G12 ECZ GMD PAPER 1 2015 SOLUTIONS

Grade 12 ECZ Geometrical and Mechanical Drawing Paper 1, 2015 (7040/1)

Construction methods + computed values -- this is a practical drafting exam, see note

am: the true answer is a full-size drawing on A2 paper. This PDF gives the exact construction method and any cleanly computable numeric ans

EXAMINATIONS COUNCIL OF ZAMBIA

Examination for School Certificate Ordinary Level

Geometrical and Mechanical Drawing 7040/1

PAPER 1

Wednesday 28 OCTOBER 2015

Additional materials:
A2 Drawing paper (1 sheet)
Standard drawing equipment

Time: 2 hours 40 minutes **marks: 100**

Instructions to candidates

Print your **name, centre number** and **candidate** number in the Title Block at the bottom right-hand corner of your drawing paper.

There are **eight** questions in this paper. Answer **five** questions.

Answer not more than **three** questions from any one section.

Unless otherwise stated, strictly geometrical methods must be used. Solutions should be drawn full size and no dimensions are required. All construction lines must be shown clearly. Lines which are parallel, perpendicular or inclined at angles of 30°, 45° or 60° to other lines may be drawn without showing construction lines.

All the drawings in this question paper are **NOT DRAWN TO SCALE**.

Use only one sheet of A2 drawing paper.

You may use **both** sides of the drawing paper for your answers.

Information for candidates

The number of marks is given in brackets [ ] at the end of each question or part question.

All dimensions are in millimetres unless otherwise stated.

Cell phones are not allowed in the examination room.

www.zedpastpapers.com

downloaded from zedpastpapers.com

SECTION A

PLANE GEOMETRY

Answer two or three questions from this section

QUESTION 1

Figure 1 shows the profile of a garden. AB is elliptical with major axis 120mm and Minor axis 60mm. Straight line BC is tangential at B. Copy the figure full size.

[Total 20 marks]

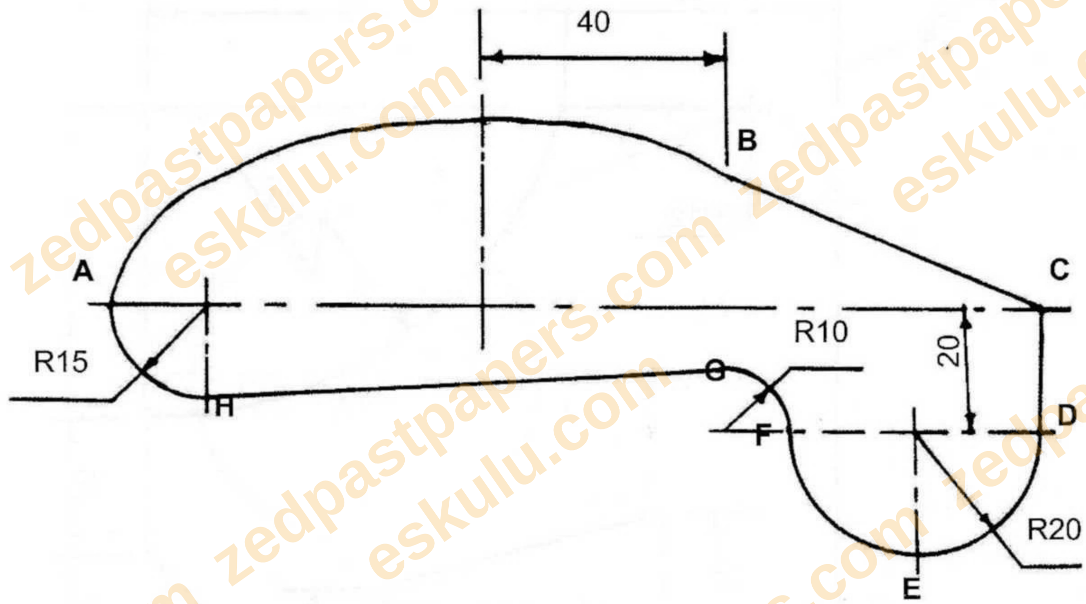

Figure 1

www.zedpastpapers.com

downloaded from zedpastpapers.com

QUESTION 2

A shaped metal plate is shown in **Figure 2**.

(a) Draw the given view full size. [7]

(b) Draw an enlarged view twice the area of the given view. [13]

[Total 20 marks]

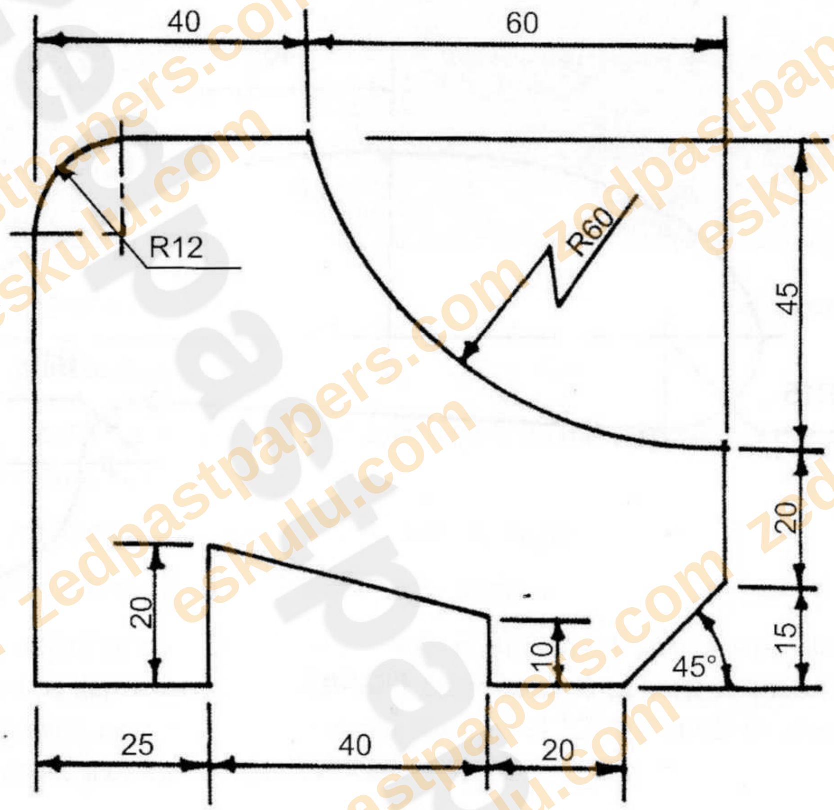

Figure 2

www.zedpastpapers.com

downloaded from zedpastpapers.com

QUESTION 3

A link mechanism is shown in **Figure 3**. The crank AB rotates about A while DC oscillates about D. Point P is on the right rigid BC which is pin-jointed at B and C. AB = 25, DC = 70, BC = 75 and BP = 40.

(a) Plot the locus of point P for one complete revolution of the crank AB.

[Total 20 marks]

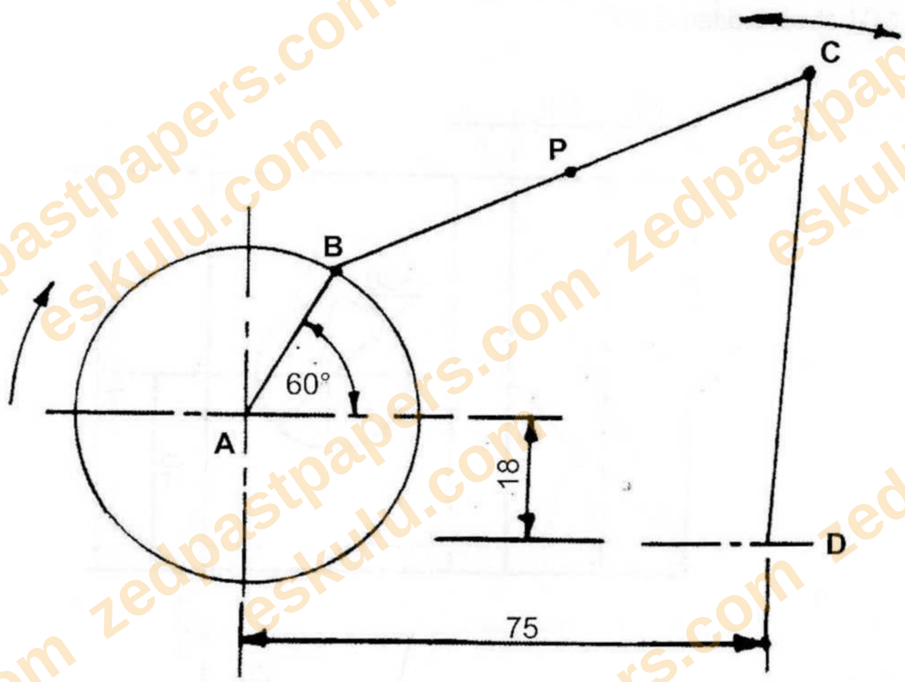

Figure 3

www.zedpastpapers.com

downloaded from zedpastpapers.com

SECTION B

SOLID GEOMETRY

Answer not more than three questions from this section.

QUESTION 4

Figure 4 shows two views of a Machine Block in Third Angle Projection.
DO NOT copy the two views, but draw full size, an isometric view of the block, making point F the lowest point in the drawing.
DO NOT show hidden details.

[Total 20 marks]

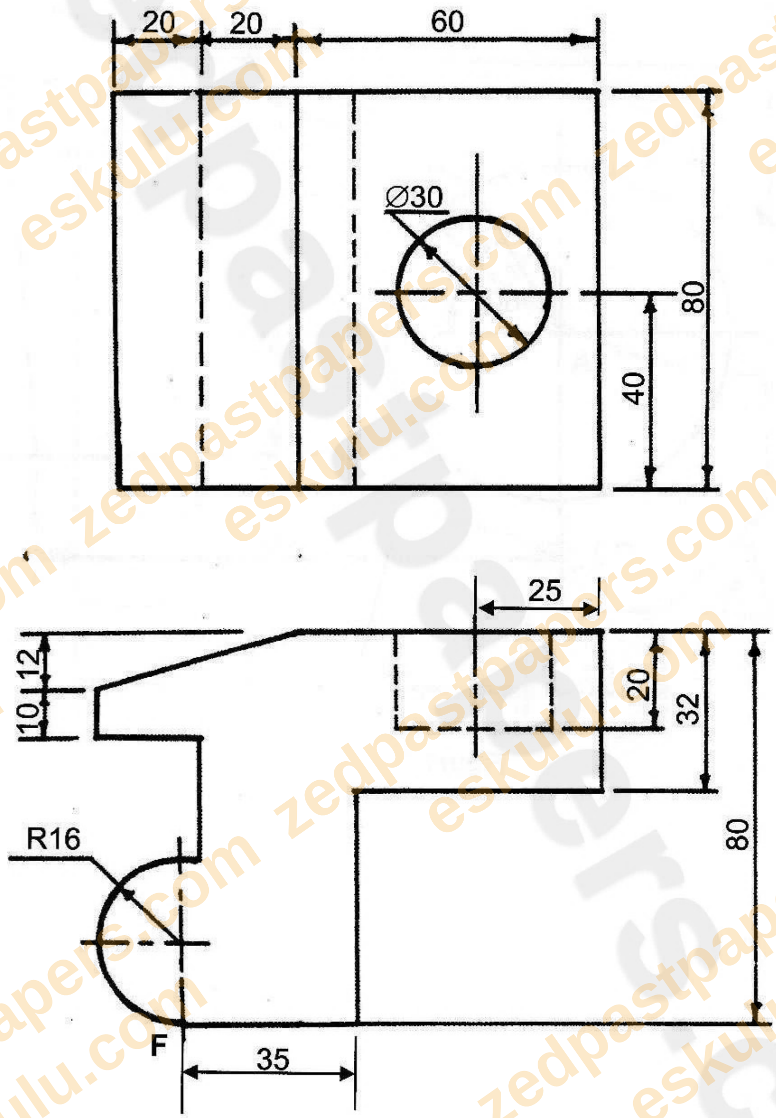

Figure 4

www.zedpastpapers.com

downloaded from zedpastpapers.com

QUESTION 5

A truncated cone is shown in **Figure 5**.

(a) Copy the given view and complete the plan. [7]

(b) Draw the development of the cone with S – S as the seam. [5]

(c) Project a true shape of the truncated surface as seen from arrow K. [8]

[Total 20 marks]

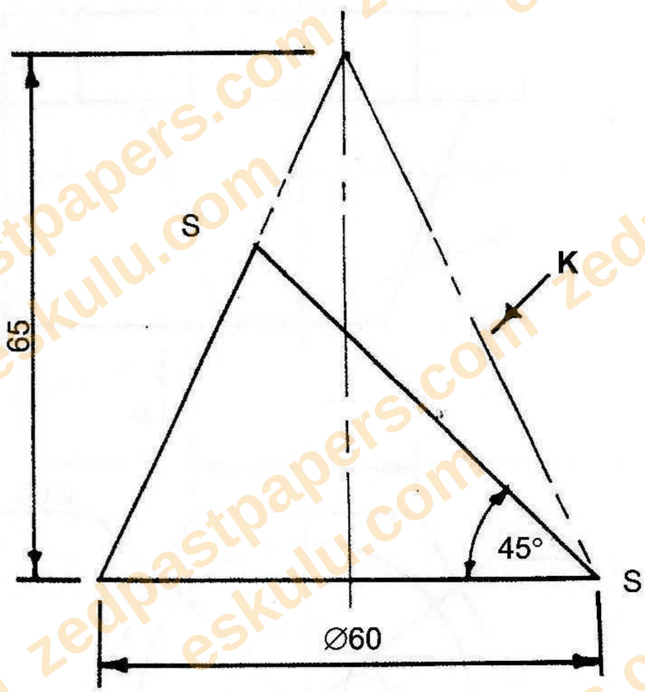

Figure 5

www.zedpastpapers.com

downloaded from zedpastpapers.com

QUESTION 6

Figure 6 shows the plan and elevation of a lamp holder in Third Angle Projection.

(a) Draw the given views. [4]

(b) Project an auxiliary view looking in the direction of arrow E.
Show hidden details. [16]

[Total 20 marks]

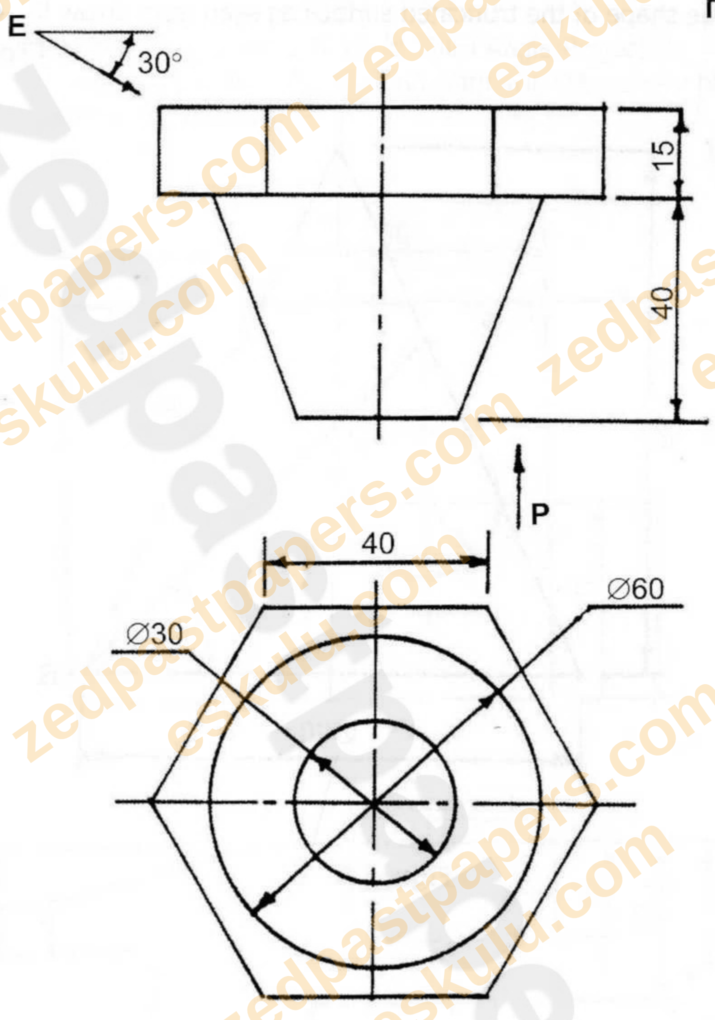

Figure 6

www.zedpastpapers.com

downloaded from zedpastpapers.com

QUESTION 7

Figure 7 shows two views of a straight line ab inclined both to the horizontal and vertical planes.

(a) Draw the two given views. [4]

(b) Determine and state the true length of ab. [7]

(c) Measure, state and indicate the true angle of inclination of the line ab and the:

(i) Horizontal and

(ii) Vertical planes [9]

[Total 20 marks]

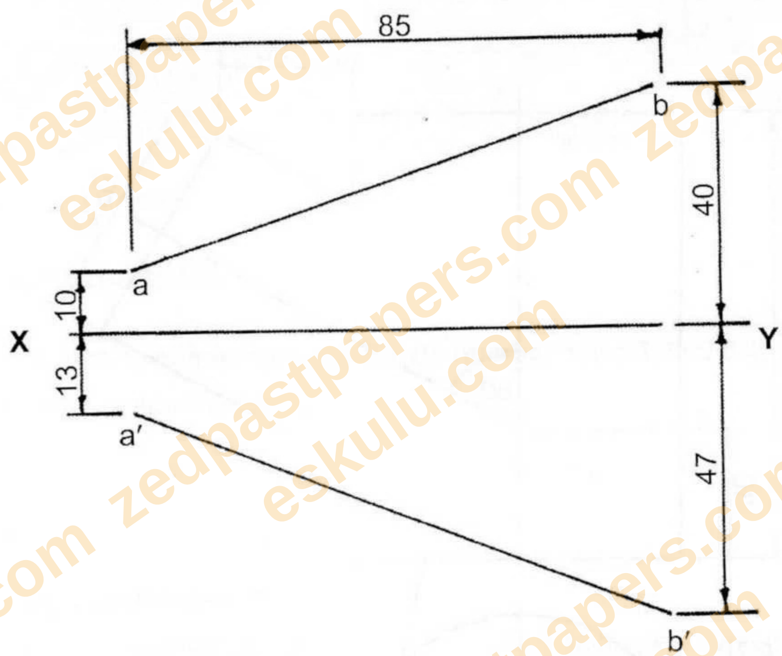

Figure 7

www.zedpastpapers.com

downloaded from zedpastpapers.com

QUESTION 8

Figure 8 shows an incomplete elevation and plan of two cylinders of unequal diameters intersecting at 30°.

(a) Draw the given views. [2]

(b) Complete the elevation clearly showing the curves of intersection between the two cylinders. [11]

(c) Complete the plan. [3]

(d) Project an end elevation viewed from arrow **E**. [4]

[Total 20 marks]

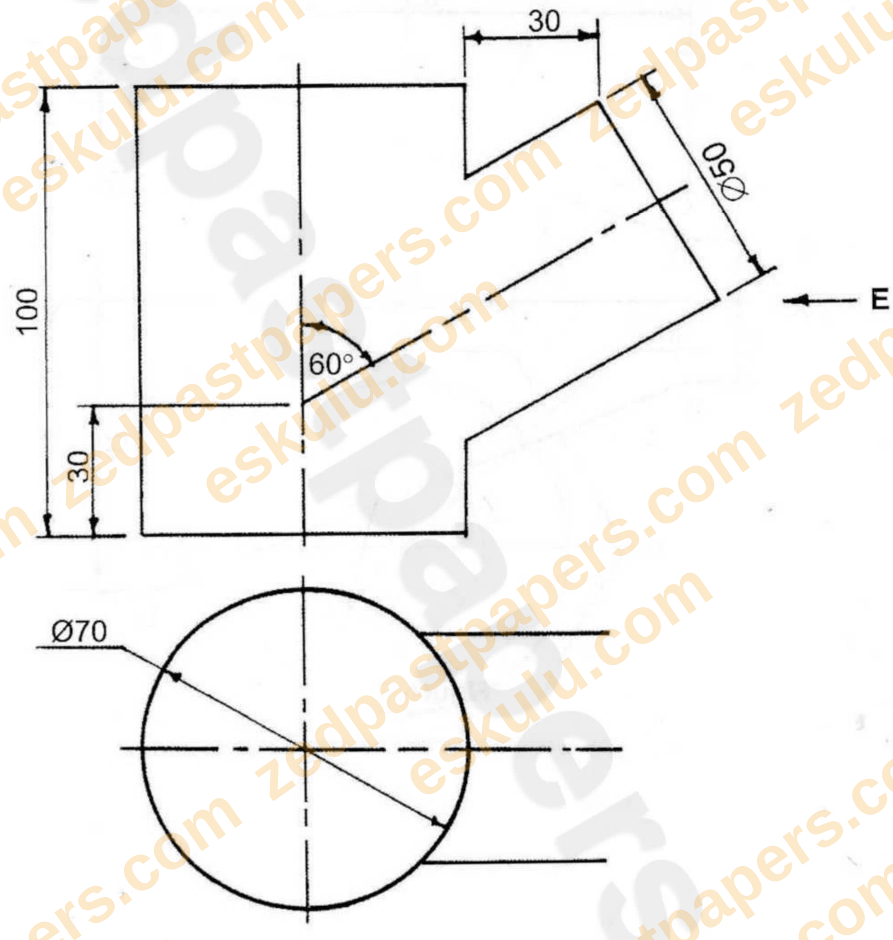

Figure 8

www.zedpastpapers.com

downloaded from zedpastpapers.com

DOWNLOAD ECZ PAST PAPERS FROM YOUR PHONE OR PC

www.zedpastpapers.com

downloaded from zedpastpapers.com

Question 1. SECTION A, Q1 [20]. Figure 1 shows a garden profile: AB is a semi-ellipse (major axis 120mm, minor axis 60mm), BC is tangential at B, followed by R10/R15/R20 blend arcs forming a curved handle-like extension. Copy the figure full size.

Construction method: draw the ellipse AB using the 'concentric circles' (or 'trammel') method for a full ellipse of major axis 120mm (semi-major 60mm) and minor axis 60mm (semi-minor 30mm), then use only the required half (the semi-ellipse from A to B). Since BC is TANGENTIAL to the ellipse at B, draw BC as the straight continuation of the ellipse's tangent line at that point (constructed perpendicular to the normal/radius direction at B, found via the auxiliary-circle method for ellipse tangents).

Continue the profile with the R15 blend fillet (tangent to the ellipse near A and to the lower straight return, centre found on the perpendicular to each tangent line at the point of tangency, at a distance of 15mm), then follow the lower straight/curved sections through the R10 arc (tangent between the upper straight run BC's return and the small hook near O/F), and the R20 arc forming the rounded 'hook' base (D-E-with the 20mm offset shown), all centres located by the standard tangent-arc rule: an arc's centre lies on the perpendicular to each line/curve it is tangent to, at a distance equal to its own radius.

Answer: Answer: construction method as above (ellipse by the concentric-circle/trammel method for the AB portion; each blend arc's centre located on the perpendicular to its tangent lines at a distance equal to its own radius: R15, R10, R20 as labelled).

Question 2. SECTION A, Q2 [20]. Figure 2 shows a shaped metal plate (R12 corner fillet, R60 large blend arc, 45 degree chamfer, with a 40+60mm width and 25+40+20mm base divisions). (a) Draw the given view full size [7]. (b) Draw an enlarged view TWICE the area of the given view [13].

(a) Construction method: set out the base divisions (25, 40, 20mm) and the vertical references (20mm step, 10mm step, 45 degree angled cut) first, then the two main straight edges, the R12 corner fillet (centre on the perpendicular bisector at 12mm from each tangent edge) and the large R60 arc blending the vertical right-hand edge into the sloped left-hand profile (centre located 60mm from both tangent points, on the perpendiculars to each).

(b) 'Twice the AREA' is NOT the same as twice the linear size: since area scales with the SQUARE of the linear scale factor, doubling the area means every linear dimension (including all the radii) must be multiplied by sqrt(2) = 1.4142 (approximately 1.414), not by 2.

Answer: (b) Enlargement linear scale factor = sqrt(2) = 1.414 (approx.). So the enlarged view's dimensions are: widths 40->56.6mm and 60->84.9mm; base divisions 25->35.4mm, 40->56.6mm, 20->28.3mm; heights 20->28.3mm and 10->14.1mm; R12->R17.0, R60->R84.9; the 45 degree angle is unchanged (angles are unaffected by scaling).

Question 3. SECTION A, Q3 [20]. Figure 3 shows a four-bar link mechanism: crank AB (=25mm) rotates about fixed centre A, rocker DC (=70mm) oscillates about fixed centre D, rigid coupler BC (=75mm) is pin-jointed at B and C, and point P lies on BC with BP=40mm. Plot the locus of P for one complete revolution of crank AB.

Construction method (standard four-bar-linkage coupler-point-locus construction): divide the crank circle (centre A, radius AB=25mm) into 12 equal 30-degree divisions, giving 12 successive positions of point B (B1, B2, ... B12) as the crank rotates through a full revolution.

For EACH position of B, find the corresponding position of C by intersecting an arc of radius BC=75mm (centred on that position of B) with an arc of radius DC=70mm (centred on the fixed point D) -- their intersection (on the correct/consistent side, matching the mechanism's actual assembly) gives that position of C.

With both B and C now located for that crank position, locate P on the straight line BC at the given distance BP=40mm from B (P lies between B and C, since BP=40 is less than BC=75). Repeat this for all 12 crank positions, plot all 12 positions of P, and join them with a smooth curve through a French curve -- this traces the coupler-point locus (a closed, generally egg/kidney-shaped 'coupler curve', not a simple named curve like a circle or ellipse, since it results from a four-bar linkage rather than a simple rolling/sliding motion).

Answer: Answer: construction method as above -- 12 crank positions at 30 degree intervals, each giving a B position (radius 25 from A), each B giving a C position via the 75mm/70mm two-arc intersection with D, and each giving a P position at 40mm from B along BC; the 12 P points joined by a smooth curve form the coupler-point locus.

Question 4. SECTION B, Q4 [20]. Figure 4 shows two views of a Machine Block in third-angle projection (overall 100mm wide across 20+20+60mm divisions, Ø30 hole, R16 fillet, stepped profile with 10/12mm and 20/25/32/80mm height divisions). Draw an isometric view full size, point F the lowest point, no hidden details.

Construction method: draw the three isometric axes at 120 degrees to each other with point F (given as the lowest point) as the origin. Set out the block's overall footprint (100mm wide by its depth, read from the two given views) along the isometric axes using TRUE lengths only (isometric drawing never foreshortens along the three isometric axis directions).

Build up the stepped L-shaped profile by marking off each height division (10, 12, 20, 25, 32, 80mm as applicable to each step) vertically, and each width division (20, 20, 60mm) horizontally along the isometric axes, joining corresponding points with isometric-axis-parallel lines only for straight edges. Construct the Ø30 circular hole using the four-centre approximate-ellipse method for a circle lying on an isometric plane (since a true circle appears as an ellipse in isometric projection), positioned at its correct offset from the block's edges as given in the two original views. Draw only visible edges as solid lines (no hidden detail, per the instruction), consistent with F being the nearest/lowest visible corner.

Answer: Answer: construction method as above (isometric axes at 120 deg from origin F; true lengths only along isometric axes; four-centre method for the Ø30 hole; no hidden lines).

Question 5. SECTION B, Q5 [20]. Figure 5 shows a truncated cone (base Ø60, height 65mm, cut by a plane at 45 degrees through point S near the base, with S-S as the seam for development). (a) Copy the view and complete the plan [7]. (b) Draw the development with S-S as the seam [5]. (c) Project the true shape of the truncated surface as seen from arrow K [8].

(a) Construction method: the full (untruncated) cone has base radius 30mm and height 65mm, giving a true slant height (apex to base edge) L = sqrt(30^2 + 65^2) = 71.59mm (computed exactly, not estimated). Draw the given elevation (apex, base circle Ø60, both slant edges), then project the plan as a circle of radius 30mm divided into 12 equal 30-degree divisions; project each division point up into the elevation view along vertical projectors to complete the plan of the truncated top surface (where the 45 degree cutting plane crosses each of the 12 generator lines at a DIFFERENT height, since the cut is oblique to the base) -- read each generator's individual cut-height directly off the elevation and transfer it to the corresponding plan division radially, joining the 12 plan points with a smooth ellipse-like curve to complete the plan.

(b) Development (with seam S-S): since the FULL cone's surface unrolls into a sector of radius = slant height = 71.59mm and included angle = 360 x (base radius / slant height) = 360 x 30/71.59 = 150.86 degrees (both values computed exactly here), first draw this full sector, divided into 12 equal angular divisions (150.86/12 = 12.57 degrees each) matching the plan's 12 generator lines, with the seam S-S as one straight edge of the sector. For each of the 12 generators, mark its TRUE cut-length (apex to where the 45 degree plane crosses that generator) along the corresponding radial line of the sector -- these true lengths must be taken from the true-length diagram/elevation (each generator's true length differs since the cut is oblique), NOT simply calculated by one formula, because the apex-to-cut distance varies by generator. Join the 12 marked points with a smooth curve to complete the development of the truncated surface; the full-radius sector arc (71.59mm) is only used for the UNTRUNCATED base edge, not the cut edge.

(c) True shape of the truncated (cut) surface as seen from arrow K: since the cutting plane is inclined (45 degrees) to both the horizontal base and the vertical axis, the cut surface appears as an ELLIPSE in true shape (a plane section of a cone at an angle to its axis, not passing through the base, is always an ellipse, PROVIDED the cutting angle is less steep than the cone's own half-angle -- otherwise it would be a parabola or hyperbola; here the cone's half-angle = arctan(30/65) = 24.78 degrees, which is LESS than the 45 degree cutting angle, so the true section IS a closed ellipse). Project this true shape by the standard auxiliary-view method: draw a new reference line parallel to the cutting-plane edge (as seen edge-on in the elevation, i.e. parallel to the 45 degree cut line), then project each of the 12 division points on the cut edge perpendicular to this new reference line, transferring each point's true offset distance (measured from the plan, at right angles to the direction of viewing) to plot the true elliptical shape.

Answer: (a)-(b) Computed exactly: full-cone slant height = 71.59mm; development sector angle = 150.86 degrees (12 divisions of 12.57 deg each); each generator's individual TRUE cut-length must still be read from the elevation/true-length diagram since the oblique cut gives each of the 12 generators a different length. (c) The true shape of the cut is an ELLIPSE (confirmed: the cone's half-angle 24.78 deg is less than the 45 deg cutting angle), projected via the auxiliary-view method described above.

Question 6. SECTION B, Q6 [20]. Figure 6 shows the plan and elevation of a lamp holder in third-angle projection (hexagonal Ø60/Ø30 base, tapered/stepped body, 15/40mm heights). (a) Draw the given views [4]. (b) Project an auxiliary view looking in the direction of arrow E (at 30 degrees), showing hidden details [16].

(a) Construction method: reproduce the given elevation (a frustum/trapezoid stepped profile, 15mm upper collar, 40mm tapered body) and the given plan (a regular hexagon of width 40mm across flats, containing concentric circles Ø30 and Ø60) directly from the given dimensions, in correct third-angle relative position.

(b) Auxiliary view from arrow E (at 30 degrees to the vertical): draw a new auxiliary reference line perpendicular to arrow E's direction of sight (i.e. at 30 degrees to the original vertical reference). Project each corner of the hexagonal base and each edge of the tapered body perpendicular to this new auxiliary datum, transferring true depths from the PLAN view (using dividers) to locate each point correctly in the auxiliary view. Since arrow E views the object obliquely, the hexagonal base will generally project as a distorted (non-regular) hexagon, and the two circles (Ø30, Ø60) will each generally project as ellipses, plotted via the ordinate method (multiple individual points transferred by divider, not by compass). Because the question explicitly requires hidden details to be SHOWN in this view, draw dashed lines for any edges of the hexagonal base, the taper, or the circular bore/collar that are obscured from the arrow-E viewing direction.

Answer: Answer: construction method as above (auxiliary datum perpendicular to arrow E at 30 deg; depths transferred from the plan by dividers; hexagon and both circles generally project as distorted/elliptical shapes in this oblique view; all hidden detail shown dashed, per the instruction).

Question 7. SECTION B, Q7 [20]. Figure 7 shows the plan (a, b at 10mm and 40mm above XY) and elevation (a-prime, b-prime at 13mm and 47mm below XY) of a straight line ab, with horizontal separation 85mm. (a) Draw the two given views [4]. (b) Determine the true length of ab [7]. (c)(i)(ii) Determine the true angle of inclination of ab to the horizontal (HP) and vertical (VP) planes [9].

Set up 3D coordinates from the two views: the horizontal (x) separation between a and b is 85mm (given directly); the HEIGHT difference (read from the upper/elevation view, where a is 10mm and b is 40mm above the XY line) is 40-10 = 30mm; the DEPTH difference (read from the lower/plan view, where a-prime is 13mm and b-prime is 47mm below XY) is 47-13 = 34mm.

The construction method (true-length auxiliary/rotation method) is: draw a right-angled triangle with one side equal to the plan length of ab (found first from the plan's horizontal AND depth components combined: sqrt(85^2+34^2) = 91.55mm) and the other (perpendicular) side equal to the height difference (30mm); the hypotenuse of this triangle is the true length, and its angle to the plan-length side is the true angle to the HP. A similar triangle using the elevation length (sqrt(85^2+30^2)=90.14mm) as one side and the depth difference (34mm) as the other gives the true angle to the VP.

Answer: (b) Computed exactly (coordinate/Pythagorean method, equivalent to the true-length triangle construction): true length of ab = sqrt(85^2 + 34^2 + 30^2) = sqrt(9281) = 96.34mm (approximately 96mm).

Answer: (c)(i) True angle of ab to the HORIZONTAL plane (HP) = arctan(30 / sqrt(85^2+34^2)) = arctan(30/91.55) = 18.14 degrees (approximately 18 degrees).

Answer: (c)(ii) True angle of ab to the VERTICAL plane (VP) = arctan(34 / sqrt(85^2+30^2)) = arctan(34/90.14) = 20.67 degrees (approximately 21 degrees).

Question 8. SECTION B, Q8 [20]. Figure 8 shows an incomplete elevation and plan of two cylinders (Ø70 main, Ø50 branch) of unequal diameter intersecting at 30 degrees (60 degrees included angle shown), with 100/30mm and 30mm offsets. (a) Draw the given views [2]. (b) Complete the elevation showing the curves of intersection [11]. (c) Complete the plan [3]. (d) Project an end elevation viewed from arrow E [4].

(a)-(c) Construction method: complete the elevation and plan using the given dimensions (main cylinder Ø70 vertical, branch cylinder Ø50 at 30 degrees to it, offset 30mm from the main axis, positioned per the 100mm and 30mm height references). Find the curve(s) of intersection by the standard 'cutting-plane' (generator) method: divide the branch cylinder's circular cross-section (Ø50) into 12 equal divisions in the plan view, project each division's generator line through both the elevation and plan, and mark where each generator crosses the main (Ø70) cylinder's surface -- join these 12 (or more, near the sharp-curvature regions) points with a smooth curve in the elevation to show the true interpenetration curve. Complete the plan similarly by projecting the same division points down/across into the plan view and joining them.

(d) End elevation from arrow E: project a new view looking along the branch cylinder's own axis (per arrow E, i.e. from the position shown at the Ø50 end). In this end view, the branch cylinder appears as a true circle (Ø50, since we are viewing along its own axis), and the main cylinder appears as a rectangle/vertical band (its true width Ø70, foreshortened height, since it is now viewed from the side at the 30 degree oblique angle) -- project each point from the completed elevation and plan across/down to this new end-view direction using the standard third-angle (or first-angle, matching the paper's convention) projection method, transferring the appropriate depth/width dimensions with dividers from the plan view.

Answer: Answer: construction method as above (12-generator cutting-plane method for the interpenetration curve, using the Ø50 branch cylinder's cross-section divisions; end elevation from arrow E shows the branch cylinder as a true Ø50 circle and the main cylinder as a foreshortened rectangular band, both located by projection from the completed elevation and plan).

Disclaimer

Created by eskulu Past Papers Tutor

These solutions were created using artificial intelligence and checked against ECZ marking guidelines. If you find an error, report it at eskulu.com/feedback.

eskulu.com | zedpastpapers.com