

SOLUTION

(i) $6,782 \times 0,65$ [1]

$$= 4,40830$$

(ii) $440830 \div 6,5$

$$= 67820$$

Q11

On a map, a length of 5 cm represents an actual area of 1 km.

(a) Express the scale of the map in the form 1:n. [2]

(b) Calculate the actual distance, in kilometres, represented by 21 cm. [1]

SOLUTION

(a) Express the scale of the map in the form 1:n. [2]

$$5 \text{ cm} : 1 \text{ km}$$

$$5 \text{ cm} : 1 \times 1000 \times 100 \text{ cm}$$

$$5 \text{ cm} : 100000 \text{ cm}$$

$$\frac{5 \text{ cm}}{5} : \frac{100000 \text{ cm}}{5}$$

$$1 : 20000$$

Q12

A cuboid of height 8 cm has a volume of 320cm^3.

Find the volume of a similar cuboid of 6 cm. [3]

SOLUTION

Ratios ;
Lenght 6 : 8
Area 36 : 64
Volume 216 : 512

$\therefore$ if 512 = 320 what about 216

$$\frac{216}{512} \times 320 = 135 \text{ cm}^3$$

Q13

Its is given that $h = \dfrac{m(v^2 - u^2)}{2gx}$,

Make u the subejct of the formula. [3]

SOLUTION

$$h = \frac{m(v^2 - u^2)}{2gx}$$

$$h(2gx) = 2gx\left[\frac{m(v^2 - u^2)}{2gx}\right]$$

$$2ghx = m(v^2 - u^2)$$

$$\frac{2ghx}{m} = \frac{m(v^2 - u^2)}{m}$$

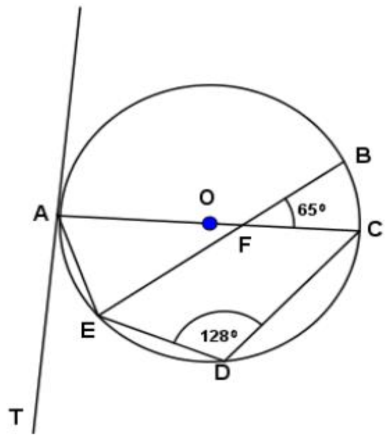
$$\frac{2ghx}{m} = v^2 - u^2$$

$$\frac{2ghx}{m} - v^2 = v^2 - v^2 - u^2$$

$$\frac{2ghx}{m} - v^2 = -u^2$$

$$-1(\frac{2ghx}{m} - v^2 = -u^2)$$

Q14



In the diagram, the points A, B, C, D and E lie on the circumference of the circle with centre O. EB and AC meet at F. TA is a tangent to the circle at A. Angle CDE = 128° and angle BFC = 65°

Calculate

(a) Angle TAE. [1]

(b) Angle AEB. [2]

SOLUTION

Calculate

(a) Angle TAE. [1]

Opposite angles of a cyclic quadrilateral are supplementary.
Hence angle EAF $= 180 - 128^\circ = 52^\circ$

The tangent to a circle is perpendicular to the radius drawn to the point of contact and conversly.
Angle TAF $= 90^\circ$

Hence angle TAE $= 90^\circ - 52^\circ = 38^\circ$

(b) Angle AEB. [2]

Angle BFC = EFA.

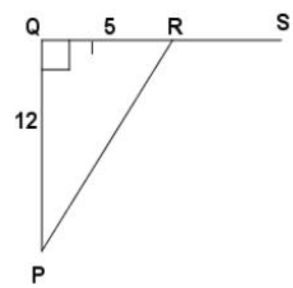
In (a) angle EAF $= 52^\circ$

Sum of interior angles of a triangle $= 180^\circ$

$\therefore$ angle AEB $= 180^\circ - 65^\circ - 52^\circ$

$= 63^\circ$

Q15



In the diagram, QRS is a straight line and PQR is a triangle such that angle PQR $= 90^\circ$, PQ = 12 cm and QR = 5 cm.

(a) Calculate PR. [1]

(b) Expressing the answer as a common fraction, write down the value of

(i) tan QPR, [1]

(ii) cos PRS [1]

SOLUTION

(a) Calculate PR. [1]

$$a^2 + b^2 = c^2$$

$$QP^2 + QR^2 = PR^2$$

$$12^2 + 5^2 = PR^2$$

$$144 + 25 = PR^2$$

$$169 = PR^2$$

$$\sqrt{169} = \sqrt{PR^2}$$

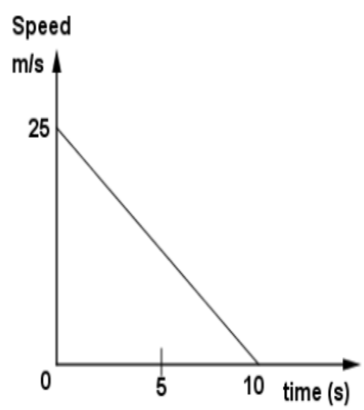
$$\therefore \ PR = \pm 13$$

(b) Expressing the answer as a common fraction, write down the value of

(i) tan QPR, [1]

$$= \frac{5}{12}$$

Q16



The graph show the motion of a car which decelerates uniformly from a speed of 25 m/s until it come to rest in 10 seconds.

Calculate the

(a) deceleration of the car during the 10 seconds. [2]

(b) tota distance travelled in the 10 seconds. [1]

SOLUTION

(a) deceleration of the car during the 10 seconds. [2]

$$= \frac{\text{Change in y}}{\text{Change in x}}$$

$$= \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{25 - 0}{0 - 10}$$

$$= \frac{25}{-10}$$

$$= -2,5 \text{ m/s}^2$$

b) tota distance travelled in the 10 seconds. [1]

Total Distance = Area Under Line/Curve

$$= \frac{1}{2} \times 25 \times 10$$

$$= 125 \text{ m}$$

Q17

Given that u varies jointly as x and as the square of y.

(a) express u in terms of x, y and a constant k. [1]

(b) find k, if $u = 14$ when $x = 1$ and $y = 2$. [2]

(c) find the value of u when $x = 6$ and $y = 3$. [1]

SOLUTION

(a) express u in terms of x, y and a constant k. [1]

$$u = kxy^2$$

(b) find k, if $u = 14$ when $x = 1$ and $y = 2$.

$$14 = k(1)(2^2)$$

$$14 = k4$$

$$\frac{14}{4} = \frac{k4}{4}$$

$$2\frac{2}{4} = k$$

$$\therefore\ k = 2,5$$

(c) find the value of u when $x = 6$ and $y = 3$.

$$u = 2,5(6)(3^2)$$

$$= 2,5(6)()9)$$

$$= 135$$

<u>Q18</u>

The equation of a straight line is given as $3y - 2x - 6 = 0$.

Find the

(a) gradient of the line. [1]

(b) coordinates of the point where the line crosses $y-$ axis. [1]

(c) equation, in the form $ax + by = c$, of a straight line paralle to the line $3y - 2x - 6 = 0$ and passing through $(-5; 2)$ [2]

SOLUTION

(a) gradient of the line. [1]

$$3y - 2x - 6 = 0$$

$$3y - 2x + 2x - 6 + 6 = 0 + 2x + 6$$

$$3y = 2x + 6$$

$$\frac{3y = 2x + 6}{3}$$

$$y = \frac{2}{3}\,x + 2$$

$$\therefore \text{ gradient is } \frac{2}{3}$$

(b) coordinates of the point where the line crosses $y-$ axis.

$$y = \frac{2}{3}\,x + 2$$

$$y = \frac{2}{3}\,x + 2$$

$$y = \frac{2}{3}\,(0) + 2$$

$$y = 2$$

$$(0;2)$$

(c) equation, in the form $ax + by = c,$ of a straight line paralle to the line $3y - 2x - 6 = 0$ and passing through $(-5;2)$ [2]

$$y = \frac{2}{3}\,x + c$$

$$2 = \frac{2}{3}\,-5 + c$$

$$2 = -3\,\frac{1}{3} + c$$

$$2 + 3\,\frac{1}{3} = -3\,\frac{1}{3} + 3\,\frac{1}{3} + c$$

$$5\,\frac{1}{3} = c$$

$$\therefore \text{ equation of parallel line is } y = \frac{2}{3}\,x + 5\,\frac{1}{3}$$

$$y - \frac{2}{3}\,x - 5\,\frac{1}{3} = 0$$

Q19

Given that $\log P = 2,4$ and $\log Q = 0,4,$ evaluate

(a) $\log \frac{1}{P}$, [2]

(b) $\frac{\log P^2}{\log Q}$ [2]

SOLUTION

(a) $\log \frac{1}{P}$, [2]

$$\log \frac{1}{P} = \log P^{-1}$$
$$= -1 \log P$$
$$= -1(2,4)$$
$$= -2,4$$

(b) $\frac{\log P^2}{\log Q}$ [2]

$$\frac{\log P^2}{\log Q} = \frac{2\log P}{\log Q}$$
$$= \frac{2 \times 2,4}{0,4}$$
$$= \frac{4,8}{0,4}$$
$$= 12$$

Q20

(a) A salesman receive a basic salary of $200,00 a month. In addition, he is paid a commission of 5% on his sales.

Calculate the gross salary in a month during which his sales amounted to $4000,00. [2]

(b) The side of an equilateral triangle is 6 cm to the nearest centimetre.

Calculate the least possible perimeter of the triangle. [2]

SOLUTION

(a) A salesman receive a basic salary of $200,00 a month. In addition, he is paid a commission of 5% on his sales.

Calculate the gross salary in a month during which his sales amounted to $4000,00. [2]

$$= \$200,00 + 0,05 \times \$4000,00$$

$$= \$200,00 + \$200,00$$

$$= \$400,00$$

(b) The side of an equilateral triangle is 6 cm to the nearest centimetre.

Calculate the least possible perimeter of the triangle. [2]

$$= 5,5 \times 3$$

$$= 16,5 \text{ cm}$$

Q21

It is given that $\overrightarrow{\mathrm{OA}} = 3p - 2q$ and $\overrightarrow{\mathrm{OB}} = p + 7q$.

(a) Find $\overrightarrow{\mathrm{AB}}$ in terms of p and q. [1]

(b) Given also that $\overrightarrow{\mathrm{AB}} = 3mp + (m - n)q$,

find the value of m and the value of n. [3]

SOLUTION

(a) Find $\overrightarrow{\mathrm{AB}}$ in terms of p and q. [1]

$$\overrightarrow{\mathrm{AB}} = \overrightarrow{\mathrm{AO}} + \overrightarrow{\mathrm{OB}}$$

$$= -1(3p - 2q) + p + 7q$$

$$= 2q - 3p + p + 7q$$

$$= 9q - 2p$$

(b) Given also that AB $= 3mp + (m - n)q$,

find the value of m and the value of n. [3]

$3m = -2$eqn (i)

$m - n = 9$ eqn (ii)

Solving eqn (i)

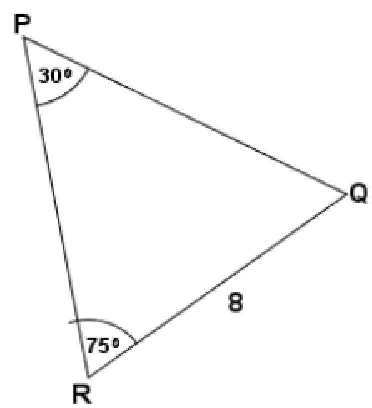
$3m = -2$

$$\frac{3m}{3} = \frac{-2}{3}$$

$$\therefore\ m = -\frac{2}{3}$$

Substitute m with $-\frac{2}{3}$ in eqn (ii)

Q22



In the diagram, PQR is a triangle which angle RPQ $= 30^\circ$, angle PRQ $= 75^\circ$ and RQ $= 8$ cm.

Using as much of the information given below as is necessary,

Calculate

(a) PQ, [3]

(b) area of triangle PQR. [2]

$$\begin{bmatrix} \sin 30^\circ = 0,50 & \cos 30^\circ = 0,87 & \tan 30^\circ = 0,58 \\ \sin 75^\circ = 0,97 & \cos 75^\circ = 0,26 & \tan 75^\circ = 3,73 \end{bmatrix}$$

SOLUTION

Calculate

(a) PQ, [3]

$$\frac{a}{\sin A}=\frac{b}{\sin B}$$
$$\frac{PQ}{\sin 75^\circ}=\frac{8}{\sin 30^\circ}$$
$$PQ=\frac{8\sin 75^\circ}{\sin 30^\circ}$$
$$=\frac{8\times 0,97}{0,5}$$
$$=4\times 0,97$$
$$=3,88$$

(b) area of triangle PQR. [2]

$$\text{Area of a Trinagle } =\frac{1}{2}ab\sin C$$

$$\text{Angle PQR } =180^\circ-75^\circ-30^\circ$$
$$=75^\circ$$

$$\therefore \text{ area } =\frac{1}{2}\times 8\times 3,88\times \sin 75^\circ$$
$$=4\times 3,88\times 0,97$$
$$=15,0544$$

Q23

The mass of 20 patients at a local hospital are shown in the table below.

Mass m kg	$100\geq m>80$	$80\geq m>70$	$70\geq m>60$
number of patients	5	8	7

(a) Calculate an estimate of the mean mass of the patient. [3]

(b) Two patients are chosen at random from the 20 patients.

Find the probability that they both have masses greater than 80 kg. [2]

SOLUTION

(a) Calculate an estimate of the mean mass of the patient. [3]

$$= \frac{100+80}{2} \times 5 + \frac{70+80}{2} \times 8 + \frac{70+60}{2} \times 7$$

$$= 90 \times 5 + 75 \times 8 + 65 \times 7$$

$$= 450 + 600 + 455$$

$$= 1505$$

$$= \frac{1505}{7+8+5}$$

$$= \frac{1505}{20}$$

$$= 75,25 \text{ kgs}$$

(b) Two patients are chosen at random from the 20 patients.

Find the probability that they both have masses greater than 80 kg. [2]

$$= \frac{5}{20} \times \frac{4}{19}$$

$$= \frac{1}{19}$$

Q24

The matrix $\begin{pmatrix} 3 & 0 \\ 0 & 3 \end{pmatrix}$ represents a transformation X.

(a) Find the coordinates of the image of the point $(-1;4)$ under X. [2]

(b) Describe fully the single transformation X. [3]

SOLUTION

(a) Find the coordinates of the image of the point $(-1;4)$ under X. [2]

$$(-1;4)\begin{pmatrix}3 & 0\\ 0 & 3\end{pmatrix} = (-1\times 3+4\times 0 \quad -1\times 0+4\times 3)$$

$$= (-3;12)$$

(b) area of triangle PQR. [2]

$$\text{Area of a Trinagle} = \frac{1}{2}ab\sin C$$

$$\text{Angle PQR} = 180^\circ - 75^\circ - 30^\circ$$
$$= 75^\circ$$

$$\therefore \text{ area} = \frac{1}{2}\times 8\times 3,88\times \sin 75^\circ$$

$$= 4\times 3,88\times 0,97$$

$$= 15,0544$$

Q25

(a) Given that x and y are integers such that $1 \geq x \geq -4$ and $8 \geq y \geq 4$

find the greatest value of $\dfrac{2y}{3x}$, [2]

(b) Solve the inequality

$2x+4 > 4x+1 \geq x-2$ giving the answer in the form $b > x \geq a$

where a and b are constants. [3]

SOLUTION

(a) Given that x and y are integers such that $1 \geq x \geq -4$ and $8 \geq y \geq 4$

find the greatest value of $\dfrac{2y}{3x}$, [2]

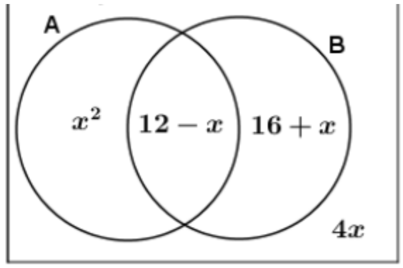
$$\frac{2y}{3x} = \frac{2(8)}{3(1)}$$
$$= \frac{16}{3}$$
$$= 5\,\frac{1}{3}$$

(b) Solve the inequality
$2x + 4 > 4x + 1 \geq x - 2$ giving the answer in the form $b > x \geq a$
where a and b are constants. [3]

$$2x + 4 > 4x + 1$$
$$2x - 2x + 4 - 1 > 4x - 2x + 1 - 1$$
$$3 > 2x$$
$$\frac{3}{2} > \frac{2x}{2}$$
$$1\,\frac{1}{2} > x$$

$$4x + 1 \geq x - 2$$
$$4x - x + 1 - 1 \geq x - x - 2 + 1$$
$$3x \geq -1$$
$$\frac{3x}{3} \geq \frac{-1}{3}$$
$$x \geq -\frac{1}{3}$$

$$1\,\frac{1}{2} > x \geq -\frac{1}{3}$$



The Venn diagram shows the universal set Q with its subsets A and B. The number of elements in each region are expressed in terms of x as above.

(a) Write an expression in terms of x for $n(AUB)$ [1]

(b) Given that $n\text{Q} = 40$, form an equation in x and show that it reduces to $x^2 + 4x - 12 = 0$ [2]

(c)(i) Solve the equation $x^2 + 4x - 12 = 0$ [2]

(ii) Hence find $n(A' \cap B)$ [1]

SOLUTION

(a) Write an expression in terms of x for $n(AUB)$ [1]

$$x^2 + 12 - x + 16 + x$$

$$x^2 + 12 + 16 - x + x$$

$$x^2 + 28$$

(b) Given that $n\text{Q} = 40$, form an equation in x and show that it reduces to $x^2 + 4x - 12 = 0$ [2]

$$x^2 + 28 + 4x = 40$$

$$x^2 + 4x + 28 - 40 = 40 - 40$$

$$x^2 + 4x - 12 = 0$$

(c)(i) Solve the equation $x^2 + 4x - 12 = 0$ [2]

$$x^2 + 4x - 12 = 0$$

$$(x-2)(x+6) = 0$$

$$\begin{gathered} x - 2 = 0 \\ x - 2 + 2 = 0 + 2 \\ x = 2 \end{gathered}$$

$$\begin{gathered} x + 6 = 0 \\ x + 6 - 6 = 0 - 6 \\ x = -6 \end{gathered}$$

$$\therefore\ x = 2 \text{ or } -6$$

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Q1

Evaluate

(a) $1,4 + 0,04$ [1]

(b) $5\,\frac{1}{4} \div 3\,\frac{1}{2}$ [2]

SOLUTION

(a) $1,4 + 0,04$ [1]

$$= 1,44$$

$$\begin{aligned} 5\,\frac{1}{4} \div 3\,\frac{1}{2} &= \frac{21}{4} \div \frac{7}{2} \\ &= \frac{21}{4} \times \frac{2}{7} \\ &= \frac{3}{2} \\ &= 1\,\frac{1}{2} \end{aligned}$$

Q2

(a) Express 31,095 correct to

(i) 2 decimal places, [1]

(ii) 2 significant figures. [2]

(b) Express $\frac{7}{30}$ as a recurring decimal fraction. [1]

SOLUTION

i) 2 decimal places, [1]

$= \mathbf{31,10}$

(ii) 2 significant figures. [2]

$= 31$

(b) Express $\frac{7}{30}$ as a recurring decimal fraction. [1]

$= 0,2333...$

Q3

(a) It is given that 0; 1; 8; 27; _;...... is a pattern.

State the next term of the pattern. [1]

(b) A length h measured to 1 decimal place is given as 9,5 cm.

State its limits. [2]

SOLUTION

(a) It is given that 0; 1; 8; 27; _;...... is a pattern.

State the next term of the pattern. [1]

$0^3; 1^3; 2^3; 3^3; 4^3$

$\therefore$ next term is 64

(b) A length h measured to 1 decimal place is given as 9,5 cm.

State its limits. [2]

$$9,65 > h \geq 9,45$$

Q4

(a) Factorise completely $x^2 - \frac{1}{36}$ [1]

(b) Remove brackets and simplify $(4a+b)(5a-3b)$ [2]

SOLUTION

(a) Factorise completely $x^2 - \frac{1}{36}$ [1]

$$x^2 - \frac{1}{36} = \left(x - \frac{1}{6}\right)\left(x + \frac{1}{6}\right)$$

(b) Remove brackets and simplify $(4a+b)(5a-3b)$ [2]

$$(4a+b)(5a-3b)$$

$$4a \times 5a + 4a \times (-3b) + b \times 5a + b \times (-3b)$$

$$20a^2 - 12ab + 5ab - 3b^2$$

$$20a^2 - 7ab - 3b^2$$

Q5

Solve the simultaneous equations

$$6y - 3x = 1$$
$$3x + y = 13 \quad [3]$$

SOLUTION

$$6y - 3x = 1 \text{ eqn (i)}$$

$$3x + y = 13 \text{ eqn (ii)}$$

Add eqn (i) and eqn (ii)

$$6y + y - 3x + 3x = 1 + 13$$

$$7y = 14$$

$$\frac{7y}{7} = \frac{14}{7}$$

$$\therefore\ y = 2$$

Substitute y with 2 in eqn (ii)

$$3x + 2 = 13$$

$$3x + 2 - 2 = 13 - 2$$

Q6

It is given that ∄=0; 1; 2; 3; 4; 5; 6; 7; 8; 9 ,
A is a set of prime numbers and B is a set of factors of 12.

(a) List the elements of

(i) A. [1]

(ii) A⋂B. [1]

(b) Find n(A⋃B)′ [1]

SOLUTION

(i) A. [1]

2; 3; 5; 7 only. NB 0 and 1 are not considered as prime numbers.

(ii) A⋂B. [1]

2 and 3

(b) Find n(A⋃B)′ [1]

$$A \bigcup B = 1;\ 2;\ 3;\ 4;\ 5;\ 6;\ 7.$$

$$(A \bigcup B)' = 0;\ 8;\ 9.$$

$$\therefore\ n(A \bigcup B)' = 3$$

Q7

(a) Expand 1234_5 in powers of 5. [1]

(b) Evauate $1011_2 + 111_2$ giving the answer in base 2. [2].

SOLUTION

(a) Expand 1234_5 in powers of 5. [1]

$= 1 \times 5^3 + 2 \times 5^2 + 3 \times 5^1 + 4 \times 5^0$

(b) Evauate $1011_2 + 111_2$ giving the answer in base 2. [2].

$1011_2 + 111_2 = 10010_2$

Q8

(a) Express 0,5 litres in cm^3 [1]

b) A woman earning $275 had her salary increased by 5%.

Calculate her new salary. [2]

SOLUTION

(a) Express 0,5 litres in cm^3 [1]

$= 500\ cm^3$

(b) A woman earning $275 had her salary increased by 5%.

Calculate her new salary. [2]

$= \$275 + 0,05 \times \$275$

$= \$275 + \$13,75$

$= \$288,75$

Q9*

If $f(x) = \frac{1}{x^2}$, $x \neq 0$, find

(a) $f(-3)$, [1]

(b) the value of x when $f(x) = 1$. [2

SOLUTION

(a) $f(-3)$, [1]

$$= \frac{1}{(-3)^2}$$

$$= \frac{1}{9}$$

$$= 0,1111.....$$

(b) the value of x **when** $f(x) = 1$. [2]

$$\frac{1}{x^2} = 1$$

$$\frac{1}{x^2} - 1 = 1 - 1$$

$$\frac{1}{x^2} - 1 = 0$$

$$\left(\frac{1}{x} - 1\right)\left(\frac{1}{x} + 1\right) = 0$$

$$\frac{1}{x} - 1 + 1 = 0 + 1$$

$$\frac{1}{x} = 1$$

$$x = 1 \text{ or}$$

$$\frac{1}{-} + 1 - 1 = 0 - 1$$

Q10

Given that $x = aq^2 + bq^2$, express q in terms of a, b and x. [3]

SOLUTION

$$x = aq^2 + bq^2$$

$$x = q^2(a+b)$$

$$\frac{x}{a+b} = \frac{q^2(a+b)}{a+b}$$

$$\frac{x}{a+b} = q^2$$

$$\sqrt{\frac{x}{a+b}} = \sqrt{q^2}$$

$$\therefore\ q = \sqrt{\frac{x}{a+b}}$$

Q11

If V varies jointly as h and the square of r,

(a) write down the equation connecting V, r, h and a constant c. [1

(b) find c if $V = 440$, $r = 2$ and $h = 35$. [2]

SOLUTION

(a) write down the equation connecting V, r, h and a constant c

$$V = chr^2$$

(b) find c if $V = 440$, $r = 2$ and $h = 35$.

$$440 = c(35)(2^2)$$

$$440 = c(35)(4)$$

$$440 = c(140)$$

$$\frac{440}{140} = \frac{c(140)}{140}$$

$$\therefore\ c = 3\frac{1}{7}$$

Q12

(a) Solve the inequality, $-2(2x-7) \geq 38$ [2]

SOLUTION

$$-2(2x-7) \geq 38$$

$$-4x+14 \geq 38$$

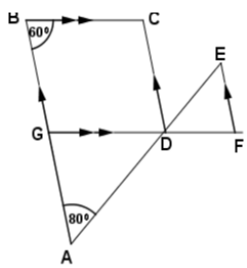
$$-4x+4x+14-38 \geq 38-38+4x$$

$$-24 \geq 4x$$

$$\frac{-24}{4} \geq \frac{4x}{4}$$

$$-6 \geq x$$

Q13



In the diagram AB, DC and FE are parallel. BC is parallel to GF.
Angle GBC = 60° and angle BAD = 80°

Find

(a) angle BGD. [1]

(b) angle ADG. [1]

(c) angle DEF. [1]

SOLUTION

Find

(a) angle BGD.

$$= 180^\circ - 60^\circ$$

$$= 120^\circ$$

(b) angle ADG. [1]

$$= 180^\circ - 60^\circ - 80^\circ$$

$$= 40^\circ$$

c) angle DEF.

$$= 80^\circ$$

Q14

Given that $r = 9 \times 10^6$, evalutae, leaving the answers in standard form

(a) $2r$ [1]

(b) r^2 [1]

(c) $\sqrt{r}$ [1]

SOLUTION

(a) $2r$ [1]

$$2r = 2(9 \times 10^6)$$

$$= 18 \times 10^6$$

$$= 1,8 \times 10^7$$

(b) r^2 [1]

$$r^2 = (9 \times 10^6)^2$$

$$= 9^2 \times 10^{6 \times 2}$$

$$= 81 \times 10^{12}$$

$$= 8,1 \times 10^{13}$$

(c) $\sqrt{r}$ [1]

$$\sqrt{r} = \sqrt{9 \times 10^6}$$

$$= (9 \times 10^6)^{\frac{1}{2}}$$

$$= 9^{\frac{1}{2}} \times 10^{\frac{1}{2} \times 6}$$

$$= 3 \times 10^3$$

Q15

The table shows the size of shoes worn by school pupils in a class.

Shoe size	5	6	7	8	9
Frequency	6	14	12	8	2

Find

(a) the total number of pupils in the class. [1]

(b) the modal shoe size. [1]

(c) the median shoe size. [1]

SOLUTION

(a) the total number of pupils in the class.

$= 6 + 14 + 12 + 8 + 2$

$= 42$

(b) the modal shoe size.

$= 6$

(c) the median shoe size.

$= 7$

Q16

The equation of a straight line l is $3x - 5y = 30$.

Find

(a) the gradient of the line l [1]

(b) the equation of a line parallel to line l passing through the points $(-5; 3)$ in the form $y = mx + c$. [2]

SOLUTION

(a) the gradient of the line l [1]

$$3x - 5y = 30$$

$$3x - 5y + 5y - 30 = 30 - 30 + 5y$$

$$3x - 30 = 5y$$

$$\frac{3x - 30 = 5y}{5}$$

$$y = \frac{3}{5}x - 6$$

$$\therefore \text{ gradient is } \frac{3}{5}$$

(b) the equation of a line parallel to line l passing through the points $(-5; 3)$ in the form $y = mx + c$. [2]

$$y = \frac{3}{5}x + c$$

$$3 = 0,6(-5) + c$$

$$3 = -3 + c$$

$$3 + 3 = -3 + 3 + c$$

$$6 = c$$

$\therefore$ equation of parallel line is $y = 0,6x + 6$

Q17

The scale of a map is given as 1: 250 000

Find

(a) the distance on the ground, in km, represented by a length of 5 cm on the map. [1]

(b) the actual area in km^2 represented by an area of 6 cm^2 on the map. [2]

SOLUTION

(a) the distance on the ground, in km, represented by a length of 5 cm on the map. [1]

$$= \frac{5 \times 250000}{100000}$$

$$= 12,5 \text{ km}$$

(b) the actual area in km^2 represented by an area of $6\ cm^2$ on the map.

$$1\ \text{cm} = 2.5\ \text{km}$$

$$6\ \text{cm}^2 = 1\ \text{cm times } 6\ \text{cm}$$

$$= 2,5 \times (2,5 \times 6)$$

$$= 12,5\ \text{km}^2$$

Q18

The size of each interior angle of a regular polygon is 135°.

(a) Find

(i) the size of each exterior angle. [1]

(ii) the order of rotational symmetry of the regular polygon. [1]

(b) State the special name of the regular polygon. [1]

SOLUTION

(i) the size of each exterior angle

$$= 180^\circ - 135^\circ$$

$$= 45^\circ$$

(ii) the order of rotational symmetry of the regular polygon.

$$= \frac{360^\circ}{45^\circ}$$

$$= 8$$

b) State the special name of the regular polygon.

= Octagon

Q19

Simplify $\dfrac{1}{a^2-3a+2}+\dfrac{1}{1-a}$ [3]

SOLUTION

$$\frac{1}{a^2-3a+2}+\frac{1}{1-a}$$
$$\frac{1}{(a-1)(a-2)}+\frac{1}{1-a}$$
$$\frac{1}{(a-1)(a-2)}+\frac{1}{1-a}\times\frac{-1}{-1}$$
$$\frac{1}{(a-1)(a-2)}+\frac{-1}{a-1}$$
$$\frac{1-1(a-2)}{(a-1)(a-2)}$$
$$\frac{1-a+2}{(a-1)(a-2)}$$
$$\frac{3-a}{(a-1)(a-2)}$$

Q20

A motorist left Masvingo for Beitbridge at 2102. The motorist spend 1 hour 30 minutes mending a punture and 3 hours driving. The motorist's average speed for the journey was 64 km/h.

(a) Express 2102 as a time on the 12 hour clock. [1]

(b) Find the arrival time in Beitbridge in 24 hour notation. [1]

(c) Calculate the distance between Masvingo and Beitbridge. [1]

SOLUTION

(a) Express 2102 as a time on the 12 hour clock.

$= 9:02$ pm

(b) Find the arrival time in Beitbridge in 24 hour notation.

$= 0132$ hrs

(c) Calculate the distance between Masvingo and Beitbridge.

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

$$64 = \frac{x}{4,5}$$

$$64(4,5) = (4,5)\frac{(}{x})4,5$$

$$x = 288 \text{ km}$$

Q21

The matrix $A = \begin{bmatrix} -2 & -14 \\ 2 & x \end{bmatrix}$, and $|A| = 2$.

(a) Find the value of x. [2]

(b) Hence find A^{-I} [2]

SOLUTION

(a) Find the value of x. [2]

$$ad - bc = 2$$

$$-2(x) - (-14)(2) = 2$$

$$-2x + 28 = 2$$

$$-2x + 28 - 28 = 2 - 28$$

$$-2x = -26$$

$$\frac{-2x}{-2} = \frac{-26}{-2}$$

$$\therefore x = 13$$

(b) Hence find A^{-I} [2]

$$= \frac{1}{2}\begin{bmatrix} 13 & 14 \\ -2 & 2 \end{bmatrix}$$

$$= \begin{bmatrix} 13 \times \frac{1}{2} & 14 \times \frac{1}{2} \\ -2 \times \frac{1}{2} & 2 \times \frac{1}{2} \end{bmatrix}$$

$$= \begin{bmatrix} 6\frac{1}{2} & 7 \\ -1 & 1 \end{bmatrix}$$

Q22

(a) Given that $\log_b M = x$, express M in terms of b and x. [1]

(b) Evaluate

(i) $\log_4 \frac{1}{64}$ [1]

(ii) $\frac{\log 81}{\log 27}$ [2]

SOLUTION

(a) Given that $\log_b M = x$, express M in terms of b and x.

$$M = b^x$$

(i) $\log_4 \frac{1}{64}$ [1]

$$\log_4 \frac{1}{64} = \log_4 64^{-1}$$
$$= \log_4 (4^3)^{-1}$$
$$= -3\log_4 4$$
$$= -3(1)$$
$$= -3$$

(ii) $\frac{\log 81}{\log 27}$ [2]

$$\frac{\log 81}{\log 27} = \frac{\log 3^4}{\log 3^3}$$
$$= \frac{4\log 3}{3\log 3}$$
$$= \frac{4}{3}$$
$$= 1\,\frac{1}{3}$$

Q23

		Coin 1	
		H	T
Coin 2	H	H H	
	T		T T

Two unbiased coins, coin 1 and coin 2 are toseed and the outcomes recorded in a table.

(a) Complete the outcome table given above, where H is a head and T is a tail. [1]

(b) Using the table or otherwise find the probability of getting

(i) 2 heads. [1]

(ii) different outcomes. [1]

(iii) at least one tail. [1]

SOLUTION

		Coin 1	
		H	T
Coin 2	H	H H	H T
	T	T H	T T

(b) Using the table or otherwise find the probability of getting

(i) 2 heads. [1]

$$= \frac{1}{4}$$

(ii) different outcomes.

$$= \frac{1}{2}$$

(iii) at least one tail.

$$= \frac{3}{4}$$

Q24

(a) On a certain day, US$100 was exchanged for R880.

Calculate the equivalent value of R165 in US$ on that day. [2]

(b) An object starts from rest and accelerates uniformly until its speed is 90km/h in 5 seconds.

(i) Express 90 km/h in m/s. [2]

(ii) Calculate the acceleration of the object in m/s^2. [1]

SOLUTION

(a) On a certain day, US$100 was exchanged for R880.

Calculate the equivalent value of R165 in US$ on that day

$$= \frac{165}{880} \times 100$$

$$= \$18,75$$

(i) Express 90 km/h in m/s.

$$= \frac{90 \times 1000}{60 \times 60}$$

$$= \frac{90000}{3600}$$

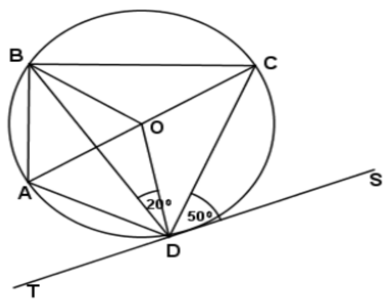
$$= 25 \text{ m/s}$$

(ii) Calculate the acceleration of the object in m/s^2.

$$= \frac{25}{5}$$

$$= 5 \text{ m/s}^2$$

Q25



In the diagram, points A, B, C and D are on the circumference of a circle with centre O. Angle CDS $= 50^\circ$ and angle BDO $= 20^\circ$.
Line TS is a tangent to the circle at D.

Calculate

(a) angle DBC. [1]

(b) angle DOC. [1]

(c) angle ODC. [1]

(d) angle ABD. [1]

SOLUTION

Calculate

(a) angle DBC.

$= 50^\circ$

(b) angle DOC.

$= 100^\circ$

(c) angle ODC.

$= 40^\circ$

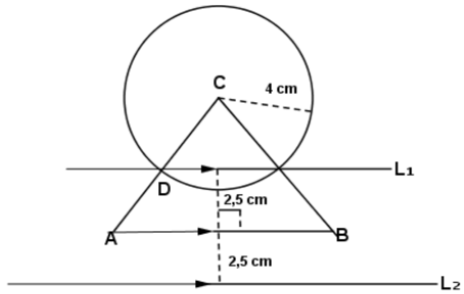
(d) angle ABD.

$= 30^\circ$

(e) angle DAC.

$= 50^\circ$

Q26



The diagram shows a triangle ABC, circle centre C of radius 4 cm and two straight lines L_1 and L_2. This diagram is not to scale.

(a) Describe fully the locus represented by the circle, centre C. [2]

(b) Describe fully the locus represented by the lines L_1 and L_2. [2]

(c) Describe the position of point D. [2]

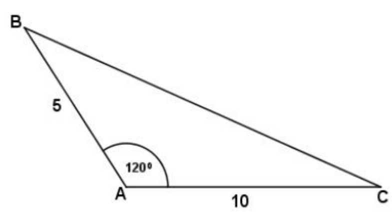
SOLUTION

(a) Defines all possible points 4 cm away from C.

(b) Defines all points 2.5 cm away, above and below from the length of line AB

(c) Point D is 2.5 cm away from line AB, 4 cm away from point C along the length of line AC.

Q27



(a) In the diagram AB = 5 cm and AC = 10 cm and angle BAC = 120

Using as much of the information given below as is necessary, calculate the

(i) area of the triangle ABC. [2]

(ii) length of BC, leaving the answer in surd form. [3]

(b) Point Q is on a bearing of S35°E from P.

Calculate the three figure bearing of P from Q. [1]

SOLUTION

(i) area of the triangle ABC.

$$= \frac{1}{2}ab \sin C$$

$$= \frac{1}{2} \times 10 \times 5 \times 0,86$$

$$= 21,5 \text{ cm}^2$$

(ii) length of BC, leaving the answer in surd form.

$$a^2 = b^2 + c^2 - 2bc \cos A$$

$$BC^2 = 5^2 + 10^2 - 2 \times 5 \times 10 \times 0,5$$

$$= 25 + 100 - 50$$

$$= 75$$

$$\sqrt{BC^2} = \sqrt{75}$$

$$= \sqrt{25 \times 3}$$

$$= 5\sqrt{3}$$

(b) $= 325^\circ$

NOVEMBER 2015

Q1

(a) Find the value of $\frac{8}{0,04}$ [1]

(b) Simplify $1\frac{1}{2} - \frac{4}{7} \div \frac{2}{3}$
giving the answer as a fraction in its simplest form. [2]

SOLUTION

$$\frac{8}{0,04} = \frac{8}{0,04} \times \frac{100}{100}$$

$$= \frac{800}{4}$$

$$= 200$$

$$1\,\frac{1}{2}-\frac{4}{7}\div\frac{2}{3}=\frac{3}{2}-\frac{4}{7}\times\frac{3}{2}$$
$$=\frac{3}{2}-\frac{6}{7}$$
$$=\frac{3(7)-6(2)}{14}$$
$$=\frac{21-12}{14}$$
$$==\frac{9}{14}$$

Q2

Given that $p=-4,\ q=3$ and $r=-1,$ evaluate

(a) $\frac{p+q}{r}$ [1]

(b) $\sqrt{p^2q-r}$ [2]

SOLUTION

$$\frac{p+q}{r}=\frac{-4+3}{-1}$$
$$=\frac{-1}{-1}$$
$$=1$$

$$\sqrt{p^2q-r}=\sqrt{(-4)^2(3)-(-1)}$$
$$=\sqrt{16(3)+1}$$
$$=\sqrt{49}$$
$$=\pm 7$$

Q3

In an athletics competition, under 20 boys compete in a 5 000m race, while under 16 boys compete in a 3 000m race.

(a) Calculate the difference in the distances they run giving the answer in standard form. [2]

(b) A lap is 400m long. Find the number of laps in the 5 000m race. [1].

SOLUTION

(a) Calculate the difference in the distances they run

$$= 5000 - 3000$$

$$= 2000$$

$$= 2,0 \times 10^3 \text{ m}.$$

(b) A lap is 400m long. Find the number of laps in the 5 000m race.

$$\frac{5000}{400} = 12,5$$

Q4

It is given that $\overrightarrow{OP} = \begin{bmatrix} -2 \\ 7 \end{bmatrix}$ and $\overrightarrow{OQ} = \begin{bmatrix} 12 \\ -5 \end{bmatrix}$ were O is the origin.

(a) Express $\overrightarrow{PQ}$ as a column vector. [1]

(b) Find

(i) $|\overrightarrow{OQ}|$ [1]

(ii) the co-ordinates of M, the midpoint of PQ. [1

SOLUTION

(a) Express $\overrightarrow{PQ}$ as a column vector.

$$\overrightarrow{PQ} = \overrightarrow{PO} + \overrightarrow{OQ}$$

$$= -1\begin{bmatrix} -2 \\ 7 \end{bmatrix} + \begin{bmatrix} 12 \\ -5 \end{bmatrix}$$

$$= \begin{bmatrix} 2 + 12 \\ -7 - 5 \end{bmatrix}$$

$$= \begin{bmatrix} 14 \\ -12 \end{bmatrix}$$

(i) $|\overrightarrow{OQ}|$ [1]

$$= \sqrt{(12)^2 + (-5)^2}$$
$$= \sqrt{144 + 25}$$
$$= \sqrt{169}$$
$$= \pm 13$$

(ii) the co-ordinates of M, the midpoint of PQ.

$$= \frac{1}{2}\left[\overrightarrow{OP} + \overrightarrow{OQ}\right]$$
$$= \frac{1}{2}\begin{bmatrix} -2 + 12 \\ 7 + -5 \end{bmatrix}$$
$$= \frac{1}{2}\begin{bmatrix} 10 \\ 2 \end{bmatrix}$$
$$= \begin{bmatrix} 10 \times \frac{1}{2} \\ 2 \times \frac{1}{2} \end{bmatrix}$$
$$= \begin{bmatrix} 5 \\ 1 \end{bmatrix}$$
$$= (5; 1)$$

Q5

a) Express $1 \times 3^5 + 2 \times 3^3 + 3$ as a number in base 3. [1]

(b) Convert 101_{10} to a number in base 9. [1]

(c) Evaluate $203_7 - 154_7$ giving the answer in base 7. [1]

SOLUTION

(a) Express $1 \times 3^5 + 2 \times 3^3 + 3$ as a number in base 3.

$$= 1 \times 3^5 + 0 \times 3^4 + 2 \times 3^3 + 0 \times 3^2 + 1 \times 3^1 + 0 \times 3^0$$
$$= 102010_3$$

(b) Convert 101_{10} to a number in base 9.

$$= 122_9$$

(c) Evaluate $203_7 - 154_7$ giving the answer in base 7.

$$= 16_7$$

Q6

Solve the simultaneous equations.

$$2x + 3y = 28$$
$$x + 5y = 35 \quad [3]$$

SOLUTION

$$\text{eqn (i)} \quad 2x + 3y = 28$$

$$\text{eqn (ii)} \quad x + 5y = 35$$

$$\text{eqn (ii)} \quad x + 5y = 35$$

$$x + 5y - 5y = 35 - 5y$$

$$x = 35 - 5y$$

Substituting x with revised eqn (ii) in eqn (i)

$$2x + 3y = 28$$

$$2(35 - 5y) + 3y = 28$$

$$70 - 10y + 3y = 28$$

$$70 - 7y = 28$$

y=6

x=5

Q7

Solve the equation.

$$\frac{2y+5}{3y-2} = \frac{9}{4} \quad [3]$$

SOLUTION

$$\frac{2y+5}{3y-2} = \frac{9}{4}$$

$$(3y-2)\left(\frac{2y+5}{3y-2}\right) = \frac{9}{4}(3y-2)$$

$$2y + 5 = \frac{9}{4}(3y-2)$$

$$4(2y+5) = \frac{9}{4}(3y-2)(4)$$

$$8y + 20 = 9(3y - 2)$$

$$8y + 20 = 27y - 18$$

$$8y - 8y + 20 + 18 = 27y - 8y - 18 + 18$$

$$38 = 19y$$

$$\frac{38}{19} = \frac{19y}{19}$$

y=2

Q8

Make a the subeject of the formula.

$$\frac{1}{a}+\frac{1}{b}=3 \quad [3]$$

SOLUTION

$$\frac{1}{a}+\frac{1}{b}=3$$

$$\frac{1}{a}+\frac{1}{b}-\frac{1}{b}=3-\frac{1}{b}$$

$$\frac{1}{a}=3-\frac{1}{b}$$

$$\left(\frac{1}{a}\right)^{-1}=\left(3-\frac{1}{b}\right)^{-1}$$

$$\therefore\ a=\left(3-\frac{1}{b}\right)^{-1}$$

Q9

When baking scones, a baker mixes SIX cups of FLOUR, ONE cup of SUGAR, TWO cups of WATER and HALF cup of MILK together with other ingredients.

(a) Express the quantities of flour, sugar, water and milk as a ratio in its simplest form. [1]

(b) Calculate the number of cups of water needed if the baker uses four cups of flour. [2]

SOLUTION

(a) Express the quantities of flour, sugar, water and milk as a ratio in its simplest form. [1]

$$(= 6:1:2:\frac{1}{2}) \times 2$$

$$= 12:2:4:1$$

(b) Calculate the number of cups of water needed if the baker uses four cups of flour. [2]

Flour: Water ratio

6 : 2 or 1 cup of flour for every $\frac{1}{3}$ cup of water.

$$= 4 \times \frac{1}{3}$$

$$= \frac{4}{3}$$

$$= 1\frac{1}{3}$$

Q10

The probability that Sihle will bring a calculator is $\frac{5}{6}$

while the probability that Yemurai will bring a calculator is $\frac{3}{5}$

Giving the answer as a fraction in its simplest form,
find the probability that,

(a) Sihle will not bring a calculator for the lesson. [1]

(b) only one of them will bring a calculator for the lesson. [2]

SOLUTION

(a) Sihle will not bring a calculator for the lesson.

$$= 1 - \frac{5}{6}$$

$$= \frac{1}{6}$$

(b) only one of them will bring a calculator for the lesson.

$$= (\frac{5}{6} \times \frac{2}{5}) + (\frac{1}{6} \times \frac{3}{5})$$

$$= \frac{10}{30} + \frac{3}{30}$$

$$= \frac{13}{30}$$

Q11

(a) Write down the special name given to a polygon with five sides. [1]

(b) State for a regular five sided polygon,

(i) the number of lines of symmetry. [1]

(ii) the order of rotational symmetry. [1]

SOLUTION

(a) Pentagon

(b)

(i) the number of lines of symmetry.

5

(ii) the order of rotational symmetry.

5

Q12

Solve the inequality $11 > 2x - 1 \geq 2 - x$ giving your answer in the form $b > x \geq a$ where a and b are integers. [3]

SOLUTION

$$11 > 2x - 1 \geq 2 - x$$

$$11 > 2x - 1 \text{ and } 2x - 1 \geq 2 - x$$

$$11 > 2x - 1$$

$$11 + 1 > 2x - 1 + 1$$

$$12 > 2x$$

$$\frac{12}{2} = \frac{2x}{12}$$

$$6 > x$$

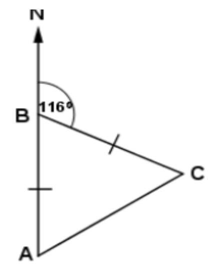
$$2x - 1 \geq 2 - x$$

$$2x + x - 1 + 1 \geq 2 + 1 - x + x$$

$$3x \geq 3$$

6>x≥1

Q13



In the diagram, A, B and C are positions of 3 boreholes where BA = BC
The borehole at C has a bearing of 116° from the borehole at B.

Calculate

(a) Angle ACB. [1]

(b) The bearing of the borehole at A from the borehole at C. [2]

SOLUTION

Calculate

(a) Angle ACB.

$$= \frac{116}{2}$$

$$= 58^\circ$$

(b) The bearing of the borehole at A from the borehole at C

$$= 180^\circ + 116^\circ - 58^\circ$$

$$= 238^\circ$$

Q14

(a) If $\log_{10} 7 = 0,8451$, evaluate

(i) $\log_{10} 0,007$ [1]

(ii) $\log_{10} 49$ [1]

(b) Evaluate $\log_2 \left[\frac{1}{64} \right]$ [2]

SOLUTION

(i) $\log_{10}0,007$ [1]

$\log_{10}0,007 = \log_{10}7 - 3$

$= 0,8451 - 3$

$= -2,1549$ or long route.

$\log_{10}0,007 = \log_{10}7 \times 10^{-3}$

$= \log_{10}7 + \log_{10}10^{-3}$

$= \log_{10}7 + (-3)\log_{10}10$

$\log_{10}10 = 1$

$= \log_{10}7 - 3 \times 1$

$= 0,8451 - 3$

= -2.1149

(ii) $\log_{10}49$ [1]

$\log_{10}49 = \log_{10}7^2$

$= 2\log_{10}7$

$= 0,8451 \times 2$

$= 1,6902$

(b) Evaluate $\log_2\left[\frac{1}{64}\right]$

$= \log_2 64^{-1}$

$= \log_2(2^6)^{-1}$

$= \log_2 2^{6\times-1}$

$= -6\log_2 2$

$\log_2 2 = 1$

$= -6 \times 1$

$= -6$

Q15

(a) Evaluate $81^{\frac{3}{4}}$ [2]

(b) Find x if $9^{x-1} \times 3^{3x-2} = 3$ [2]

SOLUTION

(a) Evaluate $81^{\frac{3}{4}}$

$= (\sqrt[4]{81})^3$

$= \pm 3^3$

$= \pm 27$

(b) Find x if $9^{x-1} \times 3^{3x-2} = 3$

$9^{x-1} = (3^2)^{x-1}$

$= 3^{2x-2}$

$9^{x-1} \times 3^{3x-2} = 3^1$

$3^{2x-2} \times 3^{3x-2} = 3^1$

$3^{2x-2+3x-2} = 3^1$

$5x - 4 = 1$

$5x - 4 + 4 = 1 + 4$

$5x = 5$

$\frac{5x}{5} = \frac{5}{5}$

X=1

Q16

Given that y is inversely proportional to $(x-1)^2$ and that $y = 2$ when $x = 7$

(a) express y in terms of x. [2]

(b) calculate the value of x when $y = 8$. [2]

SOLUTION

(a) express y in terms of x.

$$y = \frac{k}{(x-1)^2}$$

$$2 = \frac{k}{(7-1)^2}$$

$$2 = \frac{k}{36}$$

$$36(2) = 36 \times \frac{k}{36}$$

$$72 = k$$

$$y = \frac{72}{(x-1)^2}$$

SOLUTION

(b) calculate the value of x when $y = 8$.

$$y = \frac{k}{(x-1)^2}$$

$$\frac{1}{k} y = \frac{1}{k} \times \frac{k}{(x-1)^2}$$

$$\left[\frac{y}{k}\right]^{-1} = \left[\frac{1}{(x-1)^2}\right]^{-1}$$

$$\frac{k}{y} = (x-1)^2$$

$$\sqrt{\frac{k}{y}} = \sqrt{(x-1)^2}$$

$$\sqrt{\frac{k}{y}} = x - 1$$

Q17

A luxury coach leaves Bulawayo for Harare every morning at 7.30 am and arrives in Harare at 1.00 pm.

(a) Express the departure time as a time in 24 hour notation. [1]

(b) Calculate the total time taken to travel from Bulawayo to Harare. [1

(c) Calculate the average speed of the bus to the nearest whole number if the distance from Bulawayo to Harare is 439 km. [2]

SOLUTION

(a) Express the departure time as a time in 24 hour notation.

0730 hrs

(b) Calculate the total time taken to travel from Bulawayo to Harare.

$$= 1300 - 0730$$

$$= 5 \text{ hrs } 30 \text{ minutes.}$$

(c) Calculate the average speed of the bus to the nearest whole number if the distance from Bulawayo to Harare is 439 km. [2]

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

$$= \frac{439}{5,5}$$

$$= 79,818$$

$$= 80 \text{ km/hr}$$

Q18

Factorise completely

(a) $cg - dg - ch + dh$, [[2]]

(b) $5d^2 - d - 4$. [2]

SOLUTION

(a) $cg - dg - ch + dh$, [

$$cg - dg - ch + dh$$

$$= g(c - d) - h(c - d)$$

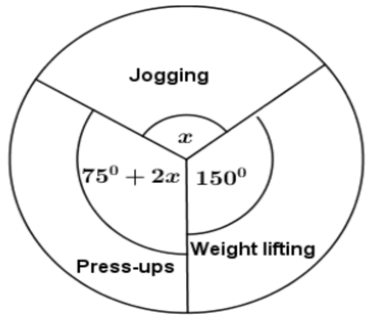
$$= (c - d)(g - h)$$

(b) $5d^2 - d - 4$. [2]

$$5d^2 - d - 4$$

$$= (5d + 4)(d - 1)$$

Q19



The pie chart shows the distribution of an athlete's daily exercise programme.

(a) calculate the value of x. [1]

(b) if the athlete spents 18 minutes jogging, calculate,

(i) the time the athlete spent on weight lifting. [1]

(ii) the total time spent exercising. [2]

SOLUTION

(a) calculate the value of x. [1]

$$360^\circ = x + 75^\circ + 2x + 150$$

$$360^\circ = 225^\circ + 3x$$

$$360^\circ - 225^\circ = 225^\circ - 225^\circ + 3x$$

$$135^\circ = 3x$$

$$\frac{135^\circ}{3} = \frac{3x}{3}$$

$$45^\circ = x$$

(b) if the athlete spents 18 minutes jogging, calculate

(i) the time the athlete spent on weight lifting. [1]

$$45^\circ = 18$$

$$150^\circ = \frac{150^\circ}{45} \times 18$$

$$= 60 \text{ minutes}$$

(ii) the total time spent exercising.

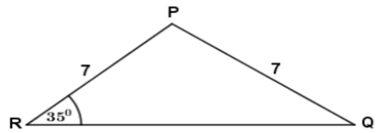
$$45^\circ = 18$$

$$360^\circ = \frac{360^\circ}{45^\circ} \times 18$$

$$= 144 \text{ minutes}$$

$$= 2 \text{ hrs } 24 \text{ mins}$$

Q20



In the diagram, PQR is an isosceles triangle such that PQ = Pr = 7 cm and angle PRQ = 35°

Using as much of the information given below as is necessary, calculate

(a) QR. [2]

(b) the area of triangle PQR. [2]

$$\begin{bmatrix} \sin 35^\circ = 0{,}57 & \cos 35^\circ = 0{,}82 & \tan 35^\circ = 0{,}70 \\ \sin 70^\circ = 0{,}94 & \cos 70^\circ = 0{,}34 & \tan 70^\circ = 2{,}75 \end{bmatrix}$$

SOLUTION

Using as much of the information given below as is necessary, calculate

(a) QR. [2]

$$\frac{QR}{\sin 110^\circ} = \frac{RP}{\sin 35^\circ}$$

$$RQ = \frac{7 \times \sin 110^\circ}{\sin 35^\circ}$$

$$= \frac{7 \times 0,94}{0,57}$$

$$= 11,54$$

(b) the area of triangle PQR.

$$= \frac{1}{2} ab\sin C$$

$$= \frac{1}{2} \times 7 \times 7 \times 0.94$$

$$= 23,03$$

Q21

It is given that,
$\nexists = \{x : 37 > x \geq 31$ and x is an integer.$\}$
has subsets P, Q and R such that,
$P = \{x : x$ is a multiple of $3\}$
$Q = \{x : x$ is a factor of $99\}$
$R = \{x : x$ is a prime number$\}$

(a) List the elements of R. [1]

(b) Write down n(P U R)$'$ [1]

(c) List all elements of (P U Q U R)$'$ [2]

SOLUTION

(a) List the elements of R

31

(b) Write down $n(P \cup R)'$

$(P \cup R) = 31;\ 33;\ 36$

$(P \cup R)' = 32;\ 34;\ 35$

$\therefore\ n(P \cup R)' = 3$

(c) List all elements of $(P \cup Q \cup R)'$

$P \cup Q \cup R = 31;\ 33;\ 36$

$(P \cup Q \cup R)' = 32;\ 34;\ 35$

Q22

A map is drawn to a scale of 1: 75 000

(a) Calculate in km the actual distance between two towns which are 40 cm apart on the map. [2]

(b) An airport has an actual area of 22,5 km^2 calculate in cm^2 the area of the airport on the map. [2]

SOLUTION

(a) Calculate in km the actual distance between two towns which are 40 cm apart on the map. [2]

$$= 40 \times 75000 \text{ cm}$$

$$= 3000000 \text{ cm}$$

$$= \frac{3000000}{100} \text{ m}$$

$$= 30000m$$

$$= \frac{30000}{1000} \text{ km}$$

$$= 30 \text{ km}$$

(b) An airport has an actual area of $22{,}5\ \text{km}^2$
calculate in cm^2 the area of the airport on the map

$$= 22,5 \times 1000 \times 1000\ \text{m}^2$$

$$= 22500000\ \text{m}^2$$

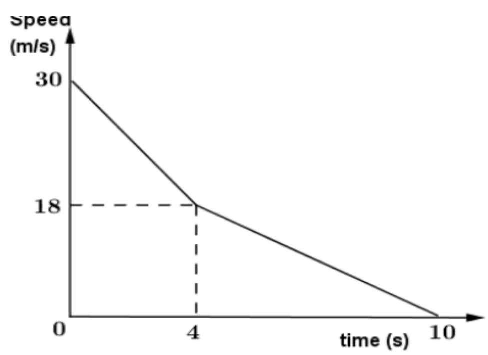
$$= 22500000 \times 100 \times 100\ \text{cm}^2$$

$$= 225000000000\ \text{cm}^2$$

$$\therefore \text{Area on map is } \frac{225000000000}{75000 \times 75000}$$

$$= 4\ \text{cm}^2$$

Q23



In the diagram, a moving object decelerates froma speed of 30 m/s to a speed of 18 m/s in 4 seconds and further decelerates from a speed of 18 m/s to rest in 6 seconds.

Calculate

(a) The speed of the object after the first 2 second. [2]

(b) The total distance covered by the object in the 10 seconds. [2]

SOLUTION

Calculate

(a) The speed of the object after the first 2 second.

$$= \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{18 - 30}{4 - 0}$$

$$= \frac{-12}{4}$$

$$= -3$$

$$-3 = \frac{V - 30}{2 - 0}$$

$$-3(2) = V - 30$$

$$-6 + 30 = V$$

$$24 = V$$

(b) The total distance covered by the object in the 10 seconds.

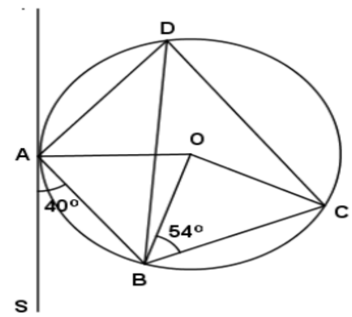
$$= \text{Total Area Under Graph}$$

$$= \frac{1}{2} \times 12 \times 4 + 18 \times 4 + \frac{1}{2} \times 18 \times 6$$

$$= 24 + 72 + 54$$

$$= 150 \text{ m}$$

Q24



In the diagram, O is the centre of the circle. TAS is a tangent to the circle at A.
Angle BAS = 40° and angle OBC = 54°

Calculate

(a) angle OAB, [1]

(b) angle AOB, [1]

(c) angle ADC, [2]

(d) reflex angle AOC. [2]

SOLUTION

Calculate

(a) angle OAB,

$$= 50^\circ$$

(b) angle AOB,

$$= 80^\circ$$

(c) angle ADC, [2]

$$= 180^\circ - 54^\circ + 50^\circ$$

$$= 76^\circ$$

(d) reflex angle AOC.

$$= 2 \times 76^\circ$$

$$= 152^\circ$$

Q25

If $F = \begin{bmatrix} 3 & x \\ -4 & -6 \end{bmatrix}$, $G = \begin{bmatrix} 3 & -2 \\ 2 & -1 \end{bmatrix}$ and $H = \begin{bmatrix} 7 \\ 1 \end{bmatrix}$

Find

(a) $F + 3G$ in terms of x. [2]

(b) the value of x if the determinant of F is -14. [2]

SOLUTION

(a) F + 3G in terms of x. [2]

$$= \begin{bmatrix} 3 & x \\ -4 & -6 \end{bmatrix} + 3\begin{bmatrix} 3 & -2 \\ 2 & -1 \end{bmatrix}$$

$$= \begin{bmatrix} 3 & x \\ -4 & -6 \end{bmatrix} + \begin{bmatrix} 3 \times 3 & -2 \times 3 \\ 2 \times 3 & -1 \times 3 \end{bmatrix}$$

$$= \begin{bmatrix} 3 & x \\ -4 & -6 \end{bmatrix} + \begin{bmatrix} 9 & -6 \\ 6 & -3 \end{bmatrix}$$

$$= \begin{bmatrix} 3+9 & x-6 \\ -4+6 & -6-3 \end{bmatrix}$$

$$\begin{bmatrix} 12 & x-6 \\ 2 & -9 \end{bmatrix}$$

(b) the value of x if the determinant of F is -14.

$$\text{Determinant} = ad - bc$$

$$-14 = 3 \times -6 - (x \times -4)$$

$$-14 = -18 + 4x$$

$$-14 + 18 = -18 + 18 + 4x$$

$$4 = 4x$$

$$\frac{4}{4} = \frac{4x}{4}$$

$$1 = x$$

(c) GH. [2]

$$= \begin{bmatrix} 3 & -2 \\ 2 & -1 \end{bmatrix}\begin{bmatrix} 7 \\ 1 \end{bmatrix}$$

$$= \begin{bmatrix} 3 \times 7 + -2 \times 1 \\ 2 \times 7 + -1 \times 1 \end{bmatrix}$$

$$= \begin{bmatrix} 19 \\ 13 \end{bmatrix}$$

JUNE 2015

Q1

Express 0,0978

(a) correct to two decimal places. [1]

(b) correct to 2 significant figures. [1]

(c) in standard form. [1]

SOLUTION

(a) correct to two decimal places.

$$= 0,10$$

(b) correct to 2 significant figures.

$$= 0,098$$

(c) in standard form.

$$= 9,78 \times 10^{-2}$$

Q2

(a) Evaluate $39,6 + 0,09$ [1]

(b) Simplify $\left[\frac{2}{3} - \frac{1}{2}\right] \times \frac{3}{4}$, giving the answer in its lowest terms. [2]

SOLUTION

(a) Evaluate $39,6 + 0,09$

$$= 39.69$$

(b) Simplify $\left[\frac{2}{3} - \frac{1}{2}\right] \times \frac{3}{4}$, giving the answer in its lowest terms.

$$\left[\frac{2}{3} - \frac{1}{2}\right] \times \frac{3}{4} = \left[\frac{2(2) - 1(3)}{6}\right] \times \frac{3}{4}$$

$$= \frac{1}{6} \times \frac{3}{4}$$

$$= \frac{1}{8}$$

Q3

A jet plane leaves Harare for Praira at 2323. The journey takes 5 hours 33 minutes and Praira's times is 2 hours behind Harare' time.

(a) Express 2323 in 12 hour notation. [1]

(b) Find the time in Praira when the jet arrives. [2]

SOLUTION

(a) Express 2323 in 12 hour notation.

$11:23$ pm

(b) Find the time in Praira when the jet arrives. [2]

Arrival time in Harare time is $2323 + 5$ hrs 33 minutes
$= 0456$ hrs

Arrival time in Praira time is $0456 - 2$ hrs
$= 0256$ hrs

Q4

(a) Write down $1 \times 2^4 + 1 \times 2^3 + 1 \times 2^1$ as a number in base 2. [1]

(b) Given that $a = -3,\ b = 3$ and $c = -1$,
evaluate $\left[\frac{c-a}{b-a}\right]^2$ giving the answer as a common fraction in its lowest terms. [2]

SOLUTION

(a) Write down $1 \times 2^4 + 1 \times 2^3 + 1 \times 2^1$ as a number in base 2.

$= 11010_2$

(b) Given that $a = -3,\ b = 3$ and $c = -1$,
evaluate $\left[\frac{c-a}{b-a}\right]^2$ giving the answer as a common fraction in its lowest terms. [2]

$$\left[\frac{c-a}{b-a}\right]^2 = \left[\frac{(-1)-(-3)}{3-(-3)}\right]^2$$
$$= \left[\frac{2}{6}\right]^2$$
$$= \left[\frac{4}{36}\right]$$
$$= \left[\frac{1}{9}\right]$$

Q5

(a) Find $\sqrt[3]{0,027}$. [1]

(b) The size of each interior angle of a regular polygon is 168°

Find the number of sides of the polygon. [2]

SOLUTION

(a) Find $\sqrt[3]{0,027}$.

$$= 0,3$$

(b) The size of each interior angle of a regular polygon is 168°

Find the number of sides of the polygon. [2]

$$= \frac{360^\circ}{180^\circ - 168^\circ}$$

$$= \frac{360^\circ}{12^\circ}$$

$$= 30 \text{ sides}$$

Q6

Given that $a = \begin{bmatrix} -1 \\ -2 \end{bmatrix}$ and $b \begin{bmatrix} -3 \\ -4 \end{bmatrix}$,

(a) express a − b as a column vector. [1]

(b) find |b|. [2]

SOLUTION

(a) express a − b as a column vector.

$$= \begin{bmatrix} -1 \\ -2 \end{bmatrix} - \begin{bmatrix} -3 \\ -4 \end{bmatrix}$$

$$= \begin{bmatrix} -1 - (-3) \\ -2 - (-4) \end{bmatrix},$$

$$= \begin{bmatrix} 2 \\ 2 \end{bmatrix},$$

(b) find |b|. [2]

$$= \sqrt{(-3)^2 + (-4)^2}$$

$$= \sqrt{9 + 16}$$

$$= \sqrt{25}$$

$$= \pm 5$$

Q7

A is a set of perfect square numbers less than 50 and B is a set of even numbers not greater than 20.

Given that the elements of A and B are whole numbers,

(a) list the elements of set A. [1]

(b) find $n(A\bigcap B)$. [2]

SOLUTION

(a) list the elements of set A

$= 1;\ 4;\ 9;\ 16;\ 25;\ 36;\ 49$

(b) find $n(A\bigcap B)$. [2]

Elements of B are 2; 4; 6; 8; 10; 12; 14; 16; 18; 20.

$A\bigcap B\ = 4;\ 16$

$\therefore\ n(A\bigcap B) = 2$

Q8

Solve the equation $\dfrac{3}{x} = x - 2$ [3]

SOLUTION

$$\frac{3}{x} = x - 2$$

$$x(\ 3x\ ) = x(x - 2)$$

$$3 = x^2 - 2x$$

$$3 - 3 = x^2 - 2x - 3$$

$$x^2 - 2x - 3 = 0$$

$$(x + 1)(x - 3) = 0$$

$$x + 1 = 0$$

$$x + 1 - 1 = 0 - 1$$

$$x = -1$$

$$x - 3 = 0$$

Q9

(a) If B is East of A, state the three figure bearing of A from B. [1]

(b) Express $33{,}55^\circ$ in degrees and minutes. [2]

SOLUTION

(a) If B is East of A, state the three figure bearing of A from B.

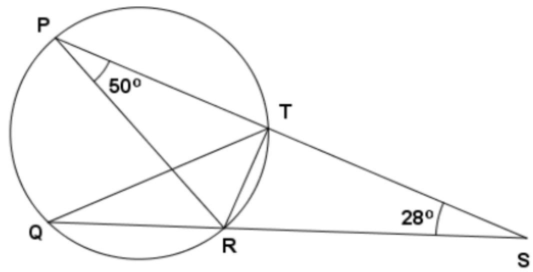
$= 270^\circ$

SOLUTION

(b) Express $33{,}55^\circ$ in degrees and minutes

$= 33$ degrees 33 minutes

Q10



In the diagram P, Q, R and T are points on the circumference of a circle. PTS and QRS are straight lines. PR is a diameter, angle QSP $= 28^\circ$ and angle RPS $= 50^\circ$

Calculate

(a) angle PRT, [1]

(b) angle QTS, [1]

(c) angle QTR. [1]

SOLUTION

Calculate

(a) angle PRT, [1]

$= 180^\circ - 90^\circ - 50^\circ$

$= 40^\circ$

(b) angle QTS, [1]

$= 180^\circ - 28^\circ - 50^\circ$

$= 102^\circ$

(c) angle QTR.

$= 102^\circ - 90^\circ$

$= 12^\circ$

Q11

Solve the simultaneous equations:

$3x - y = 7$
$y = 5 - x$ [3]

SOLUTION

$3x - y = 7$ eqn (i)

$y = 5 - x$ eqn (ii)

Substitute y with $5 - x$ in eqn (i)

$3x - (5 - x) = 7$

$3x - 5 + x = 7$

$3x + x - 5 + 5 = 7 + 5$

$4x = 12$

$\frac{4x}{4} = \frac{12}{4}$

$x = 3$

Substitute x with 3 in eqn (ii)

y=2

Q12

It is given that y varies directly as the square root of z.

(a) Write down the equation connecting y, z and a constant k. [1]

(b) Find k when $y = 3$ and $z = 4$. [1]

(c) Find y when $z = 16$. [1]

SOLUTION

(a) Write down the equation connecting y, z and a constant k.

$y = k\sqrt{z}$

(b) Find k when $y = 3$ and $z = 4$.

$$3 = k\sqrt{4}$$

$$3 = \pm k2$$

$$\frac{3}{\pm 2} = \frac{\pm k2}{\pm 2}$$

$$k = \pm 1,5$$

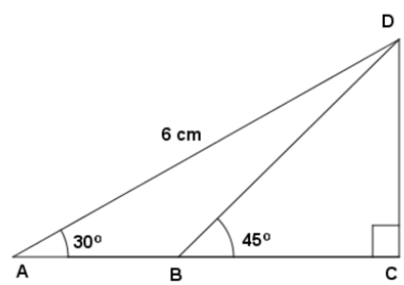
(c) Find y when $z = 16$.

$$y = \pm 1,5\sqrt{16}$$

$$= \pm 1,5(\pm 4)$$

$$= \pm 6$$

Q13



Triangle ACD is a right angled triangle at C.

AD = 6 cm, angle DBC = 45° and angle DAC = 30°. ABC is a straight line.

Using the information below, calculate

(a) CD, [1]

(b) AB, giving the answer correct to 1 decimal place. [2]

$$\begin{bmatrix} \sin 30^\circ = 0{,}50 & \cos 30^\circ = 0{,}87 & \tan 30^\circ = 0{,}58 \\ \sin 45^\circ = 0{,}71 & \cos 45^\circ = 0{,}071 & \tan 45^\circ = 1{,}00 \end{bmatrix}$$

SOLUTION

Using the information below, calculate

(a) CD, [1]

$$\frac{\text{CD}}{6} = \sin 30^\circ$$

$$\text{DC} = 6 \times 0.5$$

$$= 3 \text{ cm}$$

(b) AB, giving the answer correct to 1 decimal place.

$$\frac{AC}{6} = \cos 30^\circ$$

$$AC = 6 \times 0,87$$

$$= 5,2$$

$$BC = CD$$

$$AB = AC - BC = 5,2 - 3$$

$$= 3,2 \text{ cm}$$

Q14

Simplify

(a) $(2a)^{-2} \times 3a^2$ [2]

(b) log8 ÷ log4. [2]

SOLUTION

(a) $(2a)^{-2} \times 3a^2$ [2]

$$(2a)^{-2} \times 3a^2 = 2^2a^2 \times 3a^2$$

$$= 4a^2 \times 3a^2$$

$$= (4)(3)(a^{2+2})$$

$$= 12a^4$$

(b) $\log 8 \div \log 4$. [2]$\log 8 \div \log 4 = \dfrac{\log 8}{\log 4}$

$$= \frac{\log 2^3}{\log 2^2}$$

$$= \frac{3 \log 2}{2 \log 2}$$

$$= \frac{3}{2}$$

$$= 1\frac{1}{2}$$

Q15

Given that $A = \begin{bmatrix} x-1 & 2 \\ x+1 & -1 \end{bmatrix}$ and $B = \begin{bmatrix} 3 & 4 \end{bmatrix}$,

Find in terms of x

(a) the determinant of A in its simplest form. [2

(b) BA in its simplest form. [2].

SOLUTION

(a) the determinant of A in its simplest form

$$\text{Det} = ad - bc$$

$$= (-1)(x-1) - (2)(x+1)$$

$$= -x + 1 - (2x + 2)$$

$$= -x + 1 - 2x - 2$$

$$= -x - 2x + 1 - 2$$

$$= -3x - 1$$

(b) BA in its simplest form. [2].

$$= \begin{bmatrix} 3 & 4 \end{bmatrix} \begin{bmatrix} x-1 & 2 \\ x+1 & -1 \end{bmatrix}$$

$$= \begin{bmatrix} 3(x-1) + 4(x+1) & 3(2) + 4(-1) \end{bmatrix}$$

$$= \begin{bmatrix} 3x - 3 + 4x + 4 & 6 - 4 \end{bmatrix}$$

$$= \begin{bmatrix} 3x + 4x - 3 + 4 & 2 \end{bmatrix}$$

$$= \begin{bmatrix} 7x + 1 & 2 \end{bmatrix}$$

Q16

(a) On a day when the exchange rate was R9,03 to 1 USD, a trader exchanged 600 USD for rands.

Find the amount, in rands, the trader received. [2]

(b) Given that $f = \dfrac{mv - mu}{t}$, express m in terms of f, v, u and t. [2]

SOLUTION

(a) On a day when the exchange rate was R9,03 to 1 USD, a trader exchanged 600 USD for rands.

$$= 600 \times 9,03$$

$$= \text{R } 5418$$

(b) Given that $f = \dfrac{mv - mu}{t}$, express m in terms of $f,\ v,\ u$ and t.

$$f = \frac{mv - mu}{t}$$

$$f(t) = t\left(\frac{mv - mu}{t}\right)$$

$$ft = m(v - u)$$

$$\frac{ft}{v - u} = \frac{m(v - u)}{v - u}$$

$$\therefore\ m = \frac{ft}{v - u}$$

Q17

9 white balls and 6 yellow identical tennis balls are placed in a box. Kuda picks balls at random one at a time.

Find the probability that the first and second balls picked are

(a) both white. [2]

(b) of different colours. [2]

SOLUTION

(a) both white.

$$= \frac{9}{15} \times \frac{8}{14}$$

$$= \frac{3}{5} \times \frac{4}{7}$$

$$= \frac{12}{35}$$

(b) of different colours.

$$= \frac{9}{15} \times \frac{6}{14} + \frac{6}{15} \times \frac{9}{14}$$

$$= \frac{3}{5} \times 37 + \frac{2}{5} \times \frac{9}{14}$$

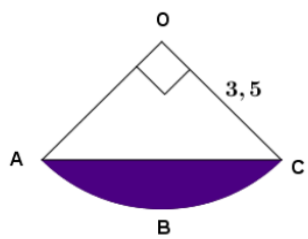
$$= \frac{9}{35} + \frac{18}{70}$$

$$= \frac{9(2) + 18}{70}$$

$$= \frac{18 + 18}{70}$$

$$= \frac{36}{70}$$

Q18



Take π to be $\frac{22}{7}$

In the diagram OABC is a sector of a circle centre O and radius $3\frac{1}{2}$ cm.

(a) State the name given to the shaded region. [1]

(b) Calculate the area of the shaded region. [3]

SOLUTION

(a) State the name given to the shaded region

Segment

(b) Calculate the area of the shaded region. [3]

Area of Sector AOCB − Area of Triangle AOC

$$= \frac{\theta}{360}\pi r^2 - \frac{1}{2}ab$$

$$= \frac{90}{360} \times \frac{22}{7} \times \frac{7}{2} \times \frac{7}{2} - \frac{1}{2} \times \frac{7}{2} \times \frac{7}{2}$$

$$= 9,625 - 6,125$$

$$= 3,5 \text{ cm}^2$$

Q19

A rural district council increases the value of land by 5% every year.

If the value of a piece of land is \$4600,

calculate its value in 2 years' time. [4]

SOLUTION

Let value of land be x

Value of land after 1 year be y and is $x + 0,05x$

Value of land after 2 years be z and is $y + 0,05y$

$$z = x + 0,05x + (x + 0,05x)0,05$$

$$= x + 0,05x + 0,05x + 0,0025x$$

$$= x(1 + 0,05 + 0,05 + 0,0025)$$

$$= x(1,1025)$$

$$= (\$4600)1,1025$$

$$= \$5071,50$$

Q20

Simplify $\dfrac{x^2 - y^2}{x^2 + xy} + \dfrac{2y - 2x}{xy}$ [4]

SOLUTION

$$\frac{x^2 - y^2}{x^2 + xy} + \frac{2y - 2x}{xy} = \frac{(x + y)(x - y)}{x(x + y)} + \frac{2y - 2x}{xy}$$

$$= \frac{x - y}{x} + \frac{(2y - 2x)}{xy}$$

$$= \frac{y(x - y) + 1(2y - 2x)}{xy}$$

$$= \frac{xy - y^2 + 2y - 2x}{xy}$$

$$= \frac{xy - 2x - y^2 + 2y}{xy}$$

$$= \frac{x(y - 2) - y(y - 2)}{xy}$$

$$= \frac{(y - 2)(x - y)}{xy}$$

Q21

(a) Solve the equation $3 - (2n - 5) = 32$. [2]

(b) Express $\frac{7x+2}{5} - \frac{5x+3}{6}$ as a single fraction is its simplest form. [2]

SOLUTION

(a) Solve the equation $3 - (2n - 5) = 32$.

$$3 - (2n - 5) = 32$$

$$3 - 2n + 5 = 32$$

$$3 + 5 - 32 - 2n + 2n = 32 - 32 + 2n$$

$$-24 = 2n$$

$$\frac{-24}{2} = \frac{2n}{2}$$

$$\therefore\ n = -12$$

(b) Express $\frac{7x+2}{5} - \frac{5x+3}{6}$ as a single fraction is its simplest form.

$$\frac{7x+2}{5} - \frac{5x+3}{6} = \frac{6(7x+2) - 5(5x+3)}{30}$$

$$= \frac{42x + 12 - 25x - 15}{30}$$

$$= \frac{42x - 25x + 12 - 15}{30}$$

$$== \frac{17x - 3}{30}$$

Q22

Ten students walk to Chitsa High School every day. The distances they walk, to the nearest kilometre, are given in the frequency table below.

Distance in kilometres.	1	2	3	4	5
Frequency	4	2	2	1	1

(a) State the least possible distance walked by a student. [1]

(b) Find (i) the modal distance walked. [1]

(ii) the median distance walked. [1]

(c) Calculate the mean distance walked. [2]

SOLUTION

(a) State the least possible distance walked by a student

$= 500$ metres

(b) Find (i) the modal distance walked.

$= 1$ km

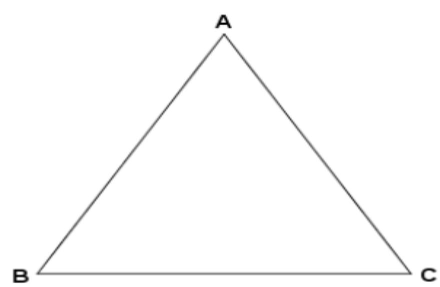
(ii) the median distance walked.

$= 2$ km

(c) Calculate the mean distance walked.

$$= \frac{4(1) + 2(2) + 2(3) + 1(4) + 1(5)}{4 + 2 + 2 + 1 + 1}$$
$$= \frac{4 + 4 + 6 + 4 + 5}{10}$$
$$= \frac{23}{10}$$
$$= 2,3 \text{ km}$$

Q23

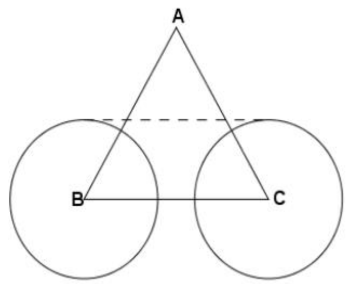


(a) On the diagram, construct using a ruler and compass only, the locus of points which are,

(i) 2 cm from BC and on the same side of BC as A, [2]

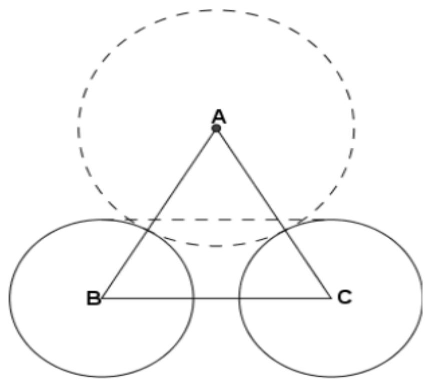
(ii) 3 cm from A. [1]

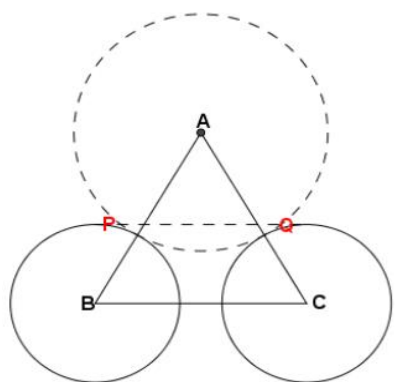
(b) Mark and label two points P and Q which are 2 cm from BC and 3 cm from A. [2]



SOLUTION

(a) On the diagram, construct using a ruler and compass only, the locus of points which are,





Q24

The scale of the map of a house is 1: 500.

(a) Find the lenght of a room on the plan which measures 8 m. [1]

(b) Calculate the actual height of a wall which is represented by 3,6 cm on the plan. [1]

(c) Find the actual area of a room which has an area of 1,6 cm^2 on the plan. [3]

SOLUTION

(a) Find the lenght of a room on the plan which measures 8 m.

$$= \frac{8 \times 100}{500}$$

$$= 1,6 \text{ cm}$$

(b) Calculate the actual height of a wall which is represented by 3,6 cm on the plan. [1]

$$= \frac{3,6 \times 500}{100}$$

$$= 18 \text{ metres}$$

(c) Find the actual area of a room which has an area of 1,6 cm^2 on the plan.

$$\text{Area on plan } = 1 \text{ cm} \times \text{ 1,6 cm}$$

$$\text{Actual Area } = \frac{(1 \times 500) \text{ cm}}{100} \times \frac{(1,6 \times 500) \text{ cm}}{100}$$

$$= 5 \times 8$$

$$= 40 \text{ m}^2$$

NOVEMBER 2014

Q1

(a) Simplify

(i) $1\frac{1}{2} - \frac{2}{3}$ [1]

(ii) $0,45 \times \frac{2}{9}$ [1]

(b) Express 0,0796 correct to 3 decimal places [1

SOLUTION

$$\text{(i) } 1\frac{1}{2} - \frac{2}{3} \quad [1]$$

$$= \frac{3}{2} - \frac{2}{3}$$

$$= \frac{(3)(3) - (2)(2)}{6}$$

$$= \frac{9 - 4}{6}$$

$$= \frac{5}{6}$$

$$\text{(ii) } 0,45 \times \frac{2}{9}$$

$$= 0,10$$

(b) Express 0,0796 correct to 3 decimal places

$$= 0,080$$

Q2

(a) Express 12.5% as a common fraction in its simplest form. [1]

(b) Find the Highest Common Factor of 168 and 252. [2]

SOLUTION

(a) Express 12.5% as a common fraction in its simplest form.

$$= 0,125 \times \frac{1000}{1000}$$

$$= \frac{125}{1000}$$

$$= \frac{1}{8}$$

(b) Find the Highest Common Factor of 168 and 252.

$$168 = 2 \times 2 \times 2 \times 3 \times 7$$

$$252 = 2 \times 2 \times 3 \times 3 \times 7$$

$$\therefore \text{ HCF } = 2 \times 2 \times 3 \times 7$$

$$= 84$$

Q3

It is given that

ε = {1; 2; 3; 4; 5; 6; 7; 8; 9; 10}

where H is a set of prime numbers and K is a set of odd numbers

(a) List the elements of set H. [1]

(b) Find n(H U K) [2]

SOLUTION

(a) List the elements of set H.

$= 2; 3; 5; 7$

(b) Find n(H U K) [2]

(H U K) $= 1; 2; 3; 5; 7; 9$

n(H U K) $= 6$

Q4

Given that $f(x) = 3 - 4x$

find

(i) $f(-2)$ [1]

(ii) x if $f(x) = 19$ [1]

(b) Express 15 minutes before midnight as time in the 24-hour notation [1]

SOLUTION

(i) $f(-2)$ [1]

$$f(x) = 3 - 4x$$

$$f(-2) = 3 - 4(-2)$$

$$= 3 + 8$$

$$= 11$$

$$\textbf{(ii) } x \textbf{ if } f(x) = 19 \ [1]$$

$$3 - 4x = 19$$

$$3 - 3 - 4x = 19 - 3$$

$$-4x = 16$$

$$\frac{-4x}{-4} = \frac{16}{-4}$$

$$x = -4$$

(b) Express 15 minutes before midnight as time in the 24-hour notation

2345hrs

Q5

Given that $\begin{bmatrix} 10 & 3 \\ 4 & 2 \end{bmatrix} - 2\begin{bmatrix} -1 & -3 \\ u & -5 \end{bmatrix} = \begin{bmatrix} v & 9 \\ -18 & 12 \end{bmatrix}$

find the values of

(a) (i) u [1]

(ii) v [1]

(b) Find the dertiminant of $\begin{bmatrix} 10 & 3 \\ 4 & 2 \end{bmatrix}$ [1]

SOLUTION

(a) (i) u [1]

$$4 + -2(u) = -18$$

$$4 - 4 - 2u = -18 - 4$$

$$-2u = -22$$

$$\frac{-2u}{-2} = \frac{-22}{-2}$$

$$u = 11$$

(ii) v [1]

$$10 - 2(-1) = v$$

$$10 + 2 = v$$

$$12 = v$$

(b) Find the dertiminant of $\begin{bmatrix} 10 & 3 \\ 4 & 2 \end{bmatrix}$

Determinant $= ad - bc$

$= 10 \times 2 - 3 \times 4$

$= 10 - 12$

$= 8$

Q6

(a) The product of a number k and 15 is 105.

Find the number k [1]

(b) Factorise completely $4x^2 + 12x - 7$ [2]

SOLUTION

(a) The product of a number k and 15 is 105.
Find the number k [1]

$k15 = 105$

$$\frac{k15}{15} = \frac{105}{15}$$

$k = 7$

(b) Factorise completely $4x^2 + 12x - 7$

$= (2x - 1)(2x + 7)$

Q7*

Solve the simultaneously equations

$$x - 2y = -2$$
$$4x + 3y = -19 \text{ [3]}$$

SOLUTION

$$x - 2y = -2 \text{ eqn (i)}$$
$$4x + 3y = -19 \text{ eqn (i1)}$$

Make x the subject in eqn (i)

$$x - 2y = -2$$

$$x - 2y + 2y = -2 + 2y$$

$$x = 2y - 2$$

Substitute x with $2y - 2$ in eqn (ii)

$$4x + 3y = -19$$

$$4(2y - 2) + 3y = -19$$

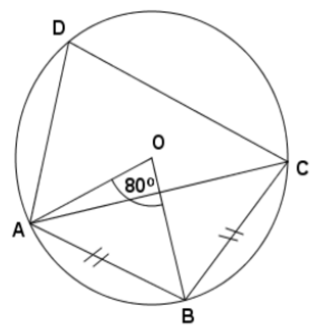
$$8y - 8 + 3y = -19$$

$$11y - 8 + 8 = -19 + 8$$

y= -1

x= -4

Q8



In the diagram, ABCD is a circle centre O. angle AOB = 80° and AB = BC

Calculate

(a) angle ACB, [1]

(b) angle ADC, [1]

(c) angle OAC. [1]

SOLUTION

Calculate

(a) angle ACB, |

$= 40^\circ$

(b) angle ADC,

$= 80^\circ$

(c) angle OAC.

$= 10^\circ$

Q9

(a) Given that $\sin\theta = \frac{5}{13}$ and $180^\circ > \theta > 90^\circ$

express as a common fraction

(i) $\cos\ \theta$ [1]

(ii) $\tan\ \theta$ [1]

(b) State the name of a polygon with rotational symmetry of order 3

Q10

The density of a certain stone is known to be $2{,}5\text{g}/\text{cm}^3$

Calculate the volume, in m^3

of a piece of the stone with a mass of 7,5kg [3]

SOLUTION

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

$$\text{Volume} = \frac{\text{Mass}}{\text{Density}}$$

$$= \frac{7500}{2,5}$$

$$= 3000 \text{ cm}^3$$

$$3000 \times 0,000001 = 0,003 \text{ m}^3$$

Q11

The time, T, hours, varies inversely as the speed, S, kilometres per hour.

(a) Express T in terms of S and constant D [1]

(b) Calculate the constant D when $T = 12$ minutes and $S = 15\text{km/h}$

SOLUTION

(a) Express T in terms of S and constant D

$$T = \frac{D}{S}$$

(b) Calculate the constant D when $T = 12$ minutes and $S = 15\text{km/h}$

$$12 = \frac{D}{15}$$

$$12 \times 15 = \frac{D}{15} \times 15$$

$$180 = D$$

Q12

Two similar drums have their diameters in the ratio 3:5

(a) Write down the ratio of their volumes. [1]

(b) Given that the volume of the bigger drum is $100l$, calculate the volume of the smaller drum. [2]

SOLUTION

(a) Write down the ratio of their volumes.

$$3^3;\ 5^3 = 27;\ 125$$

(b) Given that the volume of the bigger drum is $100l$, calculate the volume of the smaller drum. [2]

$$125 = 100l$$

$$27 = \frac{100}{125} \times 27$$

$$= 21,6l$$

$\therefore$ volume of smaller drum is 21,6 litres

Q13

(a) Write down the next term of the sequence

$$\frac{81}{625};\ \frac{27}{125};\ \frac{9}{25};\quad [1]$$

(b) Simplify $1,11 \times 10^5 \div 3,7 \times 10^{-3}$, expressing your answer in standard form. [2]

SOLUTION

a) Write down the next term of the sequence

$$\frac{81}{625};\ \frac{27}{125};\ \frac{9}{25};\quad [1]$$

$$\frac{3}{5}$$

(b) Simplify $1,11 \times 10^5 \div 3,7 \times 10^{-3}$, expressing your answer in standard form. [2]

$$1,11 \times 10^5 \div 3,7 \times 10^{-3} = 1,11 \div 3,7 \times 10^{5-(-3)}$$

$$= 0,3 \times 10^8$$

$$= 3,0 \times 10^7$$

Q14

Given that $V = \frac{1}{3}\pi r^2 h$

(a) express r in terms of V, π and h [2]

(b) find r if $\pi = \frac{22}{7}$, $V = 29\frac{1}{3}$ and $h = 7$ [2]

SOLUTION

a) express r in terms of V, π and h

$$V = \frac{1}{3}\pi r^2 h$$

$$3V = 3 \times \frac{1}{3}\pi r^2 h$$

$$3V = \pi r^2 h$$

$$\frac{3V}{\pi h} = \frac{\pi r^2 h}{\pi h}$$

$$\frac{3V}{\pi h} = r^2$$

$$\sqrt{\frac{3V}{\pi h}} = \sqrt{r^2}$$

$$\therefore\ r = \sqrt{\frac{3V}{\pi h}}$$

(b) find r if $\pi = \frac{22}{7}$, $V = 29\frac{1}{3}$ and $h = 7$

$$r = \sqrt{\frac{3V}{\pi h}}$$

$$= \sqrt{\frac{3(29\frac{1}{3})}{\frac{22}{7} \times 7}}$$

$$= \sqrt{\frac{88}{22}}$$

$$= \sqrt{4}$$

$$= \pm 2$$

Q15

(a) On 1 March 2008 a farmer deposited $36 000 into a new bank account.

On 30 June 2008 her account balance was $36 600.

Calculate

i) The time of investment as a fraction of a year in its simplest form. [1

(ii) the interest rate percent per annum. [2]

(b) Given an exchange rate of $1 to R7,50, convert $210 to rands. [2]

SOLUTION

(i) The time of investment as a fraction of a year in its simplest form

$$\frac{4}{12} = \frac{1}{3}$$

ii) the interest rate percent per annum.

$$I = PRT$$

$$600 = 36000(R)(\frac{1}{3})$$

$$600 = 12000R$$

$$\frac{600}{12000} = \frac{12000R}{12000}$$

$$5\% = R$$

(b) Given an exchange rate of $1 to R7,50, convert $210 to rands.

$$7.5 \times 210 = \text{R}1575$$

Q16

The following is a list of marks obtained by a group of students;
20; 18; 12; 19; 18; 14; 18

(a) Find

(i) the mode [1]

(ii) the median [1]

(b) If two more marks, x and $x+1$, are included in the list, the mean becomes 16.

Find x [3]

SOLUTION

(i) the mode [1]

$$= 18$$

(ii) the median

$$= 18$$

(b) If two more marks, x and $x+1$, are included in the list, the mean becomes 16.

Find x [3]

$$\text{Mean} = \frac{\text{Sum of Items}}{\text{Number of items}}$$

$$16 = \frac{12+14+18+18+18+19+20+x+x+1}{9}$$

$$16 = \frac{2x+120}{9}$$

$$16 \times 9 = \frac{2x+120}{9} \times 9$$

$$144 = 2x + 120$$

$$144 - 120 = 2x + 120 - 120$$

Q17

John, Ticha and Sharai share some sweets.
John and Ticha's shares are in the ratio 1:2
Ticha and Sharai's shares are in the ratio 3:4

(a) Express the shares in the ratio John: Ticha: Sharai. [2]

(b) Calculate

(i) Ticha's share if Sharai got 24 sweets. [2]

(ii) The total number of sweets shared. [1]

SOLUTION

(a) Express the shares in the ratio John: Ticha: Sharai

$$\text{John : Ticha} = 1 : 2 = 3 : 6$$

$$\text{Ticha : Sharai} = 3 : 4 = 6 : 8$$

$$\text{John: Ticha: Sharai} = 3 : 6 : 8$$

(i) Ticha's share if Sharai got 24 sweets

$$\text{If } 4 = 24$$

$$3 = \frac{24}{4} \times 3$$

$$= 6 \times 3$$

$$= 18 \text{ sweets}$$

(ii) The total number of sweets shared

$$\frac{6}{17} = 18$$

$$\frac{17}{17} = \frac{18}{6} \times 17$$

$$= 51 \text{ sweets}$$

Q18

The coordinates of A, B and C are (4; 2), (0; -2) and (-3; 2) respectively

(a) Express as column vectors

(i) $\overrightarrow{OA}$ [1]

(ii) $-2\overrightarrow{BC}$ [2]

(b) Calculate $|\overrightarrow{BC}|$ [2]

SOLUTION

(i) $\overrightarrow{OA}$ [1]

$$= \begin{bmatrix} 4 \\ 2 \end{bmatrix}$$

(ii) $-2\overrightarrow{BC}$ [2]

$$\overrightarrow{BC} = \begin{bmatrix} -3-0 \\ 2-(-2) \end{bmatrix}$$

$$= \begin{bmatrix} -3 \\ 4 \end{bmatrix}$$

$$-2\overrightarrow{BC} = -2\begin{bmatrix} -3 \\ 4 \end{bmatrix}$$

$$= \begin{bmatrix} -3 \times -2 \\ 4 \times -2 \end{bmatrix}$$

$$= \begin{bmatrix} 6 \\ -8 \end{bmatrix}$$

(b) Calculate $|\overrightarrow{BC}|$ [2]

$$|\overrightarrow{BC}| = \sqrt{(-3)^2 + 4^2}$$

$$= \sqrt{9+16}$$

$$= \sqrt{25}$$

$$= \pm 5$$

Q19

(a) Solve $3^y = 9^{-2}$ [2]

(b) Given that $\log_x 81 = \log_2 16$,
find the value of x [3]

SOLUTION

(a) Solve $3^y = 9^{-2}$

$$3^y = 9^{-2}$$

$$3^y = (3^2)^{-2}$$

$$3^y = 3^{2\times -2}$$
$$3^y = 3^{-4}$$

$$\therefore\ y = -4$$

(b) Given that $\log_x 81 = \log_2 16$,
find the value of x [3]

$$\log_x 81 = \log_2 16$$

$$\log_2 16 = \log_2 2^4$$

$$= 4\log_2 2$$

$$= 4 \times 1$$

$$= 4$$

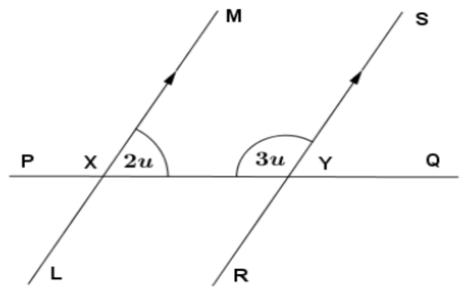
$$\therefore\ \log_x 81 = 4$$

$$\log_x 3^4 = 4$$

$$4\log_x 3 = 4$$

$$4\log_x 3 \quad = 4\,4$$

Q20



In the diagram, LM and RS are two parallel straight lines and PQ cuts LM and RS at X and Y respectively.

Given that angle MXY $= 2u^\circ$ and angle XYS $= 3u^\circ$

Calculate

(i) The value of u, [2]

(ii) angle XYS, [1]

(iii) angle PXL, [1]

(b) Evaluate $212_3 + 122_3$, giving your answer in base 3. [1]

SOLUTION

Calculate

(i) The value of u,

$$2u^\circ + 3u^\circ = 180^\circ$$

$$5u^\circ = 180^\circ$$

$$\frac{5u^\circ}{5} = \frac{180^\circ}{5}$$

$$u = 36^\circ$$

(ii) angle XYS,

$$= 3 \times 36$$

$$= 108^\circ$$

(iii) angle PXL

$$= 2u$$

$$= 2 \times 36$$

$$= 72^\circ$$

b) Evaluate $212_3 + 122_3$, giving your answer in base 3.

$$212_3 + 122_3 = 1111_3$$

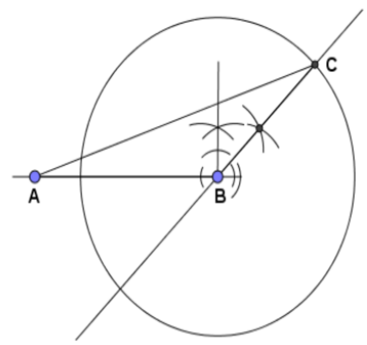
Q21

The diagram shows line AB which is part of a triangle ABC.

USING RULER AND COMPASS ONLY, CONSTRUCT, SHOWING ALL LINES AND ARCS,

(a) Triangle ABC in which angle ABC = 135, BC = 6 cm and C is above AB, [3]

(b) A perpendicular from C to meet at AB produced at X. [2]



SOLUTION

(a) Triangle ABC in which angle ABC = 135, BC = 6 cm and C is above AB

Q22

The probability that John passes a driving test is $\frac{3}{4}$

and that of Peter passing is $\frac{2}{x}$

(a) If the probability that they both pass the test is $\frac{3}{28}$, find x. [2]

(b) Calculate the probability that

(i) Peter fails the test. [1]

(ii) either John or Peter passes the test. [2]

SOLUTION

(a) If the probability that they both pass the test is $\frac{3}{28}$, find x.

$$\frac{2}{4} \times \frac{2}{x} = \frac{3}{28}$$

$$\frac{6}{4x} = \frac{3}{28}$$

$$\left(\frac{6}{4x}\right)^{-1} = \left(\frac{3}{28}\right)^{-1}$$

$$\frac{4x}{6} = \frac{28}{3}$$

$$6 \times \frac{4x}{6} = \frac{28}{3} \times 6$$

$$4x = 56$$

$$\frac{4x}{4} = \frac{56}{4}$$

$$x = 14$$

(i) Peter fails the test.

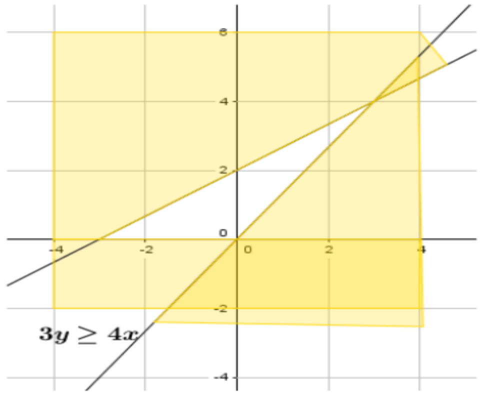
$$1 - \frac{2}{14} = \frac{12}{14}$$

(ii) either John or Peter passes the test.

$$\left(\frac{3}{4} \times \frac{6}{7}\right) + \left(\frac{1}{4} \times \frac{1}{7}\right) = \frac{18}{28} + \frac{1}{28}$$

$$= \frac{19}{28}$$

Q23



The diagram shows the region defined by three inequalities $3y \geq 4x,\ y \geq 0$ and a third inequality.

(a) Find

(i) the third inequality. [3]

(ii) the co-ordinates of point M, where the two lines intersect, as shown on the diagram. [1]

SOLUTION

(a) Find

(i) the third inequality.

$$\text{Gradient} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{2 - 0}{0 - -5}$$

$$= 0,4$$

$$\text{Equation } y = 0,4x + 2$$

$$2 + 0,4x \geq y$$

(ii) the co-ordinates of point M, where the two lines intersect as shown on the diagram. [1]

$$= (3;\ 4)$$

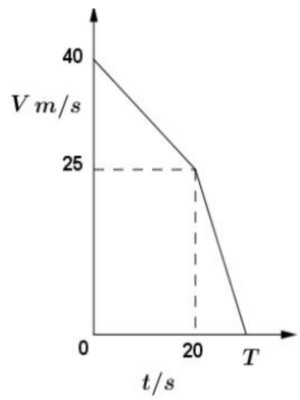
(b) By considering intergral values of x and y, calculate the least value of $x + y$.

$$x = -5$$

$$y = 0$$

$$= -5 + 0 = -5$$

Q24



The diagram shows a velocity-time graph of a particle which decelerates uniformly from a velocity of 40 m/s to a velocity of 25 m/s in 20 seconds. It further decelerates uniformly at a rate of 2,5 m/s^2 until it comes to rest.

Given that the total time of the journey is T seconds, calculate

(a) The deceleration of the particle during the first 20 seconds. [2]

(b) The value of T. [2]

SOLUTION

(a) The deceleration of the particle during the first 20 seconds

$$\text{Gradient } = \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{25 - 40}{20 - 0}$$

$$= -\frac{15}{20}$$

$$= -0,75 \text{ m/s}^2$$

(b) The value of T. [2]

$$\text{Gradient } = \frac{y_2 - y_1}{x_2 - x_1}$$

$$-2,5 = \frac{0 - 25}{T - 20}$$

$$T - 20 = \frac{-25}{-2,5}$$

$$T - 20 = 10$$

$$T - 20 + 20 = 10 + 20$$
$$T = 30$$

(c) The total distance covered in the T seconds,

$$= \frac{1}{2} \times 15 \times 20 + 20 \times 25 + \frac{1}{2} \times 10 \times 25$$

$$= 150 + 500 + 100$$

$$= 750 \text{ m}$$

(d) The average speed for the whole journey.

$$= \frac{750}{30}$$

$$= 25 \text{ m/s}$$

JUNE 2014

Q1

Express 2046, 489 correct to

(a) the nearest ten, [1]

(b) 2 deciml places, [1]

(c) 2 significant figures. [1]

SOLUTION

Express 2046, 489 correct to

(a) the nearest ten, [1]

$= 2050$

(c) 2 significant figures.

2000

Q2

Evaluate, giving your answers as common fractions in their lowest term.

(a) $\frac{3}{5} + \frac{1}{7}$ [1]

(b) $\frac{5}{8} \times \frac{32}{45}$ [1]

(c) $\frac{5}{24} \div \frac{1}{3}$ [1]

SOLUTION

(a) $\frac{3}{5} + \frac{1}{7}$ [1]

$$\frac{3}{5} + \frac{1}{7} = \frac{3(7) + 1(5)}{35}$$
$$= \frac{21 + 5}{35}$$
$$= \frac{26}{35}$$

(b) $\frac{5}{8} \times \frac{32}{45}$ [:

$$\frac{5}{8} \times \frac{32}{45} = \frac{4}{9}$$

(c) $\frac{5}{24} \div \frac{1}{3}$ [1]

$$\frac{5}{24} \div \frac{1}{3} = \frac{5}{24} \times \frac{3}{1}$$
$$= \frac{5}{8}$$

Q3

Giving your answer as a decimal, find the exact value of

(a) $0,175 - 0,049$ [1]

(b) $\sqrt{0,0144}$ [1]

(c) $(0,06)^2$ [1]

SOLUTION

(a) $0,175-0,049$

$=0,126$

(b) $\sqrt{0,0144}$

$=\pm 0,12$

(c) $(0,06)^2$ [1]

$=0,06\times 0,06$

$=0,0036$

Q4

(a) Expand $(2a-b)(1+c)$ [2]

(b) Simplify $\frac{m^2-mn}{n^2-np}\div\frac{m}{n-p}$ [1]

SOLUTION

(a) Expand $(2a-b)(1+c)$ [2]

$=2a\times 1+2a\times c-b\times 1-b\times c$

$=2a+2ac-b-bc$

(b) Simplify $\frac{m^2-mn}{n^2-np}\div\frac{m}{n-p}$

$$\frac{m^2-mn}{n^2-np}\div\frac{m}{n-p}$$

$$=\frac{m^2-mn}{n^2-np}\times\frac{n-p}{m}$$

$$=\frac{m(m-n)}{n(n-p)}\times\frac{n-p}{m}$$

$$=\frac{m-n}{n}$$

Q5

It is given that
$\xi = \{30;\ 31;\ 32;\ 33;\ 34;\ 35;\ 36;\ 37;\ 38;\ 39\}$
A is the set of odd numbers and
B is the set of prime numbers.

(a) List the elements of

(i) A. [1]

(ii) B' [1]

(b) Find $n(A \cap B')$ [1]

SOLUTION

(a) List the elements of
(i) A. [1]

31; 33; 35; 37; 39

(ii) B' [1]

$= \{30;\ 32;\ 33;\ 34;\ 35;\ 36;\ 38;\ 39\}$

(b) Find $n(A \cap B\ )$

$A \cap B' = 33;\ 35$

$\therefore\ n(A \cap B') = 2$

Q6

(a) State the special type of a triangle that has one line of symmetry. [1]

(b) A polygon has n sides. Two of its exterior angles are 55° and 45°.

The remaining $(n-2)$ exterior angles are each 20°.

Calculate the value of n [2]

SOLUTION

(a) State the special type of a triangle that has one line of symmetry

Isosceles

(b) A polygon has n sides. Two of its exterior angles are 55° and 45°. The remaining $(n-2)$ exterior angles are each 20°.

Calculate the value of n [2]

$$\text{Number of sides of a polygon} = \frac{360^\circ}{\text{Exterior Angles Size}}$$

$$\text{Number of Unknown Sides} = \frac{360-(55+45)}{20}$$

$$= \frac{260}{20}$$

$$= 13$$

$$\therefore\ n = 13+2$$

$$= 15$$

Q7

(a) Express 9 minutes after midnight as time on the 24 hour clock. [1]

(b) In 1998 the population of a village was $2,8 \times 10^2$.

In 2004 the population was $3,5 \times 10^2$

Calculate the percentage increase in population from 1998 to 2004. [2]

SOLUTION

(a) Express 9 minutes after midnight as time on the 24 hour clock. [1]

$= 0009$ hrs

(b) In 1998 the population of a village was $2,8 \times 10^2$.
In 2004 the population was $3,5 \times 10^2$
Calculate the percentage increase in population from 1998 to 2004. [2]

$$\text{Increase in population} = \text{Population in 2004} - \text{Population in 1998}$$

$$= 3,5 \times 10^2 - 2,8 \times 10^2$$

$$= 10^2(3,5 - 2,8)$$

$$= 10^2(0,7)$$

$$\text{Percentage increase} = \frac{0,7 \times 10^2}{2,8 \times 10^2} \times 100$$

$$= 25\%$$

Q8

Solve the simultaneous equations

$$\frac{1}{3}x = y$$
$$2x + y = -7 \quad [3]$$

SOLUTION

$$\frac{1}{3}x = y \text{ eqn (i)}$$

$$2x + y = -7 \text{ eqn (ii)}$$

$$\text{eqn (i)} \times 3$$

$$\frac{1}{3}x \times 3 = 3 \times y$$

$$x = 3y$$

Substituting x with $3y$ in eqn (ii)

$$2(3y) + y = -7$$

$$7y = -7$$

$$\frac{7y}{7} = \frac{-7}{7}$$

$$y = -1$$

Q9

(a) It is given that $f(x) = (x-1)(x+6)$ and that $f(0) = P$, find the value of P [1]

(b) If $yk = ax - bk$, make k the subject of the formula. [2]

SOLUTION

(a) It is given that $f(x) = (x-1)(x+6)$ and that $f(0) = P$, find the value of P [1]

$$f(0) = P = (0-1)(0+6)$$

$$= (-1)(6)$$

$$= -6$$

$$\therefore\ P = -6$$

(b) If $yk = ax - bk$, make k the subject of the formula.

$$yk = ax - bk$$

$$yk + bk = ax - bk + bk$$

$$yk + bk = ax$$

$$k(y+b) = ax$$

$$\frac{k(y+b)}{(y+b)} = \frac{ax}{y+b}$$

$$\therefore\ k = \frac{ax}{y+b}$$

Q10

(a) Express $3^4 + 3^2 + 3$ as a number in base 3. [1]

(b) Evaluate

(i) $143_8 + 57_8$ giving your answer in base 8. [1]

(ii) $4_5 + 2_3 + 1_2$ giving your answer in base in 10. [1

SOLUTION

(a) Express $3^4 + 3^2 + 3$ as a number in base 3. [1]

$$3^4 + 3^2 + 3 = 1 \times 3^4 + 0 \times 3^3 + 1 \times 3^2 + 1 \times 3^1 + 0 \times 3^0$$

$$= 10110_3$$

(i) $143_8 + 57_8$ giving your answer in base 8.

$$64_8$$

(ii) $4_5 + 2_3 + 1_2$ giving your answer in base in 10.

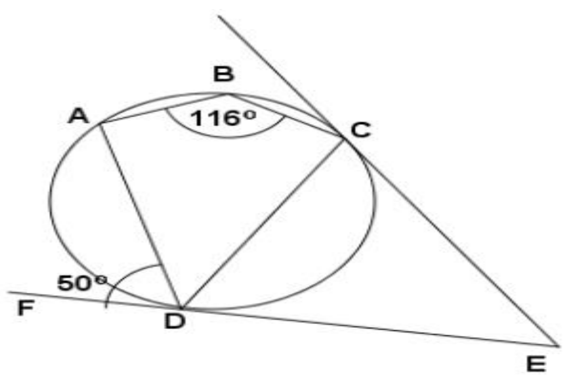
$$= 4 \times 5^0 + 2 \times 3^0 + 1 \times 2^0$$

$$= 4 \times 1 + 2 \times 1 + 1 \times 1$$

$$= 4 + 2 + 1$$

$$= 7_{10}$$

Q11



In the diagram, ABCD is a circle. Tangets at C and D meet at E and Ed is produced to F such that angle ADF = 50° and angle ABC = 116°

Calculate

(a) Angle ADC, [1]

(b) Angle CDE, [1]

(c) Angle CED. [1]

SOLUTION

Calculate

(a) Angle ADC,

$= 180^\circ - 116^\circ$

$= 64^\circ$

(b) Angle CDE, [1]

$= 180^\circ - 50^\circ - 64^\circ$

$= 66^\circ$

(c) Angle CED. [1]

$= 180^\circ - 66^\circ - 66^\circ$

$= 48^\circ$

Q12

The cost of making a telephone call on Teneco is 25 cents per minute.

Kuda has p cents and is able to make a call.

Xolani has q cents which is insufficient to make a call.

Write down 3 inequalities in terms of p and/or q
other than $p > 0$ and $q > 0$, that satisfy the given conditions. [3]

SOLUTION

$p = 25$

$p > 25$

$25 > q$

$p \geq 25 > q$

Q13

AB is a line whose equation is $6y = 7x + 48$

Find

(a) the gradient of the line AB. [1]

(b) the equation of the line parallel to AB
which passes through the point (3; 1)
giving your equation in the form $ay + bx + c = 0$ [2]

SOLUTION

(a) the gradient of the line AB

$$6y = 7x + 48$$

$$\frac{6y}{6} = \frac{7x + 48}{6}$$

$$y = 1\frac{1}{6}x + 8$$

$$\therefore \text{ gradient } = 1\frac{1}{6}$$

(b) the equation of the line parallel to AB
which passes through the point (3; 1)

giving your equation in the form $ay + bx + c = 0$

$$y = 1\frac{1}{6}x + c$$

$$1 = 3 \times 1\frac{1}{6}x + 8$$

$$1 = 3\frac{1}{2} + c$$

$$1 - 3\frac{1}{2} = 3\frac{1}{2} - 3\frac{1}{2} + c$$

$$-2\frac{1}{2} = c$$

$$\therefore \text{ equation of parallel line is } y = 1\frac{1}{6}x - 2\frac{1}{2}$$

Q14

(a) Given that $4m = 7n$, find the ration $m : n$. [1]

(b) A holiday trip to South Africa cost R333.

If the exchange rate was US$1 tp R8,
calculate the cost of the trip in US$,
giving your answer to the nearest cent. [2]

SOLUTION

(a) Given that $4m = 7n$, find the ration $m : n$.

$$\frac{4}{4} : \frac{7}{4}$$

$$= 1 : 1\frac{3}{4}$$

(b) A holiday trip to South Africa cost R333.
If the exchange rate was US$1 tp R8,

calculate the cost of the trip in US$,

giving your answer to the nearest cent. [2]

$$\frac{333}{8} = 41,625$$

$$= \$41,63$$

Q15

Factorise completely

$3x^3y - 12xy^3$ [3]

SOLUTION

$$3x^3y - 12xy^3$$

$$= 3xy(x^2 - 4y^2)$$

$$= 3xy(x - 2y)(x + 2y)$$

Q16

Solve the equation

$$\left[y+\frac{1}{4}\right]^2=\frac{9}{16} \quad [3]$$

SOLUTION

$$\left[y+\frac{1}{4}\right]^2=\frac{9}{16}$$

$$\sqrt{\left[y+\frac{1}{4}\right]^2}=\sqrt{\frac{9}{16}}$$

$$y+\frac{1}{4}=\pm\frac{3}{4}$$

$$y+\frac{1}{4}-\frac{1}{4}=\frac{3}{4}-\frac{1}{4}$$

$$y=\frac{2}{4}$$

$$y=\frac{1}{2} \text{ or}$$

$$y+\frac{1}{4}-\frac{1}{4}=-\frac{3}{4}-\frac{1}{4}$$

$$y=-\frac{4}{4}$$

Q17

(a) Simplify $(32x^{10})^{\frac{1}{5}}$ [2]

(b) Given that $\frac{2^{-2}\times 2^{c}}{2^{4}}=2^{3}$, find the value of c [2]

SOLUTION

(a) Simplify $(32x^{10})^{\frac{1}{5}}$ [2]

$$(32x^{10})^{\frac{1}{5}} = 32^{\frac{1}{5}} \times x^{10\times\frac{1}{2}}$$

$$=^5 \sqrt{32} \times x^2$$

$$= 2x^2$$

(b) Given that $\dfrac{2^{-2} \times 2^c}{2^4} = 2^3,$ find the value of c

$$\frac{2^{-2} \times 2^c}{2^4} = 2^3$$

$$2^{-2} \times 2^c \times 2^{-4} = 2^3$$

$$2^{-2+c-4} = 2^3$$

$$c - 6 = 3$$

$$c - 6 + 6 = 3 + 6$$

$$c = 9$$

Q18

It is given that $P = \begin{bmatrix} 2 & 1 \\ 1 & 1 \end{bmatrix}$ and Q=2P − I where I is the identity matrix.

Find

(a) P^I [2]

(b) Q. [2]

SOLUTION

(a) P^I [2]

$$\text{Determinant} = ad - bc$$

$$= 2 \times 1 - 1 \times 1$$

$$= 1$$

$$\therefore \quad P^I = 1 \begin{bmatrix} 1 & -1 \\ -1 & 2 \end{bmatrix}$$

$$= \begin{bmatrix} 1 & -1 \\ -1 & 2 \end{bmatrix}$$

(b) Q. [2]

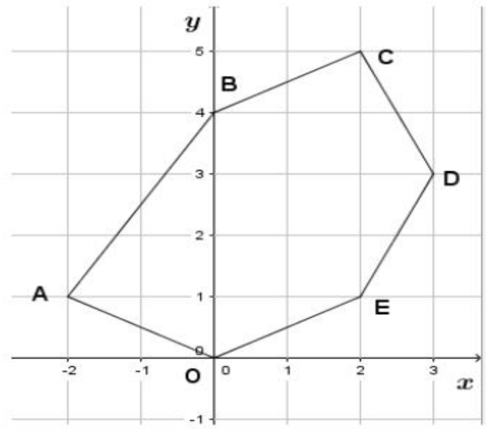
$$Q = 2P - I = 2 \begin{bmatrix} 2 & 1 \\ 1 & 1 \end{bmatrix} - \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 2 \times 2 & 1 \times 2 \\ 1 \times 2 & 1 \times 2 \end{bmatrix} - \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 4 - 1 & 2 - 0 \\ 2 - 0 & 2 - 1 \end{bmatrix}$$

$$= \begin{bmatrix} 3 & 2 \\ 2 & 1 \end{bmatrix}$$

Q19



In the diagram, OABCDE is a hexagon.

(a) Express as column vectors

(i) $\overrightarrow{OE}$, [1]

(ii) $\overrightarrow{OA} + \overrightarrow{AD}$. [1]

(b) Describe FULLY the SINGLE transformation which maps side BC onto side OE. [2]

SOLUTION

(a) Express as column vectors

(i) $\overrightarrow{OE}$, [1]

$$= \begin{bmatrix} 2 \\ 1 \end{bmatrix}$$

(ii) $\overrightarrow{OA} + \overrightarrow{AD}$. [

$$= \begin{bmatrix} -2 \\ 1 \end{bmatrix} + \begin{bmatrix} 5 \\ 1 \end{bmatrix}$$

$$= \begin{bmatrix} -2+5 \\ 1+2 \end{bmatrix}$$

$$= \begin{bmatrix} 3 \\ 3 \end{bmatrix}$$

(b) Describe FULLY the SINGLE transformation which maps side BC onto side OE. [2]

$$\text{Translation by vector } = \begin{bmatrix} 0 \\ -4 \end{bmatrix}$$

Q20

All lengths on a map are $\frac{1}{500}$ of their actual lengths

Calculate

(a) the actual length of a line represented on the map by a line of 7,3 cm. [1]

(b) the area on the map which represents an actual area of 525 m^2 giving your answer in cm^2 [3]

SOLUTION

(a) the actual length of a line represented on the map by a line of 7,3 cm.

$$\frac{1}{500}x = 7,3$$

$$500 \times \frac{1}{500}x = 7,3 \times 500$$

$$x = 3650 \text{ cm}$$

(b) the area on the map which represents an actual area of 525 m^2 giving your answer in cm^2 [3]

$$525 \text{ m}^2 = 525 \times 100 \times 100 \text{ cm}^2$$

$$= 5250000 \text{ cm}^2$$

$$\text{On map } = 5250000 \times \frac{1}{500} \times \frac{1}{500}$$

$$= 21 \text{ cm}^2$$

Q21

Evaluate

$$\text{(a)}\quad \frac{\log_5 64}{\log_5 4} \quad [2]$$

$$\text{(b)}\quad 1+\log_3 9 \quad [2]$$

SOLUTION

$$\text{(a)}\quad \frac{\log_5 64}{\log_5 4} \quad [2]$$

$$\frac{\log_5 64}{\log_5 4} = \frac{\log_5 4^3}{\log_5 4}$$

$$= \frac{3\log_5 4}{\log_5 4}$$

$$= 3$$

$$\text{(b)}\quad 1+\log_3 9 \quad [2]$$

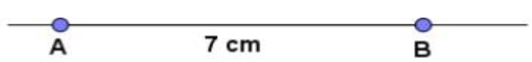
$$1+\log_3 9 = 1+\log_3 3^2$$

$$= 1+2\log_3 3$$

$$= 1+2(1)$$

$$= 3$$

Q22



In the answer space above, is a line segment AB which is 7 cm long.

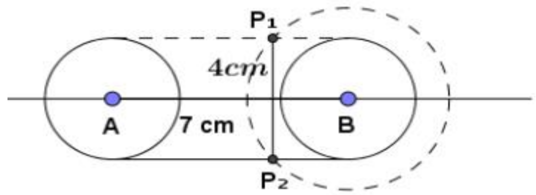
(a) Using a ruler and compasses only, construct the locus of points

(i) 3 cm from B, [1]

(ii) above AB, which are 2 cm from line AB. [2]

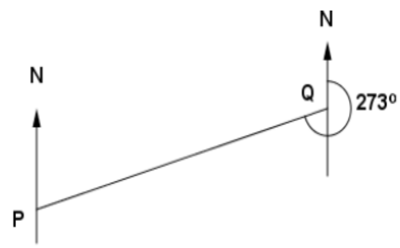
(b) (i) Mark and label P_1 and P_2 which are 3 cm from B and 2 cm from line AB. [1]

(ii) Measure the distance P_1P_2. [1]



SOLUTION

Q23



In the diagram, P and Q are points on level ground. The bearing of P from Q is 237°. Find the bearing of Q from P. [2]

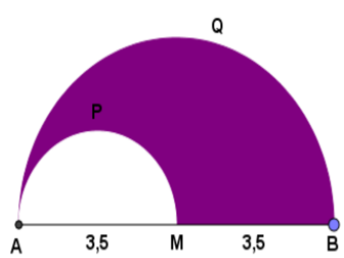
SOLUTION

In the diagram, P and Q are points on level ground. The bearing of P from Q is 237°. Find the bearing of Q from P. [2]

$$= 237^{\circ} - 180^{\circ}$$

$$= 57^{\circ}$$

Q23b



The diagram shows two semi circles APM and AQB. AM = MB = 3,5 cm.

Taking π to be $\frac{22}{7}$, calculate the perimeter of the shaded region. [3]

SOLUTION

The diagram shows two semi circles APM and AQB. AM = MB = 3,5 cm.

Taking π to be $\frac{22}{7}$, calculate the perimeter of the shaded region. [3]

$$\text{Perimeter of a circle } = 2\pi r$$

$$\text{Perimeter of large semi circe } = \frac{1}{2} \times 2 \times \frac{22}{7} \times 3,5$$

$$= 11 \text{ cm}$$

$$\text{Perimeter of small semi circle } = \frac{1}{2} \times \frac{22}{7} \times 3,5$$

$$= 5,5 \text{ cm.}$$

$$\text{Hence total perimeter } = 5,5 + 11 + 3,5 + 3,5$$

$$= 23,5 \text{ cm}$$

Q24

$$\begin{bmatrix} \text{age in years} & 11 & 12 & 13 & 14 & 15 \\ \text{no of pupils} & 3 & 10 & 8 & 6 & 3 \end{bmatrix}$$

The ages of pupils in a class of 30 are shown in the table.

(a) Two pupils are chosen at random from the class,
find the probability that one is aged 11 years and the other is aged 14 years. [2

(b) Calculate the mean age of the pupils. [3]

SOLUTION

(a) Two pupils are chosen at random from the class,
find the probability that one is aged 11 years and the other is aged 14 years

$$\text{Probability that one is aged 11 is } \frac{3}{30} = \frac{1}{10}$$

$$\text{Probability that one is aged 14 is } \frac{6}{30} = \frac{1}{5}$$

$$\therefore \text{Probability that one is aged 11 and the other 14 is } \frac{1}{10} \times \frac{1}{5}$$

$$= \frac{1}{50}$$

(b) Calculate the mean age of the pupils. [3]

$$\text{Mean} = \frac{\text{Sum of all pupils age}}{\text{Number of pupils}}$$

$$= \frac{11 \times 3 + 12 \times 10 + 13 \times 8 + 14 \times 6 + 15 \times 3}{30}$$

$$= \frac{33 + 120 + 104 + 84 + 45}{30}$$

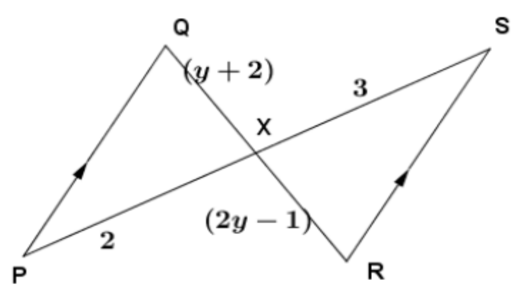
$$= \frac{386}{30}$$

$$= 12,866667$$

$$= 12 \text{ year and } 0,86667 \times 12 \text{ months}$$

$$= 12 \text{ years and } 10{,}4 \text{ months}$$

Q25



In the diagram, PQ is parallel to RS. PS and QR intersect at X.
It is given that PX = 2 cm, SX = 3 cm, QX = $(y+2)$ cm and RX = $(2y-1)$ cm.

(a) Name the triangle which is simillar to PQX. [1]

(b) Using your results in (a), find the value of y. [3]

(c) Write down the length of QR. [1]

SOLUTION

(a) Name the triangle which is simillar to PQX.

SRX

(b) Using your results in (a), find the value of y.

Use ratio of sides

$$\frac{y+2}{2} = \frac{2y-1}{3}$$

$$3(y+2) = 2(2y-1)$$

$$3y+6 = 4y-2$$

$$6+2 = 4y-3y$$

$$\therefore\ y = 8$$

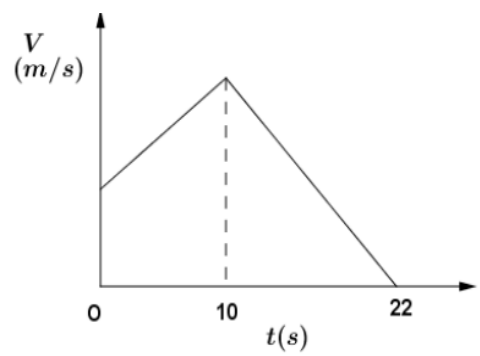
(c) Write down the length of QR

$$= 8+2+2(8)-1$$

$$= 10+15$$

$$= 25 \text{ cm}$$

Q26



The diagram is a velocity-time graph of an object which accelerated uniformly for 10 seconds. During this time the velocity, V m/s at time t seconds from the start, was given by $V = 6 + 2t$. It then decelerated to rest in a further 12 seconds.

Calculate

(a) The velocity of the object when $t = 0$, [1]

(b) The deceleration of the object, [2]

(c) The distance covered by the object in the 22 seconds, [2]

(d) The average speed of the object for the whole journey. [1]

SOLUTION

(a) The velocity of the object when $t = 0$,

$$= 6 + 2(0)$$

$$= 6 \text{ m/s}$$

(b) The deceleration of the object, [2]

$$\text{When } t = 10, V = 6 + 2(10) = 6 + 20 = 26$$

$$\text{Gradient } = \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{0 - 26}{22 - 10}$$

$$= \frac{-26}{12}$$

$$= -2\frac{1}{6} \text{ m/s}^2$$

(c) The distance covered by the object in the 22 seconds,

$$\text{Area under graph} = \frac{1}{2} \times 10 \times 20 + 6 \times 10 + \frac{1}{2} \times 12 \times 26$$

$$= 100 + 60 + 156$$

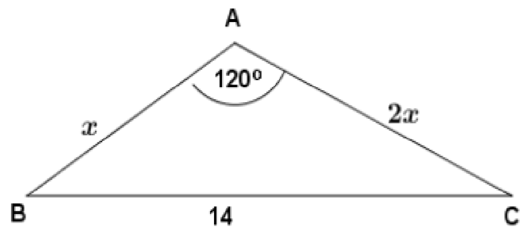
$$= 316 \text{ m}$$

(d) The average speed of the object for the whole journey.

$$= \frac{316}{22}$$

$$= 14\frac{4}{11} \text{ m/s}$$

Q27



In the diagram, ABC is a triangle in which AB = x cm, AC = $2x$ cm, BC = 14 cm and angle BAC = 120°.

Using as much of the information given in the table below as is necessary, calculate

(a) The value of x leaving your answer in surd form. [4]

(b) The area of triangle ABC. [2]

[$\sin 60^\circ = 0{,}87 \quad \cos 60^\circ = 0{,}50 \quad \tan 60^\circ = 1{,}73$]

SOLUTION

(a) The value of x leaving your answer in surd form

$$\mathrm{BC}^2 = \mathrm{AB}^2 + \mathrm{AC}^2 - 2(\mathrm{AB})(\mathrm{AC})\,(\cos \mathrm{A})$$

$$= x^2 + (2x)^2 - 2(x)(2x)(-0,5)$$

$$(14)^2 = x^2 + 4x^2 + 2x^2$$

$$196 = 7x^2$$

$$\frac{196}{7} = \frac{7x^2}{7}$$

$$28 = x^2$$

$$\sqrt{28} = \sqrt{x^2}$$

$$\therefore\ x = \sqrt{4/7}$$

$$= 2\sqrt{7}$$

(b) The area of triangle ABC. [2]

$$\text{Area of triangle } = \frac{1}{2}\,ab \sin \mathrm{C}$$

$$= \frac{1}{2} \times 2(\sqrt{7}) \times 2(2(\sqrt{7}) \times 0,87$$

$$= 0,5 \times 8 \times 0,87$$

$$= 3,48 \text{ cm}^2$$

NOVEMBER 2013

Q1

Evaluate, giving each answer as a fraction in its lowest terms.

(a) $\frac{1}{5}+\frac{1}{6}$ [1]

(b) $\frac{2}{5}\div 4$ [1]

(c) $\frac{3}{4}-\frac{1}{4}\times\frac{2}{3}$ [1]

SOLUTION

(a) $\frac{1}{5}+\frac{1}{6}$ [1]

$$=\frac{1(6)+1(5)}{30}$$

$$=\frac{11}{30}$$

(b) $\frac{2}{5}\div 4$

$$=\frac{2}{5}\div\frac{4}{1}$$

$$=\frac{2}{5}\times\frac{1}{4}$$

$$=\frac{2}{20}$$

$$=\frac{1}{10}$$

(c) $\frac{3}{4}-\frac{1}{4}\times\frac{2}{3}$

$$=\frac{3}{4}-\frac{2}{12}$$

$$=\frac{3(3)-2(1)}{12}$$

$$=\frac{9-2}{12}$$

$$=\frac{7}{12}$$

Q2

$$\text{Evaluate} \quad \frac{(0.3)^3 \times 0,02}{0,0008}$$

giving your answer in standard form. [3]

SOLUTION

$$\frac{(0.3)^3 \times 0,02}{0,0008} = \frac{0,027 \times 0,02}{0,008}$$

$$= \frac{0,00054}{0,008}$$

$$= \frac{0,00054}{0,008} \times \frac{100}{100}$$

$$= \frac{0,54}{8}$$

$$= 0,0675$$

$$= 6,75 \times 10^{-2}$$

Q3

(a) The temperature inside a freezer is -8 $^\circ$C.

During a power cut the temperature rose by 12 $^\circ$C.

Find the temperature after the rise. [1]

(b) Write down the next two terms in the following sequence;

$$1; \frac{1}{2}; \frac{1}{4}; \frac{1}{8}; - - - \quad [2]$$

SOLUTION

(a) The temperature inside a freezer is -8 $^\circ$C.
During a power cut the temperature rose by 12 $^\circ$C
Find the temperature after the rise. [1]

$$-8^\circ + 12^\circ = 4^\circ$$

(b) Write down the next two terms in the following sequence;

$$1; \frac{1}{2}; \frac{1}{4}; \frac{1}{8}; - - - \quad [2]$$

$$\frac{1}{16}; \quad \frac{1}{32}$$

Q4

(a) Write 3,35 minutes in minutes and seconds. [1]

(b) If 1 kilometre is $\frac{5}{8}$ of a mile,

convert 75 miles to kilometres. [2]

SOLUTION

(a) Write 3,35 minutes in minutes and seconds

$$3 \text{ minutes and } (0,35 \times 60) \text{ seconds}$$

$$= 3 \text{ minutes } 21 \text{ seconds}$$

(b) If 1 kilometre is $\frac{5}{8}$ of a mile,

convert 75 miles to kilometres. [2]

$$1 \text{ km} = 0,625 \text{ miles}$$

$$75 \text{ miles } = \frac{75}{0,625} \text{ km}$$

$$= 120 \text{ km}$$

Q5

A shopper spends $\$\,\frac{c}{d}$ on one item
and half of that amount on each of three other items.

Find how much she spent altogether. [3]

SOLUTION

$$\$\,\frac{c}{d} + \frac{1}{2}\,\$\,\frac{c}{d} + \frac{1}{2}\,\$\,\frac{c}{d} + \frac{1}{2}\,\$\,\frac{c}{d}$$

$$= 2\,\frac{1}{2}\,\$\,\frac{c}{d}$$

Q6

Simplify

(a) $\dfrac{(3^3)^4}{27^3}$ [1]

(b) $(4x^2y^6)^{\frac{1}{2}}$ [1]

(c) $x^0 \div x^{-2}$ [1]

SOLUTION

(a) $\frac{(3^3)^4}{27^3}$ [1]

$$\frac{(3^3)^4}{27^3} = \frac{3^{3\times 4}}{(3^3)^3}$$

$$= \frac{3^{12}}{3^{3\times 3}}$$

$$= \frac{3^{12}}{3^9}$$

$$= 3^{12-9}$$

$$= 3^3$$

$$= 27$$

(b) $(4x^2y^6)^{\frac{1}{2}}$ [1]

$$(4x^2y^6)^{\frac{1}{2}} = \sqrt{4} \times \sqrt{x^2} \times \sqrt{y^6}$$

$$= \pm 2 \times \pm x \times \pm y^3$$

$$= \pm 2xy^3$$

(c) $x^0 \div x^{-2}$ [1]

$$x^0 \div x^{-2} = x^{0-(-2)}$$

$$= x^2$$

Q7

(a) Express $\frac{7}{8}$ as a decimal fraction. [1]

(b) A car loses 55% of its value after four years.

If it cost $8500 when new, find its value after the four years. [2

SOLUTION

(a) Express $\frac{7}{8}$ as a decimal fraction

$= 0,875$

(b) A car loses 55% of its value after four years.

If it cost \$8500 when new, find its value after the four years.

Value after 4 years = Cost price − Loss in value

$= 8500 - 0,55 \times 8500$

$= 8500 - 4675$

$= \$3825$

Q8

(a) Simplify $5m - 2(x - 3m)$. [1]

(b) Solve the equation

$$\frac{x+5}{7} = \frac{3}{2} \quad [2]$$

SOLUTION

(a) Simplify $5m - 2(x - 3m)$. [1]

$5m - 2(x - 3m) = 5m - 2x + 6m$

$= 5m + 6m - 2x$

$= 11m - 2x$

(b) Solve the equation

$$\frac{x+5}{7} = \frac{3}{2} \quad [2]$$

$$\frac{x+5}{7} = \frac{3}{2}$$

$$7\left(\frac{x+5}{7}\right) = 7\left(\frac{3}{2}\right)$$

$$x+5 = \frac{21}{2}$$

$$x+5-5 = 10,5-5$$

$$x = 5,5$$

Q9

(a) Express 200km/hr as a speed in km/min. [1]

(b) Find the time taken for a racing driver to cover 120km race if he travels at 200km/h, giving your answer in minutes. [2]

SOLUTION

(a) Express 200km/hr as a speed in km/min

$$= \frac{200}{60}$$

$$= 3,33 \text{ km/min}$$

(b) Find the time taken for a racing driver to cover 120km race if he travels at 200km/h, giving your answer in minutes. [2]

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}}$$

$$= \frac{120}{200}$$

$$= 0,6 \text{ hr}$$

$$= 0,6 \times 60 \text{ minutes}$$

$$= 36 \text{ minutes}$$

Q10

Factorise completely

(a) $4y - 4$ [1]

(b) $xy^2 - 4x + 2y^2 - 8$ [2]

SOLUTION

(a) $4y - 4$ [1]

$$4(y - 1)$$

(b) $xy^2 - 4x + 2y^2 - 8$ [

$$xy^2 - 4x + 2y^2 - 8$$

$$= x(y^2 - 4) + 2(y^2 - 4)$$

$$= (y^2 - 4)(x + 2)$$

Q11

Solve the simultaneous equations

$$5d - 3e = -1$$
$$2d + 3e = 8 \quad [3]$$

SOLUTION

$5d - 3e = -1$ eqn (i)

$2d + 3e = 8$ eqn (i)

eqn (i) + eqn (ii)

$5d + 2d - 3e + 3e = -1 + 8$

$7d = 7$

$\frac{7d}{7} = \frac{7}{7}$

$\therefore \ d = 1$

Substitute d with 1 in eqn (ii)

$2(1) + 3e = 8$

$2 - 2 + 3e = 8 - 2$

Q12

(a) Solve the equation $(x+3)^2 = 49$ [3]

(b) Write down the prime numbers between 20 and 30. [1]

SOLUTION

(a) Solve the equation $(x+3)^2 = 49$

$(x+3)^2 = 49$

$\sqrt{(x+3)^2} = \sqrt{49}$

$x + 3 = \pm 7$

$x + 3 = 7$

$x + 3 - 3 = 7 - 3$

$x = 4$ or

$x + 3 = -7$

$x + 3 - 3 = -7 - 3$

$x = -10$

(b) Write down the prime numbers between 20 and 30.

23; 29

Q13

(a) Simplify $\frac{x^2+3x+2}{x+2}$ [3]

(b) Find the order of rotational symmetry
of a right angled isosceles triangle. [1]

SOLUTION

(a) Simplify $\frac{x^2+3x+2}{x+2}$ [3]

$$\frac{x^2+3x+2}{x+2} = \frac{(x+2)(x+1)}{(x+2)}$$

$$= x+1$$

(b) Find the order of rotational symmetry
of a right angled isosceles triangle. [1]

ONE

Q14

(a) Given that $n(\text{A})=10$ and $n(\text{B})=15$,
find the greatest possible value of

(i) $n(\text{A U B})$, [1]

(ii) $n(\text{A} \cap \text{B})$, [1]

SOLUTION

(a) Given that n(A)=10 and n(B)=15, find the greatest possible value of

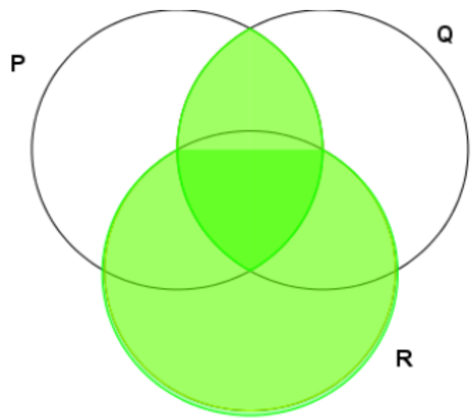
(i) n(A U B), [1]

$10 + 15 = 25$

(ii) $n(A \cap B)$,

10

Q14b



Use set notation to describe the shaded region in the above diagram in terms of sets P, Q and R. [2]

SOLUTION

Use set notation to describe the shaded region in the above diagram in terms of sets P, Q and R. [2]

$(P \bigcap Q) \bigcup R$

Q15

Give that A= $\begin{bmatrix} -2 & -1 \\ 6 & 2 \end{bmatrix}$ and B= $\begin{bmatrix} 0 & -1 \\ 4 & 3 \end{bmatrix}$

Find (a) 3A-B [2]

(b) B^2 [2]

SOLUTION

Find (a) 3A-B [2]

$$= 3\begin{bmatrix} -2 & -1 \\ 6 & 2 \end{bmatrix} - \begin{bmatrix} 0 & -1 \\ 4 & 3 \end{bmatrix}$$

$$= \begin{bmatrix} -2 \times 3 & -1 \times 3 \\ 6 \times 3 & 2 \times 3 \end{bmatrix} - \begin{bmatrix} 0 & -1 \\ 4 & 3 \end{bmatrix}$$

$$= \begin{bmatrix} -6 - 0 & -3 - (-1) \\ 18 - 4 & 6 - 3 \end{bmatrix}$$

$$= \begin{bmatrix} -6 & -2) \\ 14 & 3 \end{bmatrix}$$

(b) B^2 [2]

$$\begin{bmatrix} 0 & -1 \\ 4 & 3 \end{bmatrix}\begin{bmatrix} 0 & -1 \\ 4 & 3 \end{bmatrix}$$

$$= \begin{bmatrix} 0 \times 0 + -1 \times 4 & 0 \times -1 + -1 \times 3 \\ 4 \times 0 + 3 \times 4 & 4 \times -1 + 3 \times 3 \end{bmatrix}$$

$$= \begin{bmatrix} 0 - 4 & 0 - 3 \\ 0 + 12 & -4 + 9 \end{bmatrix}$$

$$= \begin{bmatrix} -4 & -3 \\ 12 & 5 \end{bmatrix}$$

Q16

(a) Write down the largest four digit number in base eight. [1]

(b) Convert 111_8 to a number in base two. [2]

(c) Find the sum of 444_5 and 21_5
giving your answer in base five. [1]

SOLUTION

(a) Write down the largest four digit number in base eight

7777_8

(b) Convert 111_8 to a number in base two.

$$111_8 = 1 \times 8^0 + 1 \times 8^1 + 1 \times 8^2$$

$$= 1 + 8 + 64$$

$$= 73_{10}$$

$$73_{10} = 1001001_2$$

(c) Find the sum of 444_5 and 21_5

giving your answer in base five. [1]

$$= 1020_5$$

Q17

A rugby team scored the following points in 12 matches
21; 18; 3; 12; 15; 18; 42; 18; 24; 6; 12; 3.

For the 12 matches,
find

(a) the mode. [1]

(b) the mean. [2]

(c) In the next match, the team scored 55 points.

Write down the median score for the 13 matches. [1]

SOLUTION

(a) the mode. [

18

(b) the mean. [2]

$$\text{Mean} = \frac{\text{Sum of items}}{\text{Number of items}}$$

$$= \frac{3+3+6+12+12+15+18+18+18+21+24+42}{12}$$

$$= \frac{192}{12}$$

$$= 16$$

(c) In the next match, the team scored 55 points.

Write down the median score for the 13 matches. [

3; 3; 6; 12; 12; 18; 18; 18; 21; 24; 42; 55

= 18

Q18

The scale of a map is 1: 10 000.

(a) Two hills are 4,5 cm apart on the map. Find the actual distance between the hills, giving your answer in kilometres. [2]

(b) Two towns are 80 km apart.

Find the distance between them on the map, giving your answer in centimetres. [2]

SOLUTION

(a) Two hills are 4,5 cm apart on the map.

Find the actual distance between the hills, giving your answer in kilometres. [2]

$$4,5 \times 10000 = 4500 \text{ cm}$$

$$\frac{4500}{100} \text{ m} = 450 \text{ m}$$

$$\frac{450}{1000} \text{ km} = 0,45 \text{ km}$$

(b) Two towns are 80 km apart.

Find the distance between them on the map, giving your answer in centimetres. [2]

$$80 \text{ km} = 80 \times 1000 \text{ m}$$

$$= 80000$$

$$80000 \times 100 = 8000000 \text{ cm}$$

$$\text{Scale Distance} = \frac{\text{Actual Distance}}{\text{Scale}}$$

$$= \frac{8000000}{10000}$$

$$= 800 \text{ cm}$$

Q19

The temperature $T^\circ C$ at a height of H metres above sea level, is given by the formula $T = 20 - \dfrac{H}{150}$

(a) Calculate the temperature at 4 500 metres. [1]

(b) Make H the subject of the formula. [2]

(c) Find the height at which temperature is 12°C. [1]

SOLUTION

(a) Calculate the temperature at 4 500 metres.

$$T = 20 - \frac{H}{150}$$

$$= 20 - \frac{4500}{150}$$

$$= 20 - 30$$

$$= -10^{\circ}$$

(b) Make H the subject of the formula.

$$T = 20 - \frac{H}{150}$$

$$T - 20 = 20 - 20 - \frac{H}{150}$$

$$T - 20 = -\frac{H}{150}$$

$$-150(T - 20) = -150 \times (-\frac{H}{150})$$

$$\therefore\ H = -150(T - 20)$$

(c) Find the height at which temperature is 12°C.

$$\mathbf{H = -150(T - 20)}$$

$$\mathbf{= -150(12 - 20)}$$

$$\mathbf{= -150(-8)}$$

$$\mathbf{= 1200\ m}$$

Q20

The number of revolutions, $n,$ of a wheel
over a fixed distance varies inversly
as the circumference, C cm, of the wheel.

(a) Write down an equation involving $n,\ C$ and a constant k. [1]

(b) If a wheel of circumference 80 cm makes 10 revolutions,
find the number of revolutions made by a wheel
of circumference 200 cm. [3]

SOLUTION

(a) Write down an equation involving $n,\ C$ and a constant k.

$$n = \frac{k}{c}$$

(b) If a wheel of circumference 80 cm makes 10 revolutions,
find the number of revolutions made by a wheel
of circumference 200 cm. [3]

$$n = \frac{k}{c}$$

$$10 = \frac{k}{80}$$

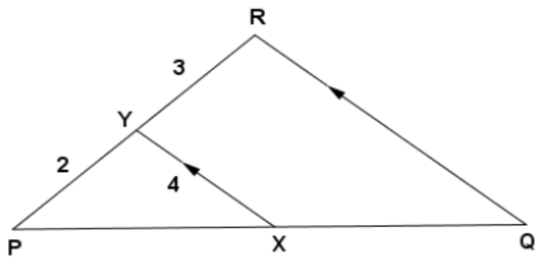
$$80 \times 10 = 80 \times \frac{k}{c}$$

$$800 = k$$

$$\therefore\ n = \frac{800}{200}$$

$$= 4$$

Q21



In the diagram, XY is parallel to QR, PY = 2 cm, YR = 3 cm and XY = 4 cm

Find

(a) The length of QR, [2]

(b) The ratio $\frac{\text{Area of Triangle PXY}}{\text{Area of Triangle QQR}}$ [2]

SOLUTION

(a) The length of QR,

$$\frac{2}{2+4} = \frac{5}{5+\text{RQ}}$$

$$2(5+\text{RQ}) = 6(5)$$

$$10 + 2\text{RQ} = 30$$

$$2\text{RQ} = 20$$

$$\therefore \quad \text{RQ} = 10$$

(b) The ratio $\frac{\text{Area of Triangle PXY}}{\text{Area of Triangle QQR}}$

$$= \begin{bmatrix} 2 \\ 5 \end{bmatrix}^2$$

$$= \frac{4}{25}$$

Q22

Tendai and Vimbai take a driving test.

The probability that Tendai will pass is $\frac{3}{5}$

and the probability that Vimbai will pass is $\frac{2}{3}$.

(a) State which one of them is more likely to pass. [1]

(b) Calculate the probability that

(i) they both fail. [2]

(ii) only one of them will pass [2]

SOLUTION

(a) State which one of them is more likely to pass.

$$\frac{3}{5} = 0,6$$

$$\frac{2}{3} = 0,666667$$

VIMBAI

(b) Calculate the probability that

(i) they both fail. [2]

$$\frac{2}{5} \times \frac{1}{3} = \frac{2}{15}$$

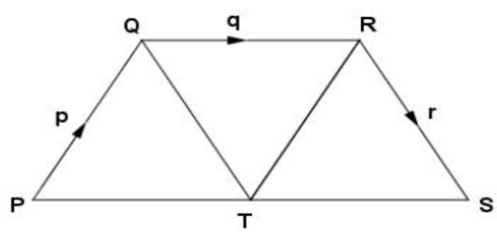
(ii) only one of them will pass

$$\frac{3}{5} \times \frac{1}{3} + \frac{2}{5} + \frac{2}{3}$$

$$= \frac{3}{15} + \frac{4}{15}$$

$$= \frac{7}{15}$$

Q23



In the diagram $\overrightarrow{PQ} = p$, $\overrightarrow{QR} = q$ and $\overrightarrow{RS} = r$. Triangles PQT, QTR and TRS are equilateral.

Express

(i) $\overrightarrow{PS}$ in terms of

1. p,q and r, [1]

2. q only. [2]

(ii) p in terms of q and r. [2]

SOLUTION

Express

i) $\overrightarrow{PS}$ in terms of

1. p,q and r, [1]

$$= p + q + r$$

Vector QR = PT = TS cause of same size and direction though parallel hence

$$\overrightarrow{PS} = q + q$$

$$= 2q$$

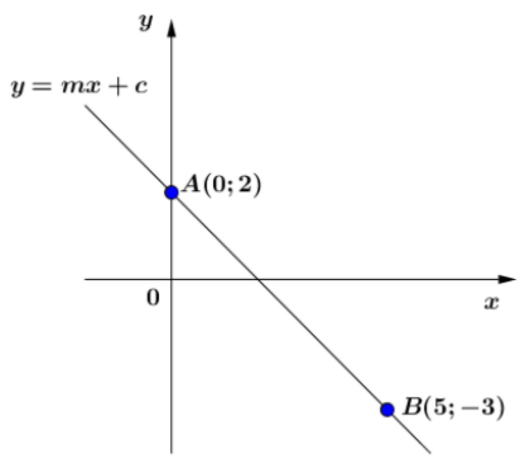
(ii) p in terms of q and r. [2]

$$\overrightarrow{PQ} = \overrightarrow{PT} + \overrightarrow{TS} + \overrightarrow{SR} + \overrightarrow{RQ}$$

$$= q + q + (-r) + (-q)$$

$$= q - r$$

Q24



The diagram shows the graph of $y = mx + c$, which passes through the points A(0; 2) and B (5; −3)

(a) Find the value of

(i) c, [1]

(ii) m, [2]

(b) Calculate the length of AB, leaving your answer in surd form. [2]

SOLUTION

(i) c, [1]

$= 2$

(a) Find the value of

(ii) m, [2]

$$\text{Gradient } = \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{-3-2}{5-0}$$

$$= -1$$

(b) Calculate the length of AB, leaving your answer in surd form.

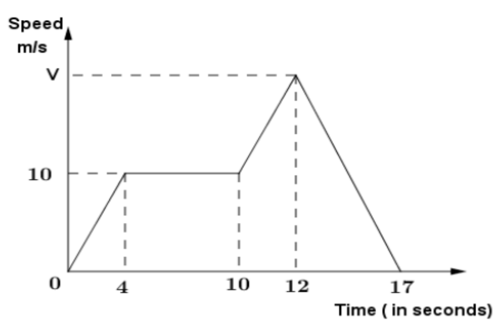
$$\text{AB}^2 = (0-5)^2 + (2 - -3)^2$$
$$= 25 + 25$$

$$= 50$$

$$\sqrt{\text{AB}^2} = \sqrt{25 \times 2}$$

$$= 5\sqrt{2}$$

Q25



The diagram represents the speed-time graph of a sprinter during an athletics training session.

(a) Calculate the distance the sprinter covers during the first 10 seconds. [2]

(b) Given that the acceleration during the time interval $t = 10$ to $t = 12$ is 5 m/s^2, find the value of V. [2]

(c) Calculate the deceleration of the sprinter, from $t = 12$ to the time the sprinter stops running. [2]

SOLUTION

(a) Calculate the distance the sprinter covers during the first 10 seconds.

$$= \frac{1}{2} \times 4 \times 10 + 6 \times 10$$

$$= 20 + 60$$

$$= 80 \text{ m}$$

(b) Given that the acceleration during the time interval $t = 10$ to $t = 12$ is 5 m/s^2, find the value of V. [2]

$$\text{Gradient } = \frac{y_2 - y_1}{x_2 - x_1}$$

$$5 = \frac{V - 10}{12 - 10}$$

$$5(2) = V - 10$$

$$10 + 10 = V - 10 + 10$$

$$\therefore \; V = 20$$

(c) Calculate the deceleration of the sprinter, from $t = 12$ to the time the sprinter stops running. [2]

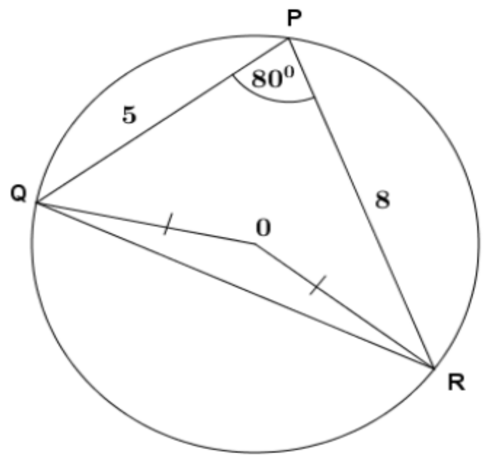
$$\text{Gradient } = \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{0 - 20}{17 - 12}$$

$$= -\frac{20}{5}$$

$$= -4 \text{ m/s}^2$$

Q26



The points P, Q and R lie on the circumference of a circle, centre O
PQ = 5 cm, PR = 8 cm and angle QPR = 80°

Using as much of the information given as is necessary, calculate

(a) The area of the triangle PQR. [2]

(b) The value of QR^2 [2]

(c) Find the reflex QOR. [2]

SOLUTION

(a) The area of the triangle PQR.

$$\text{Area of a triange } = \frac{1}{2}\, ab \sin \mathrm{C}$$

$$= 0,5 \times 5 \times 8 \times 0,985$$

$$= 19,7 \text{ cm}^2$$

(b) The value of QR^2 [2]

$$QR^2 = QP^2 + PR^2 - 2(QP)(PR)(\cos 80^\circ)$$

$$= 5^2 + 8^2 - 2(5)(8)(0,174)$$

$$= 25 + 64 - 20(0,174)$$

$$= 89 - 3.48$$

$$= 85,52$$

(c) Find the reflex QOR.

$= 80 \times 2$

$= 160^\circ$

JUNE 2013

Q1

(a) Subtract -2 from 2. [1]

(b) Leaving your answer as a common fraction, find

in its lowest term the vlue of $\frac{8}{15} \div \frac{2}{3}$ [2]

SOLUTION

(a) Subtract -2 from 2.

$2 - (-2) = 4$

(b) Leaving your answer as a common fraction, find,

in its lowest term the vlue of $\frac{8}{15} \div \frac{2}{3}$ [2]

$$\frac{8}{15} \div \frac{2}{3} = \frac{8}{15} \times \frac{3}{2}$$

$$= \frac{4}{5}$$

Q2

(a) Express $3\,\frac{4}{5}$ as a decimal number. [1]

(b) Find the exact value of $\frac{0,83 + 8,368}{0,42}$ [2]

SOLUTION

(a) Express $3\frac{4}{5}$ as a decimal number.

$$= 3,8$$

(b) Find the exact value of $\frac{0,83 + 8,368}{0,42}$

$$\frac{0,83 + 8,368}{0,42} = \frac{9,198}{0,42}$$

$$= \frac{9,198}{0,42} \times \frac{100}{100}$$

$$= \frac{919,8}{42}$$

$$= 21,9$$

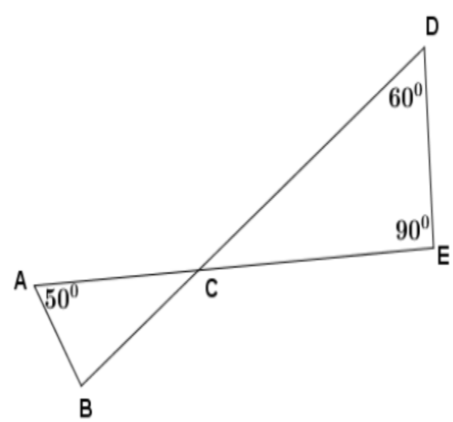
Q3

(a) Find n such that $0,0075 = 7,5 \times 10^{n}$.

SOLUTION

$$0,0075 = 7,5 \times 10^{-3}$$

$$\therefore n = -3$$



In the diagram ACE and BCD are straight lines intersecting at C. Given that angle CED = 90°, calculate angle ABC. [2]

SOLUTION

In the diagram ACE and BCD are straight lines intersecting at C. Given that angle CED $= 90^\circ$, calculate angle ABC. [2]

$$\text{Ange ACB} = 180^\circ - 90^\circ - 60^\circ$$

$$= 30^\circ$$

$$\text{Sum of interior angles of a triangle } = 180^\circ$$

$$\therefore \text{ angle ABC } = 180^\circ - 30^\circ - 50^\circ$$

$$= 100^\circ$$

Q4

(a) Write down the square of 4. [1]

(b) Evaluate $125^{\frac{1}{3}} \times \sqrt{144}$ [2]

SOLUTION

(a) Write down the square of 4.

$$= 16$$

(b) Evaluate $125^{\frac{1}{3}} \times \sqrt{144}$ [2]

$$125^{\frac{1}{3}} \times \sqrt{144} = \sqrt[3]{125} \times \pm 12$$

$$= 5 \times \pm 12$$

$$= \pm 60$$

Q5

Express (a) 3 m^2 in cm^2 [1]

(b) 32,5 m/s in km/h. [2]

SOLUTION

Express (a) 3 m^2 in cm^2 [1]

$$3 \times 100 \times 100 = 30000 \text{ cm}^2$$

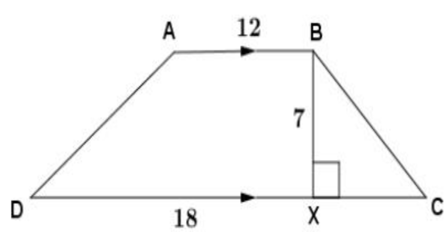
(b) 32,5 m/s in km/h.

$$= \frac{32,5 \times 60 \times 60}{1000}$$

$$= \frac{117000}{1000}$$

$$= 117 \text{ km/hr}$$

Q6



In the diagram, ABCD is a quadrilateral in which Ab is parallel to DC, AB = 12 cm CD = 18 cm, BX = 7 cm and ange BXC = 90°.

(a) State the special name given to quadrilateral ABCD. [1]

(b) Calculate the area of the quadrilateral. [2]

SOLUTION

(a) State the special name given to quadrilateral ABCD

Trapezium or Trapezoid

(b) Calculate the area of the quadrilateral.

$$\text{Area of a Trapezium } = \frac{1}{2}(a+b)h$$

$$= 0,5(18+12)7$$

$$= 15(7)$$

$$= 105 \text{ cm}^2$$

Q7

Simplify $\dfrac{x^2+7x+6}{x^2-36}$ [3]

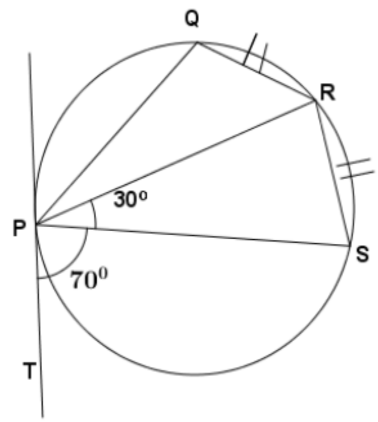
SOLUTION

$$\frac{x^2+7x+6}{x^2-36}$$

$$= \frac{(x+6)(x+1)}{(x+6)(x-6)}$$

$$= \frac{x+1}{x-6}$$

Q8



In the diagram P, Q, R and S are points on the circumference of a circle and arcs QR and RS are equal. TP is a tangent to the circle at P, angle TPS = 70° and angle RPS = 30°.

Calculate

(a) angle QPR. [1]

(b) angle PRS, [1]

(c) angle PQR. [1]

SOLUTION

Calculate

(a) angle QPR.

$= 30^\circ$

(b) angle PRS,

$= 70^\circ$

(c) angle PQR. |

$= 100^\circ$

Q9

E varies directly as the square of V.

(a) Express E in terms of V and a constant m. [1]

(b) Given that $E = 3$ when $V = 2$ find m. [2]

SOLUTION

(a) Express E in terms of V and a constant m.

$$E = mv^2$$

(b) Given that $E = 3$ when $V = 2$ find m.

$$E = mv^2$$

$$3 = m(2)^2$$

$$3 = 4m$$

$$\frac{3}{4} = \frac{4m}{4}$$

$$\therefore\ m = \frac{3}{4}$$

Q10

Evaluate

(a) $(-3)^0$ [1]

(b) $\left(\frac{16}{81}\right)^{-\frac{3}{4}}$ [2

SOLUTION

(a) $(-3)^0$ [1]

$$= 1$$

(b) $\left(\frac{16}{81}\right)^{-\frac{3}{4}}$ [2]

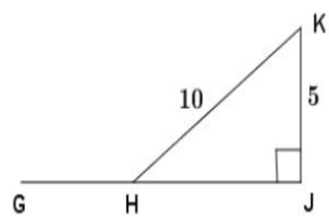
$$\left(\frac{16}{81}\right)^{-\frac{3}{4}} = \frac{1}{\sqrt[4]{\frac{16}{81}}^{3}}$$

$$= \pm\frac{3^3}{2^3}$$

$$= \pm\frac{27}{8}$$

$$= \pm 3\,\frac{3}{8}$$

Q11



In the diagram GHJ is a straight line. Angle HJK = 90°, JK = 5 cm and HK = 10 cm.

(a) Find sin GHK, [1]

(b) Calculate HJ leaving your answer in surd form. [2]

SOLUTION

(a) Find sin GHK,

$$= \frac{5}{10}$$

$$= 0,5$$

(b) Calculate HJ leaving your answer in surd form

$$HJ^2 = 10^2 - 5^2$$

$$= 100 - 25$$

$$\sqrt{HJ^2} = \sqrt{25 \times 3}$$

$$\therefore HJ = 5\sqrt{3}$$

Q12

Given that $\mathbf{M} = \begin{bmatrix} 5 & 5 \\ 3 & x \end{bmatrix}$ and $\mathbf{N} = \begin{bmatrix} 3 \\ 4 \end{bmatrix}$

Find

(a) the determinant of M in terms of x. [1]

(b) the modulus of the vector N. [1]

(c) the value of x given that det M = |N|. [1]

SOLUTION

(a) the determinant of M in terms of x.

$$5 \times x - 5 \times 3 = 5x - 15$$

(b) the modulus of the vector N.

$$= \sqrt{3^2 + 4^2}$$

$$= \sqrt{9 + 16}$$

$$= \sqrt{25}$$

$$= \pm 5$$

(c) the value of x given that $\det M = |N|$.

$$5x - 15 = 5$$

$$5x - 15 + 15 = 5 + 15$$

$$5x = 20$$

$$\frac{5x}{5} = \frac{20}{5}$$

$$x = 4$$

Q13

(a) Write down the gradient of the line whose equation is $3x + 2y = 8$ [[1]]

(b) Find the equation of the straight line which is parallel to the line $3x + 2y = 18$ and passes through $(-2;\ 3)$ [2]

SOLUTION

(a) Write down the gradient of the line whose equation is $3x + 2y = 8$ [[1]]

$$3x + 2y = 8$$

$$3x - 3x + 2y = 8 - 3x$$

$$2y = 8 - 3x$$

$$\frac{2y}{2} = \frac{8 - 3x}{2}$$

$$y = 4 - \frac{3}{2}x$$

$$\therefore \text{ gradient } = -\frac{3}{2}$$

(b) Find the equation of the straight line which is parallel to the line $3x + 2y = 18$ and passes through $(-2;\ 3)$ [2]

$$y = -\frac{3}{2}x + 8$$

$$3 = -\frac{3}{2}(-2) + 8$$

$$3 = 3 + c$$

$$3 - 3 = 3 - 3 + c$$

$$0 = c$$

$\therefore$ equation of parallel line is $y = -1\frac{1}{2}x$

Q14

Given that $h\begin{bmatrix}3\\5\end{bmatrix} + k\begin{bmatrix}2\\-1\end{bmatrix} = \begin{bmatrix}14\\6\end{bmatrix}$

find the scalars h and k. [3]

SOLUTION

$$3h + 2k = 14 \text{ eqn (i)}$$

$$5h - k = 6 \text{ eqn (ii)}$$

$$\text{eqn (ii)} \times 2$$

$$2(5h - k = 6)$$

$$10h - 2k = 12$$

$$\text{eqn (i)} + \text{eqn (ii)}$$

$$3h + 10h + 2k - 2k = 12 + 14$$

$$13h = 26$$

$$\frac{13h}{13} = \frac{26}{13}$$

$$h = 2$$

Q15

Given that $\log_{10}3 = 0,4771$ and $\log_{10}5 = 0,6991$, find

(a) $\log_{10}1\frac{2}{3}$ [2]

(b) $\log_{10}30$ [2]

SOLUTION

$$\text{(a) } \log_{10} 1\frac{2}{3} \quad [2]$$

$$\log_{10} 1\frac{2}{3} = \log_{10}\frac{5}{3}$$

$$= \log_{10} 5 - \log_{10} 3$$

$$= 0,6991 - 0,4771$$

$$= 0,222$$

$$\text{(b) } \log_{10} 30 \ [2]$$

$$\log_{10} 30 = \log_{10}(3 \times 10)$$

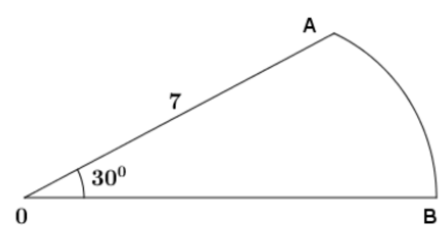
$$= \log_{10} 3 + \log_{10} 10$$

$$= \log_{10} 3 + 1$$

$$= 0,4771 + 1$$

$$= 1,4771$$

Q16



In the diagram, OAB is a sector of a circle of radius 7 cm and angle AOB = 30°.

Calculate

(a) The length of the arc AB, [2]

(b) The area of the sector AOB. [2]

USE $\pi = \frac{22}{7}$

SOLUTION

Calculate

(a) The length of the arc AB, [2]

$$\text{Perimeter of a sector of a circle} = \frac{\theta}{360}(2)\pi r$$

$$= \frac{30}{360}(2)(7)\frac{22}{7}$$

$$= 3\frac{2}{3}\text{ cm}$$

(b) The area of the sector AOB. [2]

$$\text{Area of a sector of a circle} = \frac{\theta}{360}\pi r^2$$

$$= \frac{30}{360}(7^2)\frac{22}{7}$$

$$= 12\frac{5}{6}$$

Q17

Given the capital letters M, N, Z, E and H, write down the letters with

(a) line symmetry. [1]

(b) rotational symmetry of order two. [2]

SOLUTION

(a) line symmetry.

M, E and H

(b) rotational symmetry of order two.

N, Z and H

Q18

(a) Write down the greatest possible digit of a number in base 8. [1]

(b) Convert 111_5 to a number in base 2. [2]

(c) Find the Lowest Common Multiple, (LCM) of 18 and 24. [2]

SOLUTION

(a) Write down the greatest possible digit of a number in base 8.

$$7_8$$

(b) Convert 111_5 to a number in base 2

$$111_5 = 1 \times 5^0 + 1 \times 5^1 + 1 \times 5^2$$

$$= 1 + 5 + 25$$

$$= 31_{10}$$

$$31_{10} = 11111_2$$

(c) Find the Lowest Common Multiple, (LCM) of 18 and 24.

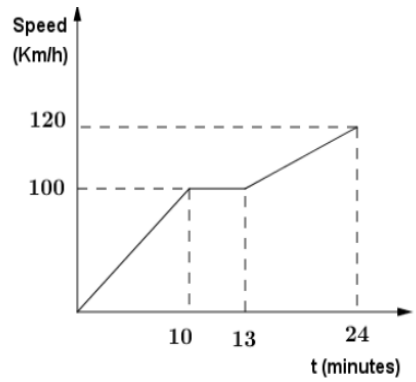
$$18 = 2 \times 3 \times 3$$

$$24 = 2 \times 2 \times 2 \times 3$$

$$\therefore \text{ LCM } = 2 \times 2 \times 2 \times 3 \times 3$$

$$= 72$$

Q19



The diagran shows part of a speed-time graph of a car. The car starts from rest and accelerates uniformly to a speed of 100 km/h in 10 minutes. It maintains that speed for 3 minutes and then accelerates uniformly for a further 11 minutes until it reaches a speed of 120 km/h.

(a) Calculate

(i) the acceeration of the car during the first 10 seconds. [1]

(ii) the distance covered at a constant speed of 100 km/h. [2]

(b) If the total distance covered was $33\frac{1}{2}$ km, calculate the average speed of the car in km/h. [2]

SOLUTION

(a) Calculate

(i) the acceeration of the car during the first 10 seconds.

$$= \frac{100}{10}$$

$$= 10 \text{ km/h/min}$$

(ii) the distance covered at a constant speed of 100 km/h.

$$= 100 \times \frac{3}{60}$$

$$= 5 \text{ km}$$

(b) If the total distance covered was $33 \frac{1}{2}$ km, calculate the average speed of the car in km/h. [2]

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$
$$= \frac{33,5}{\frac{24}{60}}$$
$$= 83,75 \text{ km/h}$$

Q20

In the working space is a line segment AB which is 8 cm long.

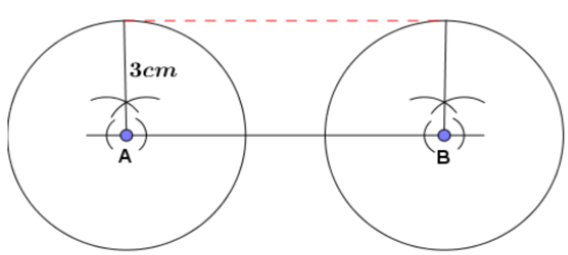
Point Q is such that the area of point triangle ABQ = 12 cm^2.

(a) Calculate the perpendicular height of the triangle ABQ. [2]

(b) Construct the possible positions of Q, above AB, which are such that the area of triangle ABQ = 12 cm^2. [3]

SOLUTION

(a)



$$\text{Area of a triangle} = \frac{1}{2} \text{ Base times Height}$$
$$12 = 0,5(8)(x)$$
$$12 = 4x$$
$$\frac{12}{4} = \frac{4x}{4}$$
$$\therefore \ x = 3$$

Q21

A trader bought a tonne of goods worth \$2 500

(a) Calculate the cost price per kilogram. [1]

(b) If the goods were later sold at \$2,10 per kilogram. Calculate the percentage loss. [2]

(c) Find the value of $n^4 - 4n,\ \text{if } n = 3$ [2]

SOLUTION

A trader bought a tonne of goods worth \$2 500

(a) Calculate the cost price per kilogram. [1]

$$\frac{2500}{1000} = \$2,50$$

(b) If the goods were later sold at \$2,10 per kilogram. Calculate the percentage loss. [2]

$$\text{Loss} = \text{Selling Price} - \text{Cost Price}$$

$$= 2,10 - 2,50$$

$$= 0,40$$

$$\text{Percentage loss} = \frac{\text{Loss}}{\text{Cost price}} \times 100$$

$$= \frac{0,40}{2,50} \times 100$$

$$= 16\%$$

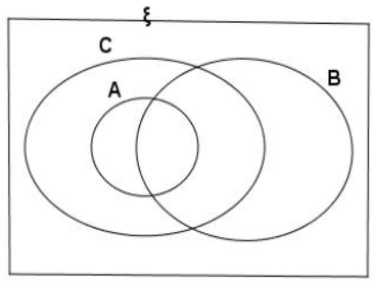
(c) Find the value of $n^4 - 4n,\ \text{if } n = 3$

$$= 3^4 - 4(3)$$

$$= 81 - 12$$

$$= 69$$

Q22



Give that

Universal Set $= \{x;\ 15 \geq x \geq 1, x \text{ is an integer.}\}$,

A $= \{x;\ x \text{ is a multiple of } 4.\}$

B $= \{x;\ x \text{ is a perfect square}\}$

and C $= \{x;\ x \text{ is a multiple of } 2.\}$

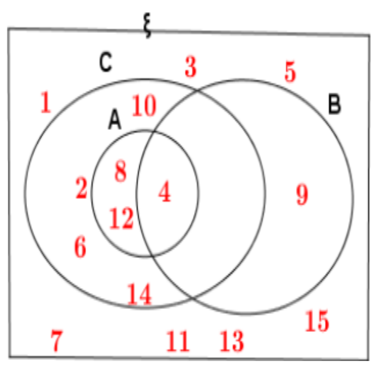
(a) In the Venn diagram in the working space, fill in the members of each subset. [3]

(b)(i) Write down the relationship between sets A and C in set notation. [1]

(ii) Find $n(A \bigcap B \bigcap C)$. [1]

SOLUTION

(a)



(b)(i) Write down the relationship between sets A and C in set notation.

$A \subset C$

(ii) Find $n(A \bigcap B \bigcap C)$.

$= 1$

Q23

A teacher gave ball point pens as prizes to pupils who passed his test.

He had two boxes of pens. Box A had 6 blue, 4 green and 3 red pens while Box B had 6 blue and 4 green pens.

Ben was asked to pick a pen from box A and Laiza from box B

Find the probability that

(a) Ben picked a blue pen. [1]

(b) Both Ben and Laiza picked blue pens. [2]

(c) Both Ben and Laiza picked pens of the same colour. [3]

SOLUTION

(a) Ben picked a blue pen

$$= \frac{6}{6+4+3}$$

$$= \frac{6}{13}$$

(b) Both Ben and Laiza picked blue pens. [2]

Probability of Laiza picking blue pen is $\frac{6}{6+4}$

$$= \frac{6}{10}$$

$\therefore$ probability of both picking blue pens is $\frac{6}{10} \times \frac{6}{13}$

$$= \frac{18}{65}$$

(c) Both Ben and Laiza picked pens of the same colour.

$$= \frac{6}{13} \times \frac{6}{10} + \frac{4}{13} \times \frac{4}{10}$$

$$= \frac{18}{65} + \frac{8}{65}$$

$$= \frac{26}{65}$$

Q24

If n is an integer, calculate the greatest possible value of n which satisfy the inequality $2 > 3n - 25$ [2]

SOLUTION

$$2 > 3n - 25$$

$$2 + 25 > 3n - 25 + 25$$

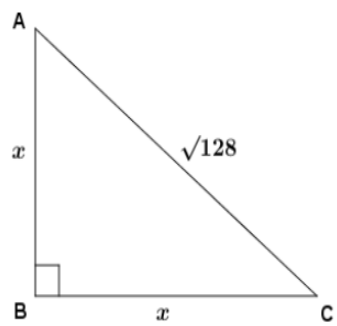
$$27 > 3n$$

$$\frac{27}{3} > \frac{3n}{3}$$

$$9 > n$$

$\therefore$ the greatest possible integer is 8

Q25



In the diagram AB = BC = $x$cm, AC = $\sqrt{128}$cm and angle ABC = 90°

(i) Form an equation in x. [1]

(ii) Find the value of x. [3]

SOLUTION

(i) Form an equation in x.

$$x^2 + x^2 = (\sqrt{128})^2$$

(ii) Find the value of x. [3] $x^2 + x^2 = (\sqrt{128})^2 2x^2 = 128$

$$2x^2 - 128 = 0$$

$$\frac{2x^2}{2} = \frac{128}{2}$$

$$x^2 = 64$$

$$\sqrt{x^2} = \sqrt{64}$$

$$\therefore x = \pm 8$$

Q25

A class of 40 pupils from different families were asked how many pets they kept. The results are shown in the table below.

Number of pets per family	1	2	3	4
Number of families	3	7	17	13

(a)(i) State the mode. [1]

(ii) Calculate the mean number of pets per family. [2]

(b) If the results in the table were shown on a pie chart, calculate the angle representing the number of pupils who kept two pets. [2]

(c) Express the number of pupils who kept three pets as a percentage of the class. [3]

SOLUTION

(a)(i) State the mode.

3 pets

(ii) Calculate the mean number of pets per family

$$\text{Mean} = \frac{\text{Sum of pets}}{\text{Number of families}}$$

$$= \frac{1 \times 3 + 2 \times 7 + 3 \times 17 + 4 \times 13}{40}$$

$$= \frac{3 + 14 + 51 + 52}{40}$$

$$= \frac{120}{40}$$

$$= 3$$

(b) If the results in the table were shown on a pie chart, calculate the angle representing the number of pupils who kept two pets

$$\frac{7}{40} \times 360^\circ = 63^\circ$$

(c) Express the number of pupils who kept three pets as a percentage of the class. [3]

$$= \frac{17}{40} \times 100$$
$$= 42,5\%$$

NOVEMBER 2012

Q1

Express 754, 96

(a) Correct to

(i) one decimal place. [1]

(ii) one significant figure. [1]

(b) in standard form. [1]

SOLUTION

Express 754, 96

(a) Correct to

(i) one decimal place.

$$= 755,0$$

Express 754, 96

(a) Correct to
(i) one decimal place. [1

(ii) one significant figure

$$= 800$$

Express $754,96$

(a) Correct to

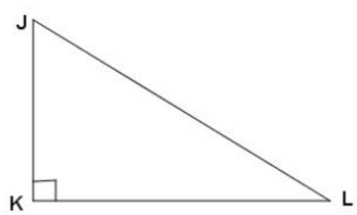
(i) one decimal place. [1

(ii) one significant figure.

(b) in standard form. [1

$$7,5496 \times 10^2$$

Q2



In the diagram, triangle JKL is right angled at K.

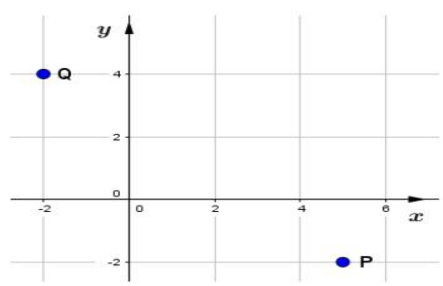
(a) Measure and write down

(i) The length of KL correct to the nearest centimetre. [1]

(ii) The size of angle KJL correct to the nearest degree. [1]

(b) Write down the special name given to the side JL. [1]

Q3



The points P and Q are shown on the grid.

(a) (i) Write down the coordinates of P. [1]

(ii) Write $\overrightarrow{PQ}$ as a column vector. [1]

(b) Given $\overrightarrow{QM} = \begin{bmatrix} 5 \\ -3 \end{bmatrix}$ draw $\overrightarrow{QM}$ on the grid. [1]

SOLUTION

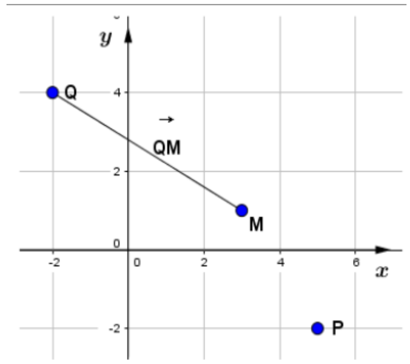
(a) (i) Write down the coordinates of P.

$$= (5; -2)$$

(ii) Write PQ as a column vector.

$$= \begin{bmatrix} -7 \\ 6 \end{bmatrix}$$

(b) Given $\overrightarrow{QM} = \begin{bmatrix} 5 \\ -3 \end{bmatrix}$ draw $\overrightarrow{QM}$ on the grid.



Q4

Simplify

(a) $3\,\dfrac{3}{4} - 3 \times \dfrac{1}{2}$ [1]

(b) $4x^2 - 3x(2x - 5)$ [2]

SOLUTION

Simplify

(a) $3\,\dfrac{3}{4} - 3 \times \dfrac{1}{2}$ [1]

$$3\,\frac{3}{4} - 3 \times \frac{1}{2} = \frac{15}{4} - \frac{3}{1} \times \frac{1}{2}$$

$$= \frac{15}{4} - \frac{3}{2}$$

$$= \frac{15(1) - 3(2)}{4}$$

$$= \frac{15 - 6}{4}$$

$$= \frac{9}{4}$$

$$= 2\,\frac{1}{4}$$

(b) $4x^2 - 3x(2x - 5)$ [2]

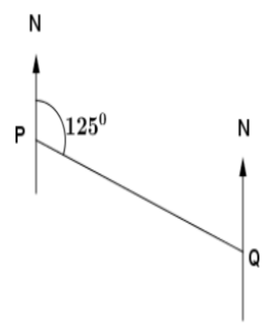
$$4x^2 - 3x(2x-5) = 4x^2 - 6x^2 + 15x$$

$$= -2x^2 + 15x$$

$$= 15x - 2x^2$$

$$= x(15 - 2x)$$

Q5



(a) The diagram shows the positions of two TV masts P and Q.
The bearing of Q from P is 125°.

Find the three figure bearing of P from Q. [2]

(b) Write down the supplement of 35°. [1]

SOLUTION

(a) The diagram shows the positions of two TV masts P and Q.
The bearing of Q from P is 125°.

Find the three figure bearing of P from Q. [2]

$$= 180^\circ + 125^\circ$$

$$= 305^\circ$$

SOLUTION

(b) Write down the supplement of 35°.

Supplementary angles add up to 180°

$$= 180^\circ - 35^\circ$$

$$= 145^\circ$$

Q6

Make y the subject of the formula.

$$x = \sqrt{cy - d} \quad [3]$$

SOLUTION

$$x = \sqrt{cy - d}$$

$$x^2 = (\sqrt{cy - d})^2$$

$$x^2 = cy - d$$

$$x^2 + d = cy - d + d$$

$$x^2 + d = cy$$

$$\frac{x^2 + d}{c} = \frac{cy}{c}$$

$$\therefore \; y = \frac{x^2 + d}{c}$$

Q7

Solve the simultaneous equations

$$4x + 9y = 33$$
$$2x - 3y = -6 \quad [3]$$

SOLUTION

$$4x + 9y = 33 \text{ eqn (i)}$$

$$2x - 3y = -6 \text{ eqn (ii)}$$

$$\text{eqn (ii)} \times 3$$

$$3(2x - 3y = -6)$$

$$6x - 9y = -18$$

$$\text{eqn (i)} + \text{eqn (ii)}$$

$$4x + 6x + 9y - 9y = 33 + (-18)$$

$$10x = 15$$

$$\frac{10x}{10} = \frac{15}{10}$$

$$x = 1\,\frac{5}{10}$$

Q8

Jojo works in the afternoons only for 5 days a week.

He starts work at 1.15 pm and finishes at 7.45 pm.

(a) Express 7.45 pm as time in 24 - hour notation. [1]

(b) If he is paid $1,20 per hour, calculate his weekly wage. [2]

SOLUTION

(a) Express 7.45 pm as time in 24 - hour notation

= 1945 hrs

(b) If he is paid \$1,20 per hour, calculate his weekly wage.

$$\text{Daiy hours works } = 1945 - 1315$$

$$= 6 \text{ hrs } 30 \text{ mins}$$

$$\therefore \text{ Weekly wage } = 6,5 \times 5 \times 1,20$$

$$= \$39,00$$

Q9

Factorise completely

(a) $7pq - 14q$, [1]

(b) $x^2 - 7x + 10$ [2]

SOLUTION

(a) $7pq - 14q$,

$$= 7q(p - 2)$$

(b) $x^2 - 7x + 10$

$$= (x - 5)(x - 2)$$

Q10

(a) Solve the inequality $19 > 4 - 5x$ [2]

SOLUTION

$$19 > 4 - 5x$$

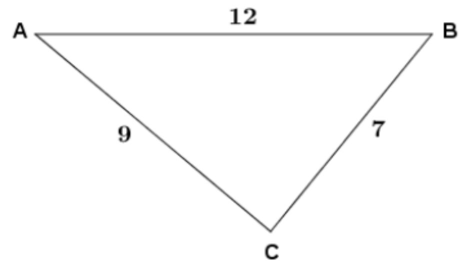
$$19 - 4 > 4 - 4 - 5x$$

$$15 > -5x$$

$$\frac{-5x}{-5} > \frac{15}{-5}$$

$$x > -3$$

Q11



In the diagram, AB = 12 cm, AC = 9 cm and BC = 7 cm.

Using as much of the information given below as is necessary,

(a) express the ratio AC: AB in its simplest form, [1]

(b) Find the area of triangle ABC, [2]

[sin A = 0,58   cos A = 0,81   tan A = 0,71]

SOLUTION

(a) express the ratio AC: AB in its simplest form,

$= 3;\ 4$

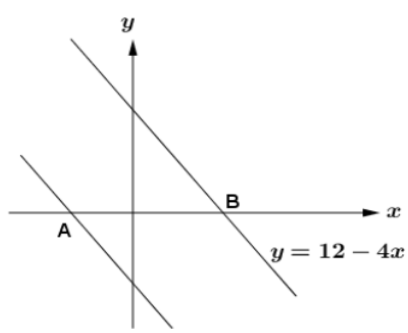
(b) Find the area of triangle ABC

$$\text{Area of a triange } = \frac{1}{2}\, ab \sin \text{C}$$

$$= 0,5(9)120,58$$

$$= 31,32$$

Q12



In the diagram, the line through A is parallel to the line $y = 12 - 4x$ and the distance AB = 5 units.

(a) Write down the x-coordinate of B. [1]

(b) Find the equation of the line through A parallel to the line $y = 12 - 4x$. [2]

SOLUTION

a) Write down the x-coordinate of B

$$y = 12 - 4x$$

$$0 = 12 - 4x$$

$$4x = 12$$

$$\therefore\ x = 3$$

(b) Find the equation of the line through A parallel to the line $y = 12 - 4x$.

$$\frac{y - c}{m} = x$$

$$\frac{0 - c}{-4} = -2$$

$$0 - c = -2(-4)$$

$$-c = 8$$

$$\therefore c = -8$$

$$y = -8 - 4x$$

Q13

If $120_3 = 13_n + 10_n$, find the value of n. [3]

SOLUTION

$$120_3 = 13_n + 10_n$$

$$120_3 = 0 \times 3^0 + 2 \times 3^1 + 1 \times 3^2$$

$$= 0 + 6 + 9$$

$$= 15_{10}$$

$$n = 6$$

Q14

(a) Find the exact value of $\left(\frac{4}{3}\right)^{-2}$ [1]

(b) Simplify $3^{-\frac{1}{2}} \times 9^{\frac{1}{4}}$ [2]

SOLUTION

$$\left(\frac{4}{3}\right)^{-2} = \left(\frac{3}{4}\right)^{2}$$

$$= \frac{9}{16}$$

$$\text{(b) Simplify } 3^{-\frac{1}{2}} \times 9^{\frac{1}{4}} \quad [2]$$

$$3^{-\frac{1}{2}} \times 9^{\frac{1}{4}} = 3^{-\frac{1}{2}} \times (3^2)^{\frac{1}{4}}$$

$$= 3^{-\frac{1}{2}} \times 3^{2\times\frac{1}{4}}$$

$$= 3^{-\frac{1}{2}} \times 3^{\frac{1}{2}}$$

$$= 3^{-\frac{1}{2}+\frac{1}{2}}$$

$$= 3^{0}$$

$$= 1$$

Q15

The mean of 10 numbers is 54,6

If the number $(x+6)$ is added to the 10 numbers, the mean becomes 51

Find the value of x. [3]

SOLUTION

$$\text{Mean } = \frac{\text{Sum of items}}{\text{Number of items}}$$

$$54,6 = \frac{y}{10}$$

$$10(54,6) = 10 \times \frac{y}{10}$$

$$546 = y$$

$$51 = \frac{546 + x + 6}{11}$$

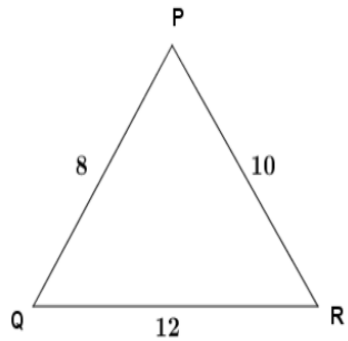
$$51 \times 11 = \frac{552 + x}{11} \times 11$$

$$561 = 552 + x$$

$$561 - 552 = 552 - 552 + x$$

$$\therefore \; x = 9$$

Q16



In the diagram, PQ = 8 cm, QR = 12 cm and PR = 10 cm.

Express cos P as a common fraction. [3]

SOLUTION

In the diagram, PQ = 8 cm, QR = 12 cm and PR = 10 cm.

Express cos P as a common fraction. [3]

$$\cos \text{A} = \frac{b^2 + c^2 - a^2}{2bc}$$

$$\therefore \text{ Cos } P = \frac{8^2 + 10^2 - 12^2}{2(8)(10)}$$

$$= \frac{64 + 100 - 144}{160}$$

$$= \frac{20}{160}$$

$$= \frac{1}{8}$$

Q17

Given that $\mathbf{C} = \begin{bmatrix} 2 & -3 \\ 0 & 4 \end{bmatrix}$ and $\mathbf{D} = \begin{bmatrix} 5 & -2 \\ -7 & 1 \end{bmatrix}$

express as a single matrix

(a) $\mathbf{C} - 2\mathbf{D}$, [2]

(b) $\mathbf{D}^2$ [2]

SOLUTION

(a) C − 2D, [2]

$$= \begin{bmatrix} 2 & -3 \\ 0 & 4 \end{bmatrix} - 2\begin{bmatrix} 5 & -2 \\ -7 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 2 & -3 \\ 0 & 4 \end{bmatrix} - \begin{bmatrix} 5 \times 2 & -2 \times 2 \\ -7 \times 2 & 1 \times 2 \end{bmatrix}$$

$$= \begin{bmatrix} 2 & -3 \\ 0 & 4 \end{bmatrix} - \begin{bmatrix} 10 & -4 \\ -14 & 2 \end{bmatrix}$$

$$= \begin{bmatrix} 2 - 10 & -3 - (-4) \\ 0 - (-14) & 4 - 2 \end{bmatrix}$$

$$= \begin{bmatrix} -8 & 1 \\ 14 & 2 \end{bmatrix}$$

(b) D^2 [2]

$$= \begin{bmatrix} 5 & -2 \\ -7 & 1 \end{bmatrix}\begin{bmatrix} 5 & -2 \\ -7 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 5 \times 5 + -2 \times 7 & 5 \times -2 + -2 \times 1 \\ -7 \times 5 + 1 \times 7 & -7 \times -2 + 1 \times 1 \end{bmatrix}$$

$$= \begin{bmatrix} 25 - 14 & -10 - 2 \\ -35 + 7 & 14 + 1 \end{bmatrix}$$

$$= \begin{bmatrix} 11 & -14 \\ -28 & 15 \end{bmatrix}$$

Q18

(a) Given that log 3 = 0,477 and log 5 = 0,699, find log 45. [2]

SOLUTION

$$\log 45 = \log(5 \times 3 \times 3)$$

$$= \log 5 + \log 3 + \log 3$$

$$= 0,699 + 0,477 + 0,477$$

$$= 1,653$$

Q19

(a) Express a scale of 2 cm to 5m , in the form 1: n, where n is a whole number. [1]

(b) the radius of a circle r cm, is given as 11 cm correct to the nearest whole number.

Find

(i) the limits between which r lies, [1]

(ii) the least possible circumference of the circle in terms of π. [2]

SOLUTION

(a) Express a scale of 2 cm to 5m , in the form 1: n,

where n is a whole number. [1]

$$= 2 : \ (5 \times 100)$$

$$= 2 : \ 500$$

$$= \frac{2}{2} : \ \frac{500}{2}$$

$$= 1 : \ 250$$

(i) the limits between which r lies,

$$11,5 > r \geq 10,5$$

(ii) the least possible circumference of the circle in terms of π.

$$\text{Circumference } = 2\pi r$$

$$= 2\pi 10,5$$

$$= 21\pi$$

Q20

IN THIS QUESTION GIVE ALL PROBABILITIES AS COMMON FRACTIONS.

Eight identical cards are numbered 2, 3, 5, 6, 7, 8, 8, and 9

(a) One of the cards is chosen at random.

(i) Write down the number whose probability of being chosen is $\frac{1}{4}$ [1]

(ii) Find the probability of choosing a card with a prime number. [1]

(b) Two of the eight cards are taken at random.

Find the probability that the sum of the two numbers is 15. [2]

SOLUTION

(i) Write down the number whose probability of being chosen is $\frac{1}{4}$

$$= 8$$

(ii) Find the probability of choosing a card with a prime number.

Prime number in the list are 2; 3; 5; 7

$$\text{Probability} = \frac{4}{8}$$

$$= \frac{1}{2}$$

(b) Two of the eight cards are taken at random.
Find the probability that the sum of the two numbers is 15.

$$15 = 9 + 6 \text{ or } 7 + 8$$

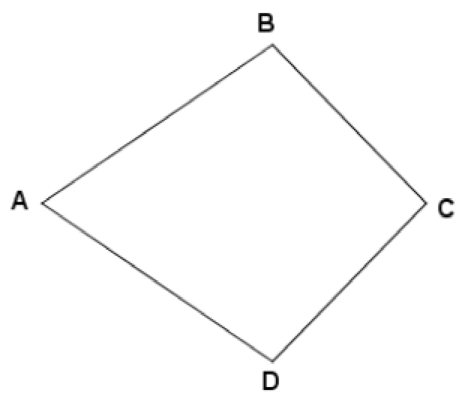
$$= \frac{1}{8} \times \frac{1}{7} + \frac{1}{7} \times \frac{1}{8} + \frac{2}{8} \times \frac{1}{7} + \frac{1}{8} \times \frac{2}{7}$$

$$= \frac{1}{56} + \frac{1}{56} + \frac{2}{56} + \frac{2}{56}$$

$$= \frac{6}{56}$$

$$= \frac{3}{28}$$

Q21



(a) IN THIS QUESTION USE RULER AND COMPASSES ONLY.

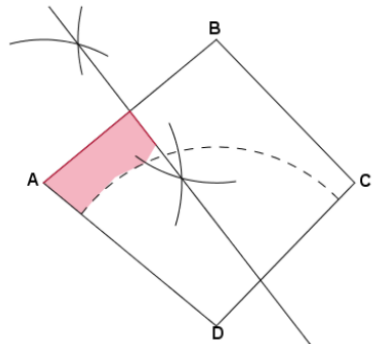
Leaving your construction lines and arcs, construct

(i) The perpendicular bisector of AB, [2]

(ii) The locus of all points inside the quadrilateral ABCD which are 5 cm from D. [1]

(b) Shade the region inside the quadrilateral ABCD which is nearer A than B and more than 5 cm from D. [1]

SOLUTION



Q22

F is inversely proportional to the square of d.

a) Express F in terms of d and a constant k. [1

(b) Find

(i) the value of k when $F = 60$ and $d = 3$, [2]

(ii) the value of F when $d = 6$. [1]

SOLUTION

(a) Express F in terms of d and a constant k.

$$F = \frac{k}{d^2}$$

(i) the value of k when $F = 60$ and $d = 3$,

$$60 = \frac{k}{3^2}$$

$$60 = \frac{k}{9}$$

$$9 \times 60 = 9 \times \frac{k}{9}$$

$$540 = k$$

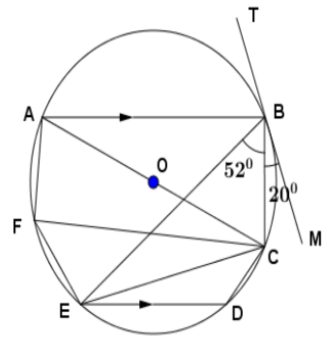
(ii) the value of F when $d = 6$.

$$F = \frac{540}{6^2}$$

$$= \frac{540}{36}$$

$$= 15$$

Q23



ABCDEF is a circle centre O. TBM is a tangent to the circle at B.
Angle EBC = 52°, angle CBM = 20° and AB is parallel to ED.

Find

(a) angle EFC, [1]

(b) angle BEC, [1]

(c) angle ABE, [1]

(d) angle CED. [2]

SOLUTION

(a) angle EFC,

$= 52^\circ$

(b) angle BEC,

$= 20^\circ$

(c) angle ABE,

$= 90^\circ - 52^\circ$

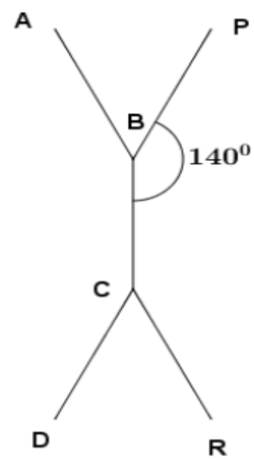
$= 38^\circ$

(d) angle CED. [2]

$= 90 - 52^\circ - 20^\circ$

$= 18^\circ$

Q24



AB, BC and CD are sides of a regular 12-sided polygon.
PB, BC and CR are sides of a regular n-sided polygon and angle PBC $= 140^\circ$

Find

(i) The value of n, [2]

(ii) The size of angle DCR. [2]

(b) Write down the special name of the regular polygon which has three lines of symmetry. [1]

SOLUTION

Find

(i) The value of n, [2]

$$\text{Exterior angle } = 180^\circ - 140^\circ$$

$$= 40^\circ$$

$$\text{Hence number of sides is } \frac{360^\circ}{40^\circ}$$

$$= 9$$

$$\therefore\ n = 9$$

(ii) The size of angle DCR. [2]

Exterior angle of ABCD + exterior angle of PBCR

$$\text{Exterior angle for ABCD } = \frac{360^\circ}{12} = 30^\circ$$

$$\text{Exterior angle for PBCR } = 180^\circ - 140^\circ = 40^\circ$$

$$\therefore \text{ angle DCR } = 40^\circ + 30^\circ = 70^\circ$$

(b) Write down the special name of the regular polygon which has three lines of symmetry. [1]

Equilateral Triangle

Q25

It is given that $f(x) = x^2 + 3x + 2$

(a) Find

(i) $f(0)$, [1]

(ii) the values of x for which $f(x) = 0$. [2]

(b) Given also that the line of symmetry of the graph of $f(x) = x^2 + 3x + 2$ is $x = -1\frac{1}{2}$ find the coordinates of the turning point of this graph. [2]

SOLUTION

(i) $f(0)$, [1]

$$= 0^2 + 3(0) + 2$$

$$= 0 + 0 + 2$$

$$= 2$$

SOLUTION

(ii) the values of x for which $f(x) = 0$.

$$f(x) = 0\ x^2 + 3x + 2 = 0$$

$$(x + 1)(x + 2) = 0$$

$$x + 1 = 0$$

$$x + 1 - 1 = 0 - 1$$

$$x = -1$$

$$x + 2 = 0$$

$$x + 2 - 2 = 0 - 2$$

$$x = -2$$

$$\therefore\ f(x) = 0 \text{ when } x = -1 \text{ or } -2$$

(b) Given also that the line of symmetry of the graph of $f(x) = x^2 + 3x + 2$ is $x = -1\frac{1}{2}$ find the coordinates of the turning point of this graph. [2]

$$y = (-15)^2 + 3(-1,5) + 2$$

$$= 2,25 - 4,5 + 2$$

$$= -0,25$$

$$= -\frac{1}{4}$$

$$\therefore \text{ the coordinates are } (-1\frac{1}{2};\ -\frac{1}{4})$$

JUNE 2012

Q1

(a) Find 3% of \$70 [1]

(b) Evaluate $4,01 - 3,4 \times 1,08$. [2]

SOLUTION

(a) Find 3% of \$70

$$= 0,03 \times 70$$

$$= \$2,10$$

(b) Evaluate $4,01 - 3,4 \times 1,08$.

$$= 4,01 - (3,4 \times 1,08)$$

$$= 4,01 - 3,672$$

$$= 0,338$$

Q2

(a) Solve the inequality $5 - 3x > 3x + 17$ [2]

(b) Write down the maximum possible integer value of x such that $5 - 3x > 3x + 17$ [1]

SOLUTION

(a) Solve the inequality $5 - 3x > 3x + 17$

$$5 - 3x > 3x + 17$$

$$5 - 17 - 3x + 3x > 3x + 3x + 17 - 17$$

$$-12 > 6x$$

$$\frac{-12}{6} > \frac{6x}{6}$$

$$-2 > x$$

(b) Write down the maximum possible integer value of x such that $5 - 3x > 3x + 17$ [1]

$$x = -3$$

Q3

A cube has an edge of length 1,99 cm correct to three significant figures.

(a) Estimate correct to one significant figure, the volume of the cube. [2]

(b) State the lower limit of the length of the edge in centimetres. [1]

SOLUTION

(a) Estimate correct to one significant figure, the volume of the cube

$$= 1,99 \times 1,99 \times 1,99$$

$$= 7,88$$

$$= 8 \text{ cm}^3$$

(b) State the lower limit of the length of the edge in centimetres

$$= 1,985 \text{ cm}$$

Q4

Solve the simultaneous equations

$$4x - 2y = 16$$
$$3x + 2y = 19 \quad [3]$$

SOLUTION

$$4x - 2y = 16 \text{ eqn (i)}$$

$$3x + 2y = 19 \text{ eqn (ii)}$$

$$\text{eqn (i)} + \text{eqn (ii)}$$

$$4x + 3x - 2y + 2y = 16 + 19$$

$$7x = 35$$

$$\frac{7x}{7} = \frac{35}{7}$$

$$x = 5$$

Substituting x with 5 in eqn (i)

$$4(5) - 2y = 16$$

$$20 - 2y = 16$$

Q5

Find p in base eight such that $p_8 + 234_5 = 421_5$ [3]

SOLUTION

$$p_8 + 234_5 = 421_5$$

$$p_8 + 234_5 - 234_5 = 421_5 - 234_5$$
$$p_8 = 132_5$$

$$132_5 = 2 \times 5^0 + 3 \times 5^1 + 1 \times 5^2$$

$$= 2 + 15 + 25$$

$$= 42_{10}$$

$$42_{10} = 52_8$$

$$\therefore \ p = 52$$

Q6

A is the point (0; 6) and B is the point (4; 2).

Find

(a) $\overrightarrow{AB}$ in column form. [1]

(b) the gradient of the line AB. [1]

(c) the equation of the line AB. [1]

SOLUTION

(a) $\overrightarrow{AB}$ in column form.

$$\overrightarrow{AB} = \begin{bmatrix} 4-0 \\ 2-6 \end{bmatrix}$$
$$= \begin{bmatrix} 4 \\ -4 \end{bmatrix}$$

(b) the gradient of the line AB.

$$\text{Gradient} = \frac{\text{Change in } y}{\text{Change in } x}$$
$$= \frac{y_2 - y_1}{x_2 - x_1}$$
$$= \frac{4-0}{2-6}$$
$$= \frac{4}{-4}$$
$$= -1$$

(c) the equation of the line AB. [1]

$$6 = -1(0) + c$$

$$6 = c$$

$\therefore$ the equation of the line is $y = -1x + 6$

Q7

(a) State the reason why the matrix $\begin{bmatrix} 6 & -3 \\ -2 & 1 \end{bmatrix}$ has no inverse. [1]

(b) Find the 2×2 matrix M such that

$$\begin{bmatrix} 2 & -3 \\ -1 & 6 \end{bmatrix} - \begin{bmatrix} 2 & -6 \\ 5 & 0 \end{bmatrix} = 3M. \ [2]$$

SOLUTION

(a) State the reason why the matrix $\begin{bmatrix} 6 & -3 \\ -2 & 1 \end{bmatrix}$ has no inverse. [1]

Determinant of matrix $= ad - bc$

$$= 6 \times 1 - (-3 \times -2)$$

$$= 6 - 6$$

$$= 0$$

(b) Find the 2×2 matrix M such that

$$\begin{bmatrix} 2 & -3 \\ -1 & 6 \end{bmatrix} - \begin{bmatrix} 2 & -6 \\ 5 & 0 \end{bmatrix} = 3M. \ [2]$$

$$\begin{bmatrix} 2-2 & -3-(-6) \\ -1-5 & 6-0 \end{bmatrix} = 3M.$$

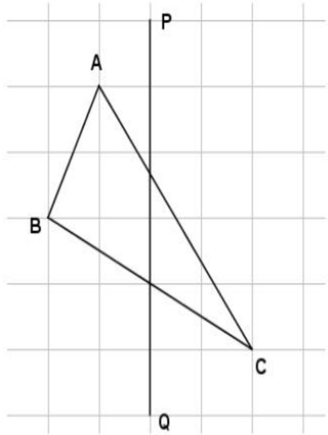
$$\begin{bmatrix} 0 & 3 \\ -6 & 6 \end{bmatrix} = 3M.$$

$$\frac{1}{3}\begin{bmatrix} 0 & 3 \\ -6 & 6 \end{bmatrix} = 3M. \times \frac{1}{3}$$

$$\begin{bmatrix} 0 \times \frac{1}{3} & 3 \times \frac{1}{3} \\ -6 \times \frac{1}{3} & 6 \times \frac{1}{3} \end{bmatrix} = M.$$

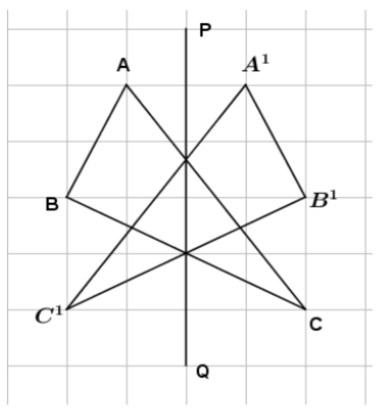
$$\begin{bmatrix} 0 & 1 \\ -2 & 2 \end{bmatrix} = M.$$

Q8



Draw triangle $A^I B^I C^I$, the image of triangle ABC under a reflection in the line PQ. [3]

SOLUTION



Q10

(a) Simplify $\sqrt{(5p+2)^2}$ [1]

(b) Factorise $9x^2 - 12x + 4$ [2]

SOLUTION

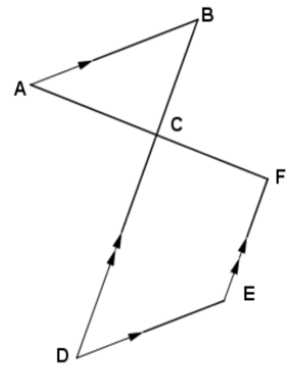
(a) Simplify $\sqrt{(5p+2)^2}$

$$\sqrt{(5p+2)^2} = 5p + 2$$

(b) Factorise $9x^2 - 12x + 4$

$$9x^2 - 12x + 4$$
$$= (3x-2)(3x-2)$$

Q11



In the diagram, AB is parallel to DE. DB is paralle to EF. ACF and DCB straight lines. Given that angle DEF $= 140^{\circ}$, calculate

(a) angle CDE, [1]

(b) angle ABC, [1]

(c) the size of angle DCF which makes CDEF a cyclic quadrilateral. [1]

SOLUTION

(a) angle CDE,

$= 180^{\circ} - 140^{\circ}$

$= 40^{\circ}$

(b) angle ABC,

$= 40^{\circ}$

(c) the size of angle DCF which makes CDEF a cyclic quadrilateral.

$= 40^{\circ}$

Q12

A boy completes a 400 metre race in one minute.

Express

(a) 400 metres as a percentage of a kilometre. [1]

(b) his speed in kilometres per hour. [2]

SOLUTION

(a) 400 metres as a percentage of a kilometre

$$= \frac{400}{1000} \times 100$$
$$= 40\%$$

(b) his speed in kilometres per hour

$$= \frac{400 \times 60}{1000}$$
$$= 24 \text{ km/hr}$$

Q13

One litre of paraffin cost $1.00

Calculate

(a) the cost of 750 milli-litres of paraffin. [1]

(b) the number of 750 milli-litre bottle of paraffin which can be obtained from a full 30 litre container. [2]

SOLUTION

(a) the cost of 750 milli-litres of paraffin

$$= \frac{750}{1000} \times 1$$
$$= \$0,75$$

(b) the number of 750 milli-litre bottle of paraffin which can be obtained from a full 30 litre container. [2]

$$= \frac{30000}{750}$$
$$= 40 \text{ bottles}$$

Q14

Simplify the following, giving your answers in standard form.

(a) $\sqrt{6250000}$ [2]

(b) 5^{-2} [2]

SOLUTION

(a) $\sqrt{6250000}$ [2]

$$\sqrt{6250000} = \pm 2500$$

$$= \pm 2,5 \times 10^{3}$$

(b) 5^{-2} [2]

$$5^{-2} = \frac{1}{5^{2}}$$

$$= \frac{1}{25}$$

$$= 0,04$$

$$= 4,0 \times 10^{-2}$$

Q15

It is given that y varies inversely as $(2x+3)$ and that $y = 1$ when $x = 1$

(a) Express y in terms of x [2]

(b) Find the value of x when $y = 5$. [2]

SOLUTION

(a) Express y in terms of x

$$y = \frac{k}{2x+3}$$

$$1 = \frac{k}{2(1)+3}$$

$$1 = \frac{k}{5}$$

$$1 \times 5 = \frac{k}{5} \times 5$$

$$k = 5$$

$$\therefore\ y = \frac{5}{2x+3}$$

(b) Find the value of x when $y = 5$.

$$5 = \frac{5}{2x+3}$$

$$5(2x+3) = \frac{5}{2x+3}(2x+3)$$

$$10x + 15 = 5$$

$$10x + 15 - 15 = 5 - 15$$

$$10x = -10$$

$$\frac{10x}{10} = \frac{-10}{10}$$

$$x = -1$$

Q16

Given that $p = (x-q)(x+q)$,

(a) express q in terms of x and p. [2]

(b) find the values of q when $x = 3$ and $p = -7$. [2]

SOLUTION

(a) express q in terms of x and p.

$$p = (x - q)(x + q)$$

$$p = x^2 - q^2$$

$$p - x^2 = x^2 - x^2 - q^2$$

$$p - x^2 = -q^2$$

$$-1(p - x^2 = -q^2)$$

$$x^2 - p = q^2$$

$$\sqrt{x^2 - p} = \sqrt{q^2}$$

$$\therefore\ q = \sqrt{x^2 - p}$$

(b) find the values of q when $x = 3$ and $p = -7$.

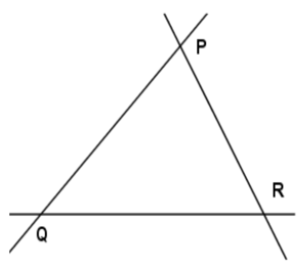
$$q = \sqrt{x^2 - p}$$

$$q = \sqrt{3^2 - (-7)}$$

$$q = \sqrt{16}$$

$$q = \pm 4$$

Q17



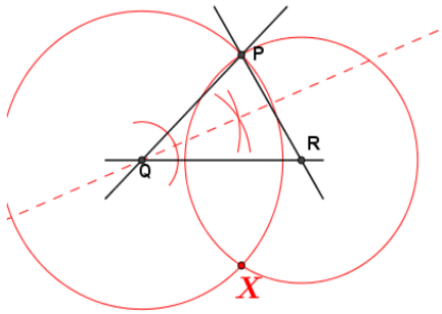
USE RULER AND COMPASESS ONLY FOR ALL CONSTRUCTIONS
SHOW CLEARLY ALL CONSTRUCTION LINES AND ARCS.

Construct on the diagram above

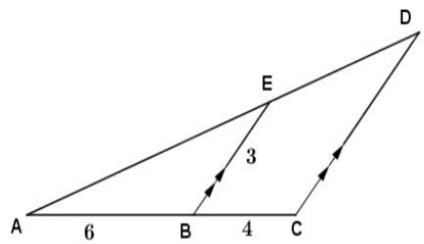
(a) The locus of a point which is equivalent from PQ and QR. [2]

(b) The locus of point X such that the area of triangle QXR = area of triangle QPR. [2]

SOLUTION



Q18



In the diagram, AB = 6 cm, BC = 4 cm, BE = 3 cm and Be is parallel to CD.

(a) Find the length of CD. [2]

(b) Express each of the following ratios in the simplest form,

(i) BE : CD, [1]

(ii) area of triangle ABE : area of quadrilateral BCDF. [2]

SOLUTION

(a) Find the length of CD.

$$\frac{CD}{10} = \frac{3}{6}$$

$$CD = 0,5(10)$$

$$= 5 \text{ cm}$$

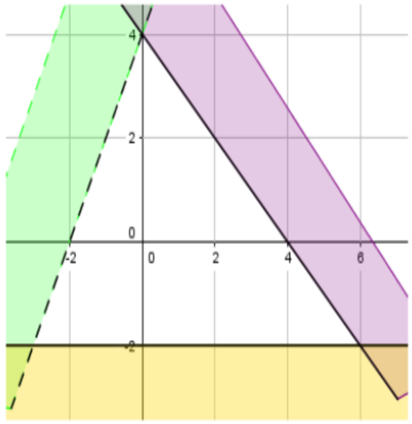
(b) Express each of the following ratios in the simplest form,

(i) BE : CD, [1]

3; 5

(ii) 9:25

Q19



Find the three inequalities which define the unshaded region in the diagram. [5]

SOLUTION

(i) $-2 \geq y$

$$\text{Gradient} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{4-0}{0--2}$$

$$= 2$$

(ii) $y > 2x + 4$

$$\text{Gradient} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{0-4}{4-0}$$

$$= -1$$

(iii) $y \geq 4 - x$

Q20

(a) Evaluate

(i) $\log_{10}1 - \log_{10}0,0001$. [2]

(ii) $\log_2\sqrt{2}$ [2]

(b) Express $(9^2 \times 9^3)$ as a power of 3. [2]

SOLUTION

(i) $\log_{10}1 - \log_{10}0,0001$. [2]

$$\log_{10}1 - \log_{10}0,0001 = \log_{10}\frac{1}{0,0001}$$

$$= \log_{10}10000$$

$$= \log_{10}10^4$$

$$= 4\log_{10}10$$

$$= 4$$

(ii) $\log_2\sqrt{2}$ [2]

$$\log_2\sqrt{2} = \log_2 2^{\frac{1}{2}}$$

$$= \frac{1}{2}\log_2 2$$

$$= \frac{1}{2} \times 1$$

$$= 0,5$$

(b) Express $(9^2 \times 9^3)$ as a power of 3.

$$9^2 \times 9^3 = 9^{2+3}$$

$$= 9^5$$

$$= (3^2)^5$$

$$= 3^{2\times 5}$$

$$= 3^{10}$$

Q21

A rectangle measures $(5x-2)$ cm by $(x+1)$ cm.

(a) Write down an expression for the area of the rectangle in terms of x. [1]

(b) Given that the area of the rectangle is 12 cm^2,

form an equation and show that it reduces to $5x^2+3x-14=0$ [2]

(c) Solve the equation $5x^2+3x-14=0$. [2]

(d) Hence find the length of the rectangle. [1]

SOLUTION

(a) Write down an expression for the area of the rectangle in terms of x

$$(5x-2)(x+1) \text{ cm}$$

(b) Given that the area of the rectangle is 12 cm^2,

form an equation and show that it reduces to $5x^2+3x-14=0$

$$(5x-2)(x+1)=12$$

$$5x\times x+5x\times 1-2\times x-2\times 1=12$$

$$5x^2+5x-2x-2=12$$

$$5x^2+3x-2-12=12-12$$

$$5x^2+3x-14=0$$

(c) Solve the equation $5x^2+3x-14=0$.

$$5x^2+3x-14=0$$

$$(5x-7)(x+2)=0$$

$$5x-7=0$$

$$5x-7+7=0+7$$

$$5x=7$$

$$\frac{5x}{5}=\frac{7}{5}$$

$$x=1,4 \text{ or}$$

$$x+2=0$$

$$x+2-2=0-2$$

$$x=-2$$

(d) Hence find the length of the rectangle.

$$5x - 2 = 5(1,4) - 2$$

$$= 7 - 2$$

$$= 5 \text{ cm}$$

Q22

A box contains twelve tennis balls which are identical except for color.

Three of the tennis balls are YELLOW, four GREEN and five WHITE.

(a) Find the probability that a ball picked from the box at random is

(i) white. [1]

(ii) black [1]

(b) Two balls are picked from the box at random.

Find the probability that they are

(i) of the same color. [2]

(ii) of different colors. [2]

SOLUTION

(i) white. [1]

$$= \frac{5}{12}$$

(ii) black

$$= 0$$

(b) Two balls are picked from the box at random.
Find the probability that they are
(i) of the same color. [2]

$$= \frac{3}{12} \times \frac{2}{11} + \frac{4}{12} \times \frac{3}{11} + \frac{5}{12} \times \frac{4}{11}$$

$$= \frac{6}{132} + \frac{12}{132} + \frac{20}{132}$$

$$= \frac{38}{132}$$

$$= \frac{19}{66}$$

(ii) of different colors.

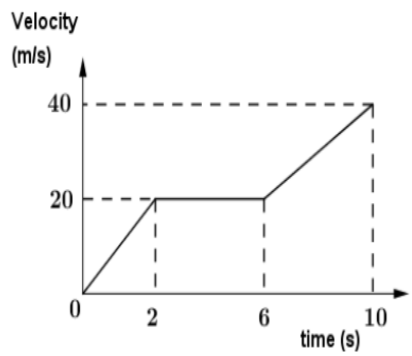
$$= 1 - \frac{19}{66}$$

$$= \frac{66}{66} - \frac{19}{66}$$

$$= \frac{66 - 19}{66}$$

$$= \frac{47}{66}$$

Q23



The diagram is the velocity-time graph of an object which accelerates uniformly from rest and attains a velocity of 20 m/s in 2s. The object maintains a constant velocity for a further 4s and then accelerates uniformly again for 4s after which it reaches a velocity of 40 m/s.

Calculate

(a) the acceeration of the object during the first 2 seconds. [1]

(b) the distance covered by the object during the 10 seconds. [3]

(c) the average speed of the object during the 10 seconds. [1]

(d) the velocity of the object 9 seconds from rest. [2]

SOLUTION

Calculate

(a) the acceeration of the object during the first 2 seconds.

$$= \frac{20}{2}$$

$$= 10 \text{ m/s}^2$$

SOLUTION

(b) the distance covered by the object during the 10 seconds

$$= \text{Total Area Under Graph.}$$

$$= \frac{1}{2} \times 2 \times 20 + 2 \times 8 + \frac{1}{2} \times 4 \times 20$$

$$= 20 + 160 + 40$$

$$= 220 \text{ m}$$

(c) the average speed of the object during the 10 seconds.

$$= \frac{220}{10}$$

$$= 22 \text{ m/s}$$

(d) the velocity of the object 9 seconds from rest.

$$\text{Gradient} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{40 - 20}{10 - 6}$$

$$= \frac{20}{4}$$

$$= 5$$

$$5 = \frac{V - 20}{9 - 6}$$

$$5(3) = V - 20$$

$$15 + 20 = V - 20 + 20$$

$\therefore$ **Velocity after 9 seconds is 35 m/s**