ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

ZIMSEC
For Performance Measurement

EMERALD KEY

COMBINED SCIENCE - 4003

GCE ORDINARY LEVEL

Volume 1
November 2018 - November 2019 Examinations

www.zimsec.co.zw

Table of contents

Preamble

The Combined Science Question and Answer booklet is made up of question papers, expected answers and some revision notes for November 2018, June 2019 and November 2019 examinations. The booklet is meant to help the learners in their 'O' level studies and in their preparation for examinations.

Revision notes and calculations have been provided to clarify related concepts. Questions are drawn from the whole syllabus and are important for self assessment. The Questions address the syllabus objectives.

General information

Questions in the papers are drawn from the Biology, Chemistry and Physics sections of the syllabus. The questions cover the whole syllabus and candidates are discouraged from spotting the topics. Questions represent different skills, that is, recall, comprehension, data analysis, evaluation, application and deductive reasoning. Questions intending to capture the candidate's creativity, data application, data analysis, evaluation et cetera may be set from novel situations. In this booklet, answers are given in form of phrases but candidates are expected to present their answers as complete sentences. Candidates use different expressions as they present their answers. Candidates should be guided by the instructions on particular questions e.g. if a question requires a candidate to state any two, it means that there are more than two possible answers and the candidate is expected to give any two, but when a question requires a candidate to state the two, it means that there are only two possible answers and the candidate is expected to give the two.

On calculations, candidates are required to give the formula for any calculation. The answer should be accompanied with a correct unit; otherwise it will be marked as incorrect. Answers should be aligned to the question in terms of the correct number of decimal places.
Answers that are separated by a slash (/) are alternatives for the same mark and can not be given as independent marking points, for example:

Question: State any two conditions needed for germination.
Marking scheme: Water/moisture
warmth/suitable temperature
air/oxygen. Water is an alternative for moisture so its one marking point even if the candidate gives the two.

Paper 1 (Multiple Choice)

In Multiple Choice, there is only one correct response and the other three are distracters. The distracters are concepts closely related to the answer or misconceptions closely related to the answer or the topic.

Paper 2 (Structured and Short Essay Questions)

The paper consists of sections A, B. C and D. Section A is structured and compulsory.
Each of the sections B, C and D consists of three short essay questions and candidates choose any two. Candidates are advised to read through all the three questions so that they make informed choices based on the questions they can answer correctly. A copy of the Periodic Table is provided and candidates are supposed to make their own discretion on questions that require reference to it.

Paper 3 (Practical Examination)

The paper consists of two practical questions which require candidates to carry out experiments to collect data, to make deductions and conclusions. Marks are awarded according to the supervisor's results only when the supervisor's results are within the candidates' range. If the supervisor's results are out of range of the candidates' results, an average of the candidates' results is used. Candidates' results are marked per centre because they are affected by factors such as temperature, apparatus used and purity of chemicals. In a practical, there is no universally correct answer. Marks are awarded for correct data trends. Numerical data collected should show the precision of the instrument used through the number of decimal places.

DATA SHEET
The Periodic Table of the Elements

Group																	
I	II										III	IV	V	VI	VII	O	
							1 H Hydrogen 1									4 He Helium 2	
7 Li Lithium 3	9 Be Beryllium 4										11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10	
23 Na Sodium 11	24 Mg Magnesium 12										27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulphur 16	35.5 Cl Chlorine 17	40 Ar Argon 18	
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57 *	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	Po Polonium 84	At Astatine 85	Rn Radon 86
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 †															

*Lanthanoid series	140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
†Actinoid series	232 Th Thorium 90	Pa Protactinium 91	238 U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96	Bk Berkelium 97	Cf Californium 98	Es Einsteinium 99	Fm Fermium 100	Md Mendelevium 101	No Nobelium 102	Lr Lawrencium 103

Key: a X b — a = relative atomic mass; X = atomic symbol; b = proton (atomic) Number

The volume of one mole of any gas is 28 dm^3 at room temperature and pressure (r.t.p.)

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Ordinary Level

COMBINED SCIENCE 4003/1

PAPER 1 Multiple Choice

NOVEMBER 2018 SESSION 1 hour

Additional materials:
Multiple Choice answer sheet
Soft clean eraser
Soft pencil (type B or HB is recommended.)
Calculator (Optional)

INSTRUCTIONS TO CANDIDATES

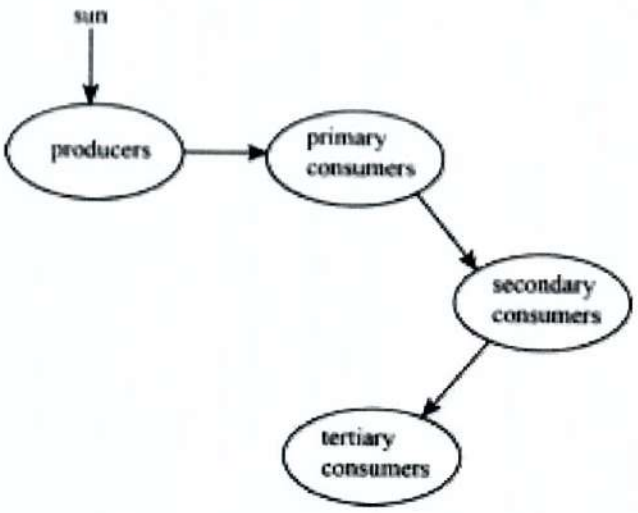
Do **not** open this booklet until you are told to do so.
Write your name, centre number and candidate number on the answer sheet in the spaces provided unless this has already been done for you.
Read very carefully the instructions on the answer sheet.

INFORMATION FOR CANDIDATES

Each correct answer will score **one** mark. A mark will **not** be deducted for a wrong answer. Any rough working should be done in this booklet.

There are **forty** questions in this paper. Answer **all** questions. For each question, there are four possible answers, **A**, **B**, **C** and **D**. Choose the one you consider correct and record your choice in soft pencil on the separate answer sheet provided.

1. The diagram shows the flow of energy through an ecosystem.



Which level has the highest amount of energy?

A producers
B primary consumers
C secondary consumers
D tertiary consumers

2. What makes proteins an essential component of the human diet?

A They are needed for cell growth.
B They are the main source of energy.
C They can be stored as a food reserve.
D They are needed to prevent anaemia.

3. A child is showing stunted physical and mental growth.

Which mineral element is lacking in the child's diet?

A iron
B iodine
C calcium
D phosphorus

4. A person with poor night vision lacks

A vitamin A.
B vitamin C.
C vitamin D.
D vitamin K.

5. How is an alveolus adapted for gaseous exchange?

A It has a dry surface.
B It has a thick alveolus wall.
C It has a large surface area.
D It has few blood capillaries.

6. Which adaptation of a plant reduces transpiration?

A large surface area of a leaf
B small surface area of a leaf
C thin layer of cuticle on a leaf
D large number of stomata on a leaf

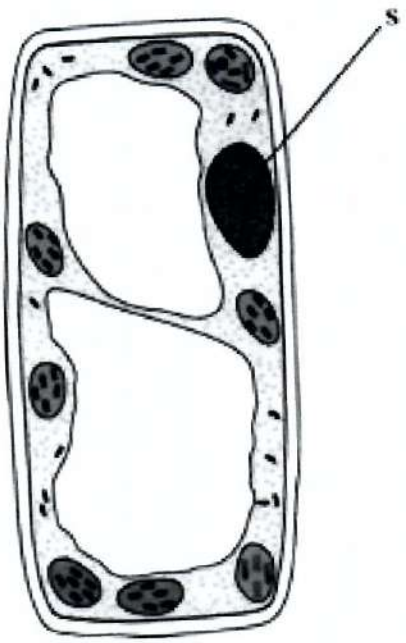
7. Which method of propagation is used to grow Irish potatoes?

A cuttings
B rhizomes
C seeds
D tubers

8. One method that may lead to the spread of HIV/AIDS is

A faithfulness to one uninfected partner.
B abstinence from sexual activity.
C sharing contaminated needles.
D proper use of condoms.

9. The diagram shows a palisade cell.



What is the function of **S**?

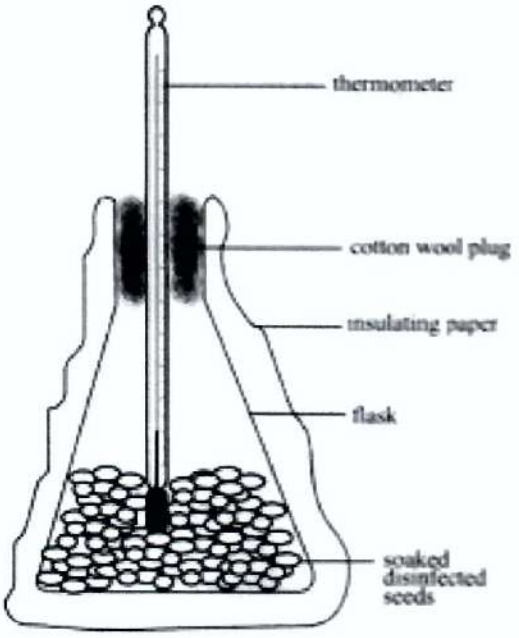
A stores salts and sugars
B controls the cell's activities
C carries out photosynthesis
D controls what gets in and out of the cells

10. A toddler is suffering from a deficiency disease which causes bones to remain soft and become deformed.

The disease is caused by lack of

A carbohydrates.
B vitamin D.
C proteins.
D iodine.

11. The diagram shows apparatus to investigate a biological process.

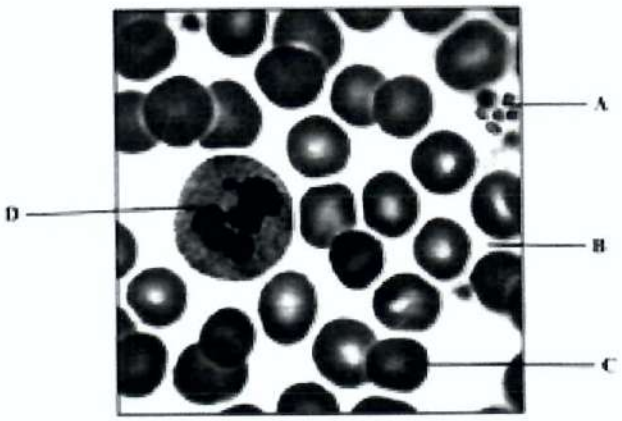


Which process causes the temperature in the flask to increase?

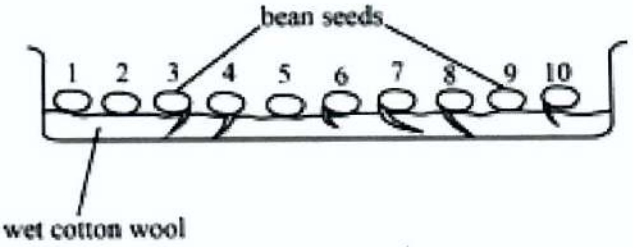
A decay
B respiration
C germination
D gaseous exchange

12. The diagram shows some components of human blood.

Which component of blood transports oxygen to the body cells?



13. The diagram shows a container with germinating bean seed.



What is the percentage germination?

A 4%
B 6%
C 40%
D 60%

14. Which method of contraception is also effective in the prevention of sexually transmitted infections?

A condom
B spermicide
C rhythm method
D the contraceptive pill

15. Which statement is true about metals?

A They are alloys.
B They are brittle.
C They are ductile.
D They are good insulators.

16. Which method is used to separate a mixture of dyes?

A decanting
B crystallisation
C chromatography
D fractional distillation

17. Which pH range would turn the universal indicator to blue?

A 0 to 2
B 4 to 6
C 7 to 8
D 10 to 12

18. The reaction between ammonia and nitric acid produces

A a refrigerant.
B a detergent.
C a fertiliser.
D paint.

19. An element **Y** has the electronic configuration of 2, 8, 6.

Which statement is true about **Y**?

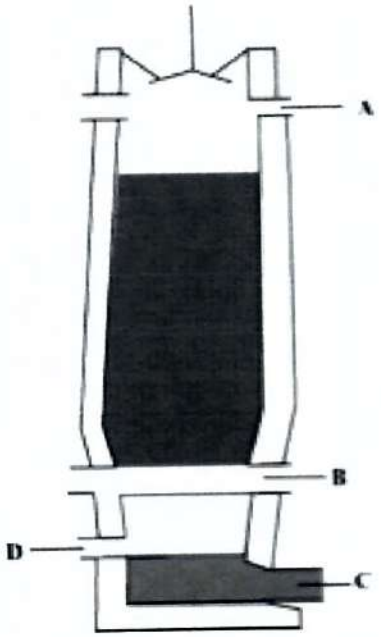
A It has six protons.
B It forms an ion of charge +2.
C It forms an ionic compound with sodium.
D It forms a covalent compound with magnesium.

20. Which gas is obtained from the fractional distillation of liquid air?

A nitrogen
B hydrogen
C sulphur dioxide
D carbon monoxide

21. The diagram shows the blast furnace.

Which outlet is used to remove iron from the furnace?



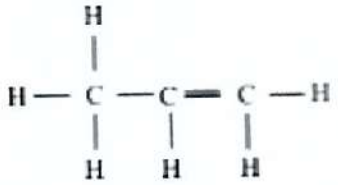
22. Which statement about ethane is true?

A It is a fuel.
B It is an alcohol.
C It forms polythene.
D It has a double bond.

23. Oxidation is the

A gain of hydrogen by a compound.
B gain of electrons by a compound.
C removal of oxygen from a compound.
D removal of hydrogen from a compound.

24. The diagram shows an organic compound.



The organic compound is

A an alcohol.
B an alkane.
C an alkene.
D saturated.

25. Why is vanadium (V) oxide used in the conversion of sulphur dioxide to sulphur trioxide?

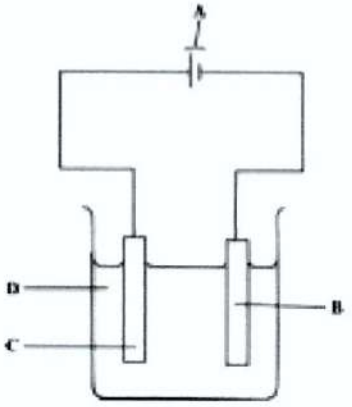
A It reacts with sulphur dioxide.
B It increases the rate of the reaction.
C It increases the temperature of the reaction.
D It recycles the unreacted reactants during the reaction.

26. What do the fuels methane, charcoal and petrol have in common?

A they are all gases
B they all contain oxygen
C they all contain carbon
D they are all hydrocarbons

27. The diagram shows an electrolytic cell.

Which part, **A**, **B**, **C** or **D**, is the anode?



28. Which surface is the worst emmitter of heat energy?

A dull black
B dull white
C shiny black
D shiny white

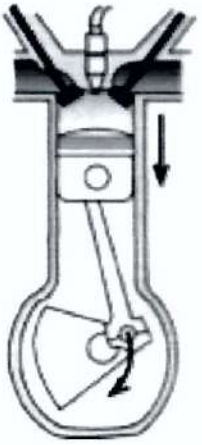
29. Which one is a way of reducing friction?

A adding mass
B reducing mass
C using rough surfaces
D increasing contact area of moving parts

30. Which instrument is used to measure the diameter of a thin wire accurately?

A metre rule
B tape measure
C vernier callipers
D micrometer screw gauge

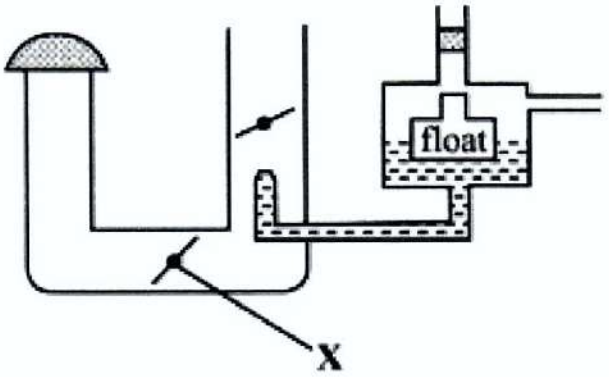
31. The diagram shows a cylinder in a petrol engine.



Which stroke is shown in the diagram?

A compression
B intake
C power
D exhaust

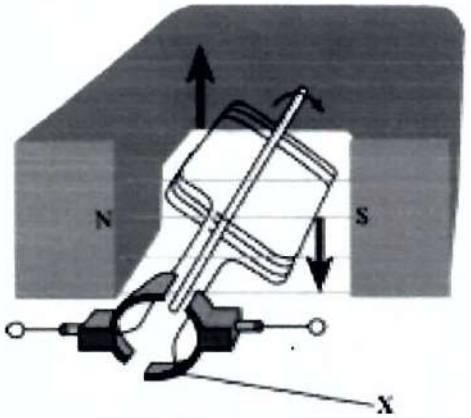
32. The diagram shows a carburetor.



What is **X**?

A choke
B throttle
C air filter
D petrol filter

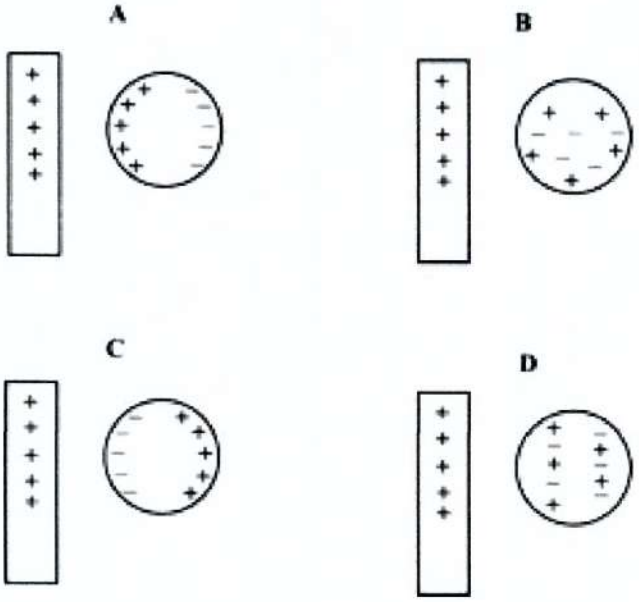
33. The diagram shows a simple direct current (d.c) motor.



What is the part labelled **X**?

A brush
B slip ring
C magnet
D commutator

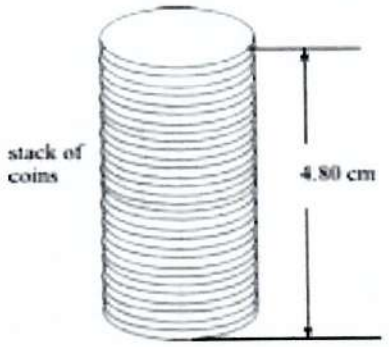
34. Which diagram shows the correct distribution of charges between an uncharged sphere and a positively charged rod?



35. Which one is a unit of potential difference?

A Ohm
B volt
C watt
D ampere

36. The diagram shows the height of a stack of 30 identical coins.



What is the thickness of one coin?

A 0.16 cm
B 6.25 cm
C 25.20 cm
D 144.00 cm

37. A rock has a weight of 6.7 N. The gravitational acceleration, g, is 10 N/kg.

What is the mass of the rock?

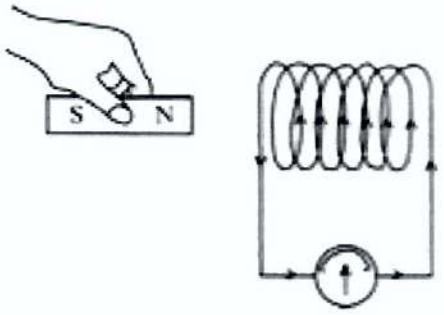
A 0.67 kg
B 6.7 kg
C 67 kg
D 670 kg

38. The diagram shows parts of a solar water heater.

What is the function of **Z**?

A It allows heat to reach the tubing.
B It is used to store heat energy.
C It is used to insulate the tubing.
D It is a good conductor of heat.

39. A magnet is placed near a solenoid connected to a galvanometer, as shown by the diagram.

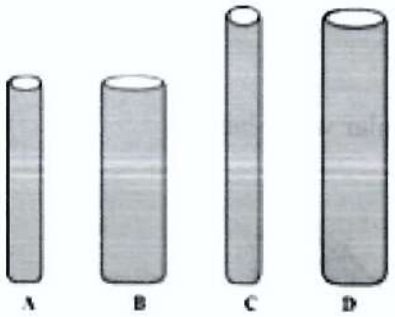


When is the reading in the galvanometer zero?

A when the magnet is moving fast into the solenoid
B when the magnet is stationary inside the solenoid
C when the magnet is moving slowly into the solenoid
D when the solenoid is moving slowly towards the magnet

40. The diagrams show four wires of different sizes but made up of the same material.

Which wire has the greatest electrical resistance?



ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Ordinary Level

COMBINED SCIENCE: 4003/1

MARKING SCHEME : NOVEMBER 2018

1. A
2. A
3. B
4. A
5. C
6. B
7. D
8. C
9. B
10. B
11. B
12. C
13. D
14 A
15. C
16. C
17. D
18. C
19. C
20. A
21. C
22. A
23. D
24. C
25. B
26. C
27. C
28. D
29. B
30. D
31. C
32. A
33. D
34. C
35. B
36. A
37. A
38. A
39. B
40. C

REVISION NOTES FOR 4003/1 N2018

1. The longer the chain the more energy is lost, so the shortest chain has the highest amount of energy.

2. The question is asking for a function of protein which is given as response A.

3. Iodine deficiency causes goitre in adults and stunted physical and mental growth in children.

4. The question is based on the functions of vitamins and hence the related deficiency diseases.
   A deficiency of vitamin A causes poor night vision.
   A deficiency of vitamin C causes scurvy.
   A deficiency of vitamin D causes rickets.
   Vitamin K enhances blood clotting so its deficiency leads to excessive bleeding when injured.

5. An alveolus has the following adaptations: large surface area, many blood capillaries, a wall which is one cell thick and a moist surface. The adaptations enable gases to diffuse easily across the membrane.

6. Transpiration is low under the following leaf adaptations: small leaf surface area, thick cuticle, few stomata and presence of hairs on leaves.

7. Irish potatoes are grown from the tuber which is the source of food as it develops roots and shoots.

8. HIV/AIDS is spread through having unprotected sex with infected partner(s) and sharing contaminated sharp objects or needles.

9. S is the nucleus and the nucleus controls the activities of the cell.

10. The question may be put across as "what is required for the formation of strong bones?" Possible answers are calcium and vitamin D.

11. Germinating seeds respire. Respiration is an exothermic process which releases heat energy. The heat released cause a temperature rise in the flask.

12. The question requires candidates to know that oxygen is transported by red blood cells and also to know the shape of the red blood cells. A represents platelets, B represents blood plasma, and D represents a white blood cell (a phagocyte).

13. % germination = $\frac{\text{number of seeds germinated}}{\text{Total number of seeds}} \times 100\%$

    The number of seeds that germinated is 6 (from the development of the radicle)

    $= \frac{6}{10} \times 100\%$

    $= 60\%$

14. The correct method of contraception should be the one that prevents interchanging of body fluids during sexual intercourse so it is the condom.

15. Candidates have to be able to recall properties of metals. The properties of metals include being ductile, malleable, good conductors of heat and electricity and high tensile strength.

16. Decanting separates immiscible liquids of different densities, crystallisation produces crystals (solids) from concentrated solutions through slow evaporation, chromatography separates a mixture of dyes through the use of a solvent which places the dyes at different positions and fractional distillation separates miscible liquids which have different boiling points.

17. Universal indicator pH chart

pH	1	2-4	5-6	7	8-10	11-13	14
colour	red	brown	yellow	green	blue	purple	violet

18. The reaction between ammonia and nitric acid produces ammonium nitrate which is a fertilizer
ammonia + nitric acid →ammonium nitrate
$NH_{3(g)} + HNO_{3(aq)} \rightarrow NH_4NO_{3(aq)}$

19. Y has an electronic configuration of 2.8.6 which means it has 6 valence electrons. For it to reach octet state, it needs to gain 2 electrons forming an ionic compound of charge -2.

20. Fractional distillation of liquid air produces mainly nitrogen and oxygen. Carbon dioxide and noble gases (helium & neon) are by-products.

21. Iron is denser than slag, so it is taped through the bottom hole, C. A is an outlet for waste gases, B is an inlet for oxygen and D is an outlet for slag.

22. Ethane is a hydrocarbon with 2 carbon atoms, has single C-C bonds only and is used as a fuel

ethane

23. Oxidation is defined in three ways:

(a) addition of oxygen e.g. $C+O_2 \rightarrow CO_2$. Carbon has been oxidised through the addition of oxygen through the loss of electrons.

(b) loss of electrons e.g $Mg \rightarrow Mg^{2+}+2e^-$. Magnesium has been oxidised from an oxidation state of 0 to +2 through the loss of electrons.

(c) removal of hydrogen from a substance e.g. $H_2S+Cl_2 \rightarrow 2HCl + S$. Sulphur has been oxidised through the loss of hydrogen.

24. The organic compound is a hydrocarbon because it has C and H atoms only, it is unsaturated because it has a double C=C bond, it has a general formula of C_nH_{2n} hence it is an alkene.

25. Vanadium (V) oxide is a catalyst therefore it increases the rate of reaction.

26. Methane is a gaseous fuel which consists of C and H atoms only, charcoal is a solid fuel which consists of C and petrol is a liquid fuel which consists of C and H, hence the correct response is C.

27. The anode is the positively charged electrode connected to the positive terminal of the cell or battery. A is the cell. B is the cathode (electrode connected to the negative terminal). D is the electrolyte (a solution or liquid which conducts electricity).

28. Shiny white surfaces are bad absorbers and bad emitters of heat.

29. Friction is reduced by reducing mass of moving parts, reducing contact area of moving parts and lubricating/ using ball bearings on moving parts.

30. The diameter of a thin wire is measured using an instrument that measures very small lengths so the micrometer screw gauge is the most suitable.

31. Power stroke because the piston is moving downwards and both valves are closed. In the power stroke, chemical energy is converted to kinetic energy causing motion in the vehicle.
Why A, B and D are incorrecct
During compression, both valves are closed but the piston will be moving upwards.
During intake the inlet valve should be open.
During exhaust, the exhaust valve should be open.

32. X is a choke which controls the amount of air that enters.

33. Commutator/split rings ensure(s) that the movement of current is in one direction.

34. An uncharged body is neutral and negative and positive charges are equal. When a positively charged body is brought near an uncharged body, the positive charges are repelled to the other end of the sphere and the negative charges are brought near the positive charge as shown by the answer C.

35. Potential difference is also known as voltage and its unit is the volt/V.

36. To find the thickness of one coin = thickness of the stack of coins divided by the number of coins.

$$= \frac{4.80 \text{ cm}}{30}$$
$$= 0.16 \text{ cm}$$

37. F=ma therefore m = F/a
F = 6.7 N and g = 10 N/Kg
$$m = \frac{6.7 \text{ N} \times \text{Kg}}{10\text{N}}$$
$$= 0.67 \text{ Kg}$$

38. The panel is heated directly by the radiation from the sun. The heat is transferred to water inside the panel by conduction. The glass plate traps hot air in the panel by the greenhouse effect.

39. A reading on the galvanometer is recorded when the magnetic field lines are cut and emf/voltage is induced. When the magnet is stationary inside the solenoid or when it is completely out of the solenoid, no emf/voltage is being produced because there are no magnetic field lines being cut.

40. Resistance is affected by length of the conductor, thickness of the conductor (cross sectional area) and temperature.
Resistance increases with increasing length of wire, reducing thickness of wire and increasing temperature.

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Ordinary Level

COMBINED SCIENCE 4003/2

PAPER 2 Theory

NOVEMBER 2018 SESSION 2 hours

Candidates answer on the question paper

Additional materials: Calculator (Optional)

Allow candidates 5 minutes to count pages before the examination.

This booklet should not be punched or stapled and pages should not be removed.

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces at the top.
Write your centre and candidate number in the boxes on the top right corner of every page of this paper.
Check if the booklet has all the pages and ask the invigilator for a replacement if there are duplicate or missing pages.
Write your answers in the spaces provided on the question paper.

Section A
Answer **all** questions.

Section B
Answer any two questions.

Section C
Answer any **two** questions.

Section D
Answer any **two** questions.

INFORMATION FOR CANDIDATES

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

Section A

Answer all questions in this section in the spaces provided.

1. **Fig.1.1** shows a palisade cell.

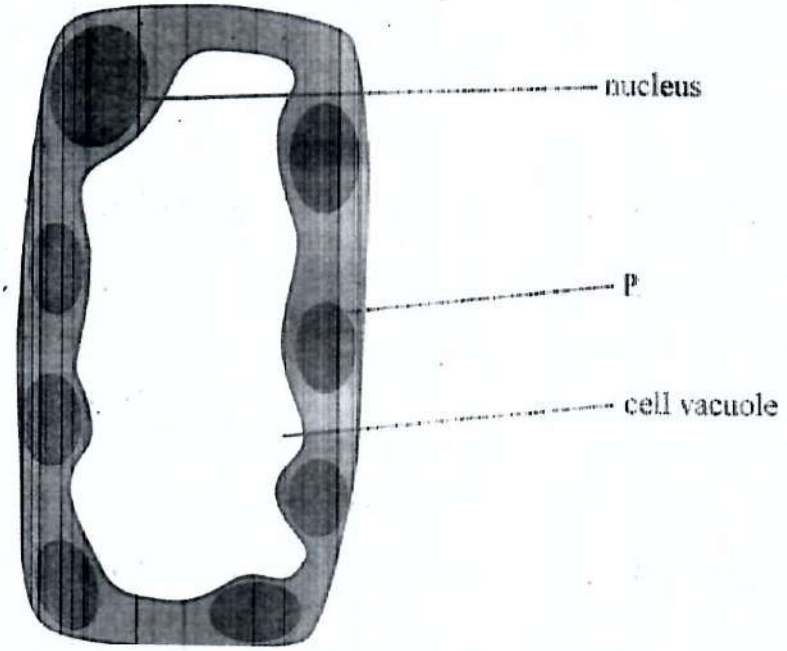


Fig. 1.1

(a) **(i)** Identify structure **P**.

_____ [1]

(ii) Explain how the palisade cell is adapted for its function.

[4]

(b) State any **two** nutrient deficiency diseases in humans.

[2]

2. **(a)** Name any **two** types of teeth and give one function for each.

[4]

(b) **(i)** Explain the importance of chemical digestion.

[2]

(ii) State the enzyme that converts starch to maltose in the mouth.

[1]

3. **Fig.3.1** shows the electrolytic cell used for the electrolysis of molten lead bromide.

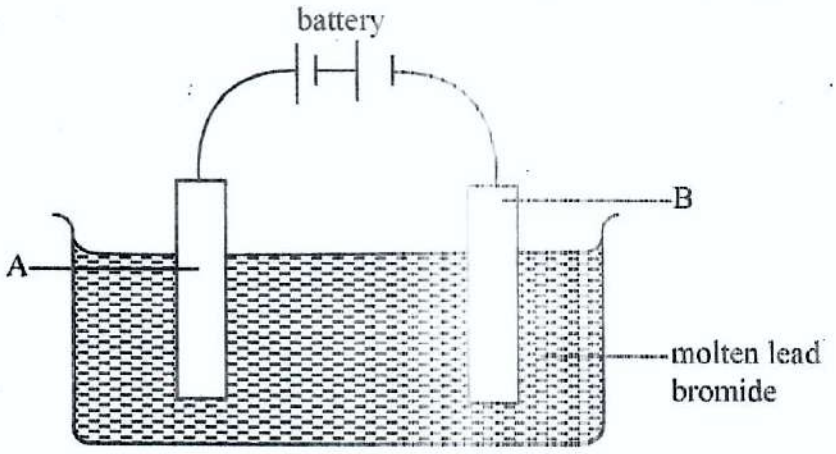


Fig.3.1

(a) Define the term *electrolysis*.

[2]

(b) **(i)** State the name given to electrode **A**.

[1]

(ii) Name the product formed at electrode **B**.

[1]

(iii) Write an equation for the reaction which occurs at **B**.

[2]

4. **Fig.4.1** shows a method used to completely neutralise sodium hydroxide solution, $NaOH_{(aq)}$.

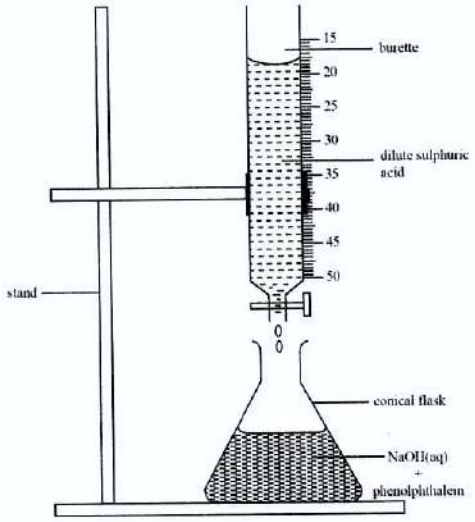


Fig.4.1

(a) Name the method shown in **Fig.4.1**

[1]

(b) Explain why the phenolphthalein indicator is added.

[2]

(c) Complete and balance the chemical equation for the reaction between sodium hydroxide and sulphuric acid.

$$2NaOH \quad + \quad H_2SO_4 \quad \rightarrow$$

[3]

(d) Calculate the molecular mass of NaOH.

[1]

5. **(a)** State Ohm's law and give any **one** limitation to the law.

Ohm's law _____

_____

Limitation _____

_____

[2]

(b) **Fig.5.1** shows an electric circuit with three resistors, $\mathbf{R}_1$ which is 2 Ω, $\mathbf{R}_2$ which is 2Ω and $\mathbf{R}_3$ which is 6 Ω.

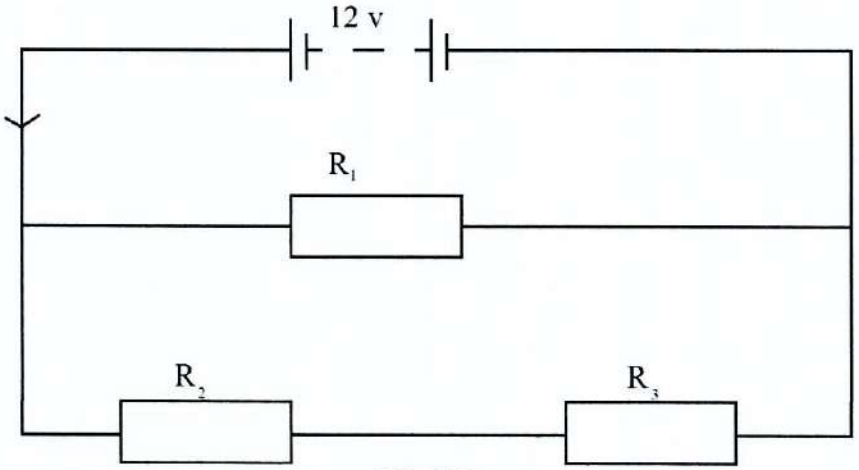


Fig.5.1

(i) State the way in which $\mathbf{R}_1$ is connected in relation to $\mathbf{R}_2$ and $\mathbf{R}_3$.

[1]

(ii) Calculate the total current, I, in the circuit.

[3]

6. (a) **Fig.6.1** shows a water pump.

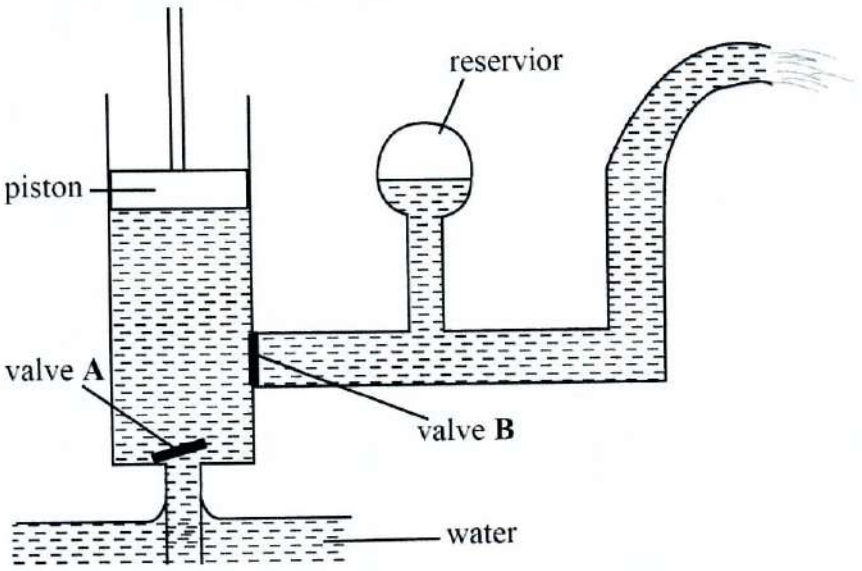


Fig.6.1

(i) Name the type of the water pump shown in **Fig.6.1**.

[1]

(ii) Outline what happens during the upward stroke.

[3]

(b) **Fig.6.2** is a pie chart showing people using a particular source of energy.

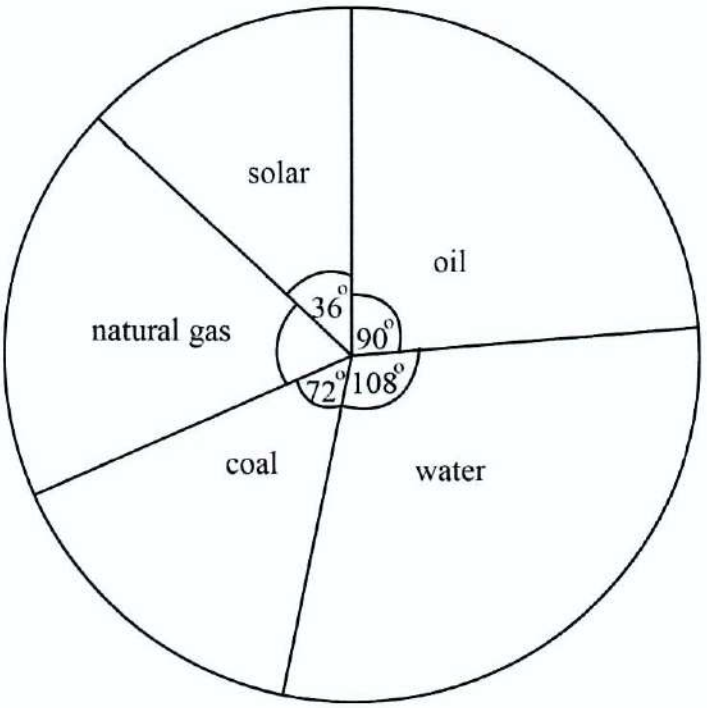


Fig.6.2

(i) Identify the energy source which is most widely used.

[1]

(ii) Calculate the percentage of people using natural gas.

[2]

Section B

*Answer any **two** questions. Write your answers in the spaces provided on the question paper.*

7. **(a)** Define the term *pollination.*

[2]

(b) Explain the importance of coloured petals, sticky pollen grains and enclosed anthers of an insect pollinated flower.

[4]

(c) **(i)** State any **two** conditions necessary for germination.

[2]

(ii) State any **two** advantages of reproducing plants using seeds over vegetative propagation.

[2]

8. (a) **Fig. 8.1** shows a sperm.

Fig. 8.1

(i) Explain how the structure of the sperm is related to its function.

[4]

(ii) Suggest why sperms need to be produced in large numbers compared to female gametes.

[1]

(b) (i) State any **two** phases of the human menstrual cycle.

[2]

(ii) State the part of the female reproductive system where implantation of the fertilised ovum takes place.

[1]

(iii) Name any **two** substances which move from the mother to the foetus through the placenta.

[2]

9. **(a)** **Fig.9.1** shows a food web in an ecosystem.

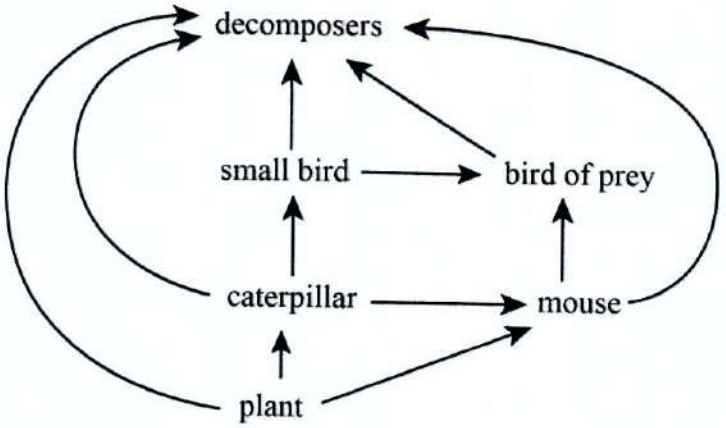


Fig.9.1

(i) State what is represented by arrows between organisms.

[1]

(ii) State the organism that feeds on all other organisms in the web.

[1]

(iii) State, with reasons, an organism in the web which could exist in small numbers.

[3]

(b) Explain how a food web is a better representation of what happens in an ecosystem than a food chain.

[1]

(c) State any **two** activities of man that can be harmful to an ecosystem.

[2]

(d) Give any **two** factors that reduce the rate of transpiration.

[2]

Section C

Answer any **two** questions. Write your answers in the spaces provided on the question paper.

10. **(a)** **(i)** Define the term *hydrocarbon*.

[1]

(ii) Name any **one** homologous series under hydrocarbons.

[1]

(iii) From the homologous series named in **(ii)**, name the hydrocarbon with three carbon atoms.

[1]

(iv) Draw the displayed formula of the hydrocarbon named in **(iii)**.

[1]

(b) Biogas is a renewable fuel obtained from organic wastes.

(i) Describe how biogas is produced.

[3]

(ii) State the **three** conditions needed for optimum production of biogas.

[3]

11. Nitrogen and hydrogen gases were compressed in the reaction chamber at a temperature of 450 °C–500 °C to produce ammonia.

(a) Describe what would happen to the yield of ammonia if the temperature of the reaction chamber was raised to 800 °C.

[2]

(b) State **two** optimum conditions for the Haber process other than temperature.

_____

_____

[2]

(c) Explain why ammonia and other gases are recycled into the reaction chamber.

_____

[1]

(d) State any **two** industrial uses of ammonia.

_____

_____

[2]

(e) Calculate the number of moles in 56 dm^3 of ammonia.

[3]

12. (a) **Fig.12.1** shows how the volume of gas **X** varied with time as a 2 cm piece of magnesium ribbon reacted with dilute hydrochloric acid (HC*l*).

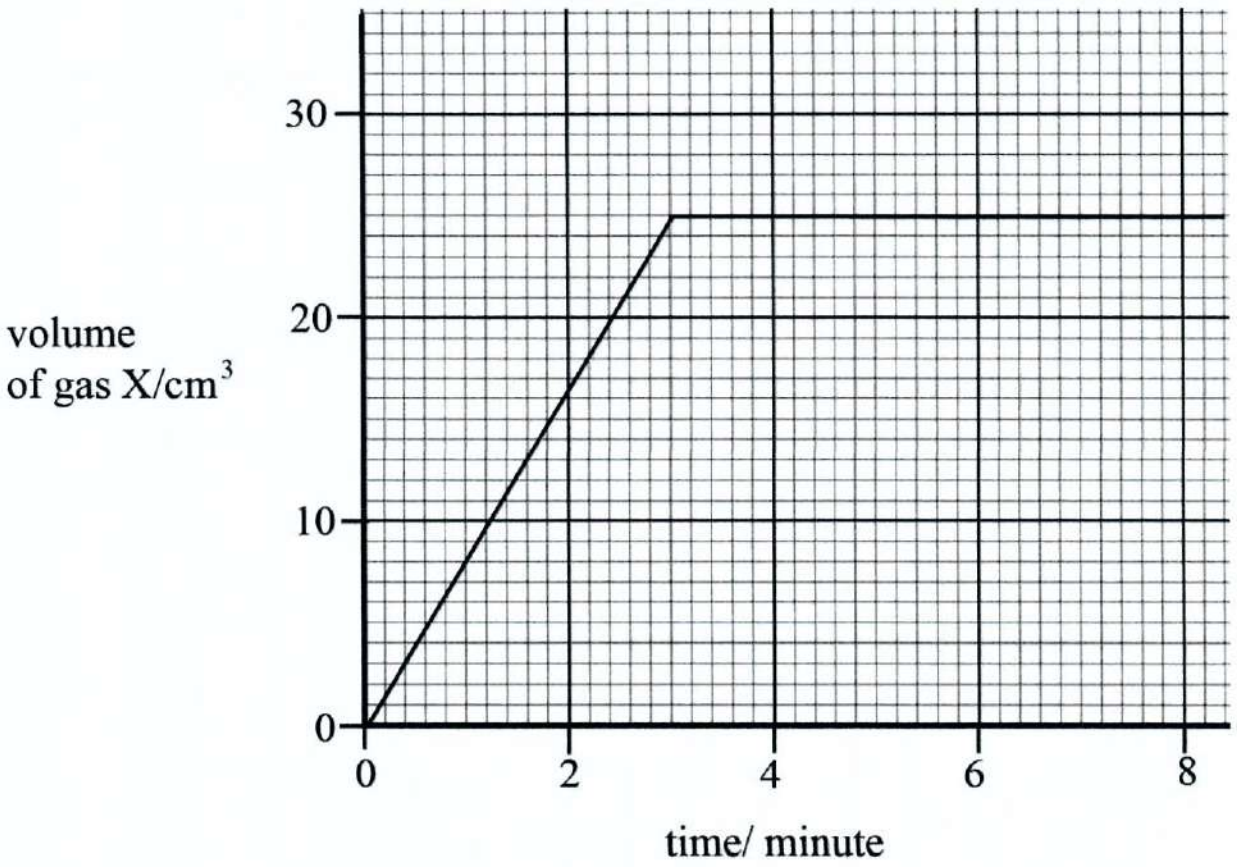


Fig.12.1

(i) Name gas **X**.

[1]

(ii) From the graph, deduce the maximum volume of gas **X** produced at the end of the reaction.

[1]

(iii) Determine the time taken for the reaction to get to completion.

[1]

(iv) Describe the effect of using magnesium powder instead of the magnesium ribbon to the rate of the reaction.

[2]

(v) State any **two** factors, other than surface area that would increase the rate of reaction.

[2]

(b) **(i)** State an industrial process that produces nitrogen.

[1]

(ii) State any **two** uses of nitrogen.

[2]

Section D

*Answer any **two** questions. Write your answers in the spaces provided on the question paper.*

13. **(a)** A diesel engine undergoes a four stroke cycle during its operation.

(i) Describe what happens during the intake stroke of the diesel engine.

[3]

(ii) Explain why the diesel engine does **not** have spark plugs.

[2]

(f) A hand feels hot when placed above an electric heater which is switched on.

(i) Describe how the heat reaches the hand.

[3]

(ii) Calculate the energy drawn by the electric heater if it is connected to 240 V mains supply and draws a current of 6 A for 1 minute.

[2]

14. **(a)** A direct current (d.c) motor is a device which converts electrical energy to kinetic energy.

(i) Describe how motion is produced in a d.c motor.

[3]

(ii) State any **two** factors that would affect the motion of the d.c motor.

[2]

(iii) State what would happen if the d.c power supply is replaced by alternating current (a.c).

[1]

(b) State any **three** precautions taken against lightning.

[3]

(c) Name a device which can be used to determine whether or not a glass rod is charged.

[1]

15. (a) **Fig.15.1** shows a 3-pin plug.

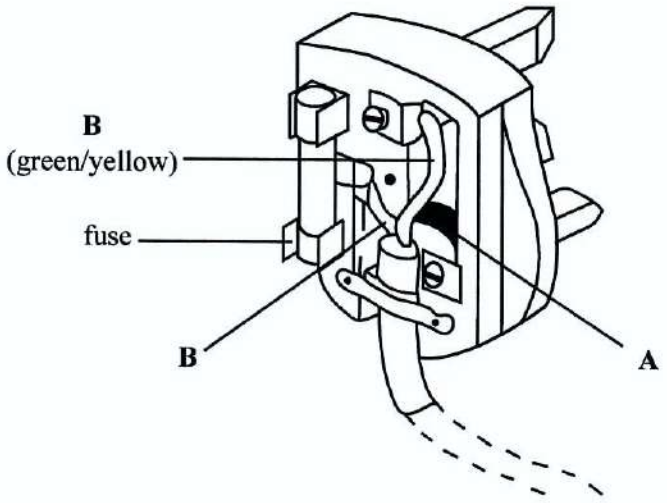


Fig.15.1

(i) State which of the labelled wires is the live wire.

[1]

(ii) State the colours of wires **A** and **C**.

A _____

C _____

[2]

(iii) State any **one** advantage and any **one** disadvantage of using photo voltaic cells as a source of electricity.

advantage

disadvantage

[2]

(iv) Explain how photo voltaic cells are used as a source of electrical power for appliances which use both alternating current and direct current.

[4]

(b) State any **one** use of electricity in the home.

[1]

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Ordinary Level

MARKING SCHEME

NOVEMBER 2018

1. **(a)** **(i)** chloroplast; [1]

Notes: In the palisade cell, the structures which are many and cylindrical are the chloroplasts

(ii) column shaped for exposure to sunlight
numerous chloroplasts for maximum absorption of light [4]

Notes: Adaptations should be linked to the increase in the manufacture of food

(b) kwashiorkor
goitre
rickets
scurvy
anaemia
night blindness any two [2]

2. **(a)**

canine	tearing,	gripping
incisor	cutting,	biting
premolar	crushing,	grinding/chewing
molar	crushing,	grinding/chewing

[4]

(b) **(i)** increases food solubility for absorption (into the blood stream) [2]

Notes: chemical digestion breaks down insoluble food particles into soluble food molecules which can be absorbed into the bloodstream

(ii) salivary amylase [1]

Notes: amylase alone will be rejected because there are two types of amylases which are the salivary amylase found in the mouth and the pancreatic amylase released by the pancreas

3. **(a)** **(i)** a chemical change caused by passing an electric current through an electrolyte
or electrical decomposition of an electrolyte/breaking down of a compound using electricity [2]

(b) **(i)** anode [1]

Notes: Electrode A is connected to the positive terminal of the cell so it is the anode. The candidates deduces this from the symbol of a cell/battery

(ii) lead [1]

Notes: Molten lead bromide has lead ions, Pb^{2+} and bromide ions, Br^- only. B is the cathode so Pb^{2+} ions are attracted to it and they gain electrons and are discharged as lead, Pb

(iii) $Pb^{2+} + 2e^- \rightarrow Pb$ or lead ions + electrons → lead [2]

Notes: A chemical equation should always be balanced

4. **(a)** titration [1]

Notes: answer is derived from the set up and the apparatus used

(b) to determine end-point by changing colour [2]

Notes: the indicator changes colour according to the acidity or alkalinity of the solution it is in. The Table gives the colour changes for methyl orange and phenolphthalein.

indicator	**colour in acidic conditions**	**colour in alkaline conditions**
methyl orange	red	yellow
phenolphthalein	colourless	pink

(c) $2\,NaOH_{(aq)} + H_2SO_{4(aq)} \rightarrow Na_2SO_{4(aq)} + 2\,H_2O_{(l)}$ [3]

Notes: the equation must have the correct chemical formulae for products and must be balanced. The reaction of an acid and a base gives a salt and water as products

(d) $23 + 1 + 16 = 40$ [1]

Notes: add the relative atomic masses of Na, O and H to get the molecular mass of NaOH

5. **(a)** the voltage across a conductor is directly proportional to the current passing through it
limitations: temperature is not constant and conductor is in a magnetic field [2]

Notes: resistance of electron flow in the circuit causes temperature to rise so temperature is never constant

(b) **(i)** parallel [1]

(ii) total resistance in series $= R_2 + R_3$

$= 2\Omega + 6\Omega$

$= 8\Omega$

total resistance in circuit $= \frac{Product}{sum}$

$= \frac{8\Omega \times 2\Omega}{8\Omega + 2\Omega}$

$= \frac{16}{10}$

$= \underline{1.6\,\Omega}$

$I = \frac{V}{R} = \frac{12\,V}{1.6\,\Omega} = \underline{7.5\,A}$ [3]

Notes: the formula for calculating current is I = V/R.
To calculate current given voltage and more than one resistor, first calculate resistance in series using the general formula: total resistance=$R_1 + R_2 + \ldots\ldots\ldots + R_n$

From the diagram, total resistance in series is calculated as follows:

total resistance in series = $R_2 + R_3$

substitute with values = $2\Omega + 6\Omega$

= 8Ω

The calculated total resistance in series is in parallel to R_1

Total resistance for the circuit is calculated by the following formula

$$\frac{\text{total resistance in series} \times R_1}{\text{total resistance in series} + R_1}$$

$$= \frac{8\ \Omega \times 2\ \Omega}{8\ \Omega + 2\ \Omega}$$

$$= \frac{16\ \Omega}{10\ \Omega}$$

$$= 1.6\ \Omega$$

$$I = V/R$$

$$= \frac{12\ V}{1.6\ \Omega}$$

$$= 7.5\ A$$

6. **(a)** **(i)** force pump [1]

(ii) piston moves up
volume in the barrel/cylinder increases/pressure decreases
valve A opens/valve B closes
water moves into the barrel
due to pressure difference [3]

Notes: valves on the pump act antagonistically i.e. when one valve is open the other one is closed

(b) **(i)** water [1]

Notes: to get the answer the candidate is required to study the pie chart and find the section that has the largest angle

(ii) Percentage of people using natural gas

Angle of natural gas = $360° - (108° + 90° + 72° + 36°)$
$= 360° - 306°$
$= 54°$

Percentage of people using natural gas = $\frac{54°}{360°} \times 100\%$
$= 15\%$ [2]

7. (a) transfer of pollen grains from anther to stigma [2]

(b) coloured petals attract insects which transfer pollen grains
sticky pollen grains stick to the insect and are transferred to other flowers
enclosed anthers brushes with insect to transfer pollen grains to the insect [4]

(c) (i) moisture/water
warmth/suitable temperature
air/oxygen any two [2]

(ii) provides genetic variation
plants can be spaced
reduced competition for resources
propagation can be in larger numbers [2]

8. (a) (i) tail helps it to swim in the female reproductive system
reduced cytoplasm reduce weight/for faster swimming
acrosome helps to penetrate the ovum;
nucleus at the front for quick entrance into the ovum
haploid nucleus to prevent doubling of chromosomes after fertilisation
mitochondria for energy
any two stated and explained [4]

(ii) some of the sperms die in the female reproductive system/increased chances of fertilisation [1]

(b) (i) menstrual/bleeding stage
ovum by FSH/ ovulation stage/ovulation/ follicular stage/development of follicle
luteal stage any two [2]

(ii) uterus [1]

(iii) dissolved food nutrients e.g. glucose/amino acids/mineral salts/ vitamins/water/fatty acids and glycerol
antibodies
oxygen
any two [2]

9. **(a)** **(i)** energy flow [1]

(ii) decomposers/fungi/bacteria [1]

(iii) bird of prey occupy highest trophic level
numbers decrease up trophic levels
due to loss of energy and nutrients [3]

(b) an organism depends on several sources of food in real life
this can only be shown on food webs and not in a food chain [1]

(c) use of pesticides/herbicides
poor farming methods
deforestation
waste disposal
industrial activities
any two correct activities [2]

(d) high humidity
low light intensity
reduced leaf surface/ fewer stomata
low wind speed
low temperature
any two [2]

10. **(a)** **(i)** compound of carbon and hydrogen only [1]

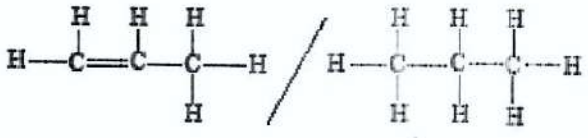
(ii) alkane or alkene [1]

(iii) propane or propene (iii) is linked to (ii) [1]

Notes: the candidate is required to know the general formula for alkanes and alkenes. See Table below

	alkane	name	alkene	name
general formula	C_nH_{2n+2}		C_nH_{2n}	
n = 1	CH_4	methane	-	-
n = 2	C_2H_6	ethane	C_2H_4	ethene
n = 3	C_3H_8	propane	C_3H_6	propene

(iv)



(iv) is linked to (iii) [1]

(b) **(i)** organic waste is fed into a closed pit
wastes mixed with water
bacteria ferment the organic waste [3]

(ii) optimum temperature of between 35–55°C
optimum pH/slightly acidic/slightly alkaline
no air/no oxygen needed [3]

11. **(a)** yield of ammonia decreases since higher temperature cause decomposition of ammonia [2]

(b) catalyst/powdered iron
200–300 atmospheres [2]

(c) returns unreacted gases/nitrogen and hydrogen for further reaction [1]

(d) making fertilisers, making household cleaners, purification of water, used as a refrigerant any two [2]

(e) Number of moles (n) = Volume /molar gas volume
$= 56\ dm^3/28\ dm^3$
$= 2$ moles [3]

12. **(a)** **(i)** hydrogen [1]

Notes: The reaction is between a n acid and a metal so a salt and hydrogen gas are the products

(ii) $25\ cm^3$ [1]

(iii) 3 minutes [1]

Notes: This is the place where the graph levels off and hydrogen is no longer produced

(iv) surface area increases so rate of reaction increases [2]

(v) increase in temperature of HCl
increase in concentration of HCl
using a catalyst any two [2]

(b) **(i)** fractional distillation of liquid air [1]

(ii) production of ammonia
preservation of sperms/production of ammonia/synthesis of protein/freezing vegetables/medical uses/electric bulbs [2]

13. **(a)** **(i)** piston moves down
volume in cylinder increase/pressure decreases
inlet valve open
exhaust valve closed
air enters into cylinder any three [3]

(ii) has a high compression ratio
high pressure ignites diesel-air mixture [2]

(b) **(i)** heat travels by convection as air above heater gains kinetic energy and expands. The air becomes less dense and rises
or heat travels through radiation as heat waves move through space [3]

(ii) $E = VIt$
$= 240 \times 6 \times 60$
$= 86\,400$ J;

Notes: an answer with a wrong or no unit is not awarded a mark [2]

14. **(a)** **(i)** wire carrying current has a magnetic field around it
permanent magnets of a d.c motor also have a magnetic field
the interaction between the two magnetic fields causes the coil to rotate [3]

(ii) strength of magnets
number of turns in coil
magnitude of current any two [2]

(iii) no rotation [1]

(b) avoid contact with metallic objects
avoid being the tallest object
do not shelter under lone trees
do not bath or swim [3]

Notes: colour of clothing does not put anyone at risk of being struck by lightning, it is a myth

(c) gold leaf electroscope [1]

15. **(a)** **(i)** C

Notes: The live wire is the one connected to the fuse [1]

(ii) A: blue;
C: brown; [2]

Notes: candidates are required to use blue for neutral, brown for live and yellow and green for earth

(iii) an advantage is that they are renewable/clean/low cost
a disadvantage is that they many cells need to be connected together to produce enough power/only work when there is enough light intensity [2]

(iv) they convert light/solar energy to electrical energy stored in a battery
generates direct current and use invertors to transform d.c to a.c [4]

(b) lighting/powering electrical appliances [1]

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Ordinary Level

COMBINED SCIENCE 4003/3

PAPER 3 (Practical Test)

NOVEMBER 2018 SESSION 1 hour 30 minutes

Candidates answer on the question paper

Additional materials:
As listed in instructions to Supervisors
Calculator (optional)

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **both** questions.

Write your answers in the spaces provided on the question paper.

Use a sharp pencil for your drawings. Coloured pencils or crayons should not be used.

You should record all experimental results and show the essential steps in any calculation in the spaces provided in the question paper.

INFORMATION FOR CANDIDATES

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

FOR EXAMINER'S USE	
1	
2	
TOTAL	

Answer all questions.

1. You are required to determine the pH of three liquids, A1, A2 and A3.
You are provided with the three liquids in test tubes labelled A1, A2 and A3, universal indicator solution, a universal indicator chart and a dropper.

(a) **(i)** Add 2 drops of universal indicator solution to each of the liquids A1, A2 and A3. Record the colour and pH of each of the liquids in **Table 1.1**.

Table 1.1

liquid	**colour after adding universal indicator solution**	**pH**	**acid-base nature of liquid**
A1			
A2			
A3			

[12]

(ii) State the colour of the universal indicator solution.

..... **[1]**

(b) Apart from using universal indicator solution or universal indicator paper, describe another way of determining the acid-base nature of liquids A1, A2 and A3, stating the expected results for each of the liquids.

A1.....
.....
A2.....
.....
A3.....
.... **[5]**

(c) **(i)** State any **one** precaution that should be taken during the experiment.

.....
..... **[1]**

(ii) State **one** possible source of error in the experiment.

.....
..... **[1]**

2. You are required to compare the densities of water and cooking oil.
You are provided with water and cooking oil, 2 beakers labelled **A** and **B**, a measuring cylinder and access to a balance.

Measure the mass of the empty beaker labelled **A** and record the mass in **Table 2.1** under the column labelled **for water**.

Measure 20.0 cm^3 of water and pour it into beaker **A.**
Record the mass of the water and the beaker in the table of results.
Calculate the mass of the water and record it in the table of results. Repeat the procedure using beaker **B** and cooking oil instead of water.

Table 2.1

mass of beaker + contents/g	**for water**	**for cooking oil**
mass of empty beaker/g		
mass of contents/g		

[12]

(b) **(i)** Calculate the density of the water.

..... **[2]**

(ii) Calculate the density of the cooking oil.

..... **[2]**

(c) Mix about 5 cm^3 of water and about 5 cm^3 of cooking oil in a test tube.
State, giving a reason, the liquid that oats.

.....
.....
.....**[2]**

(d) **(i)** State **one** source of error in the experiment.

..... **[1]**

(ii) Suggest **one** way of improving the experiment.

..... **[1]**

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Ordinary Level

MARKING SCHEME

NOVEMBER 2018

COMBINED SCIENCE 4003/03

Identities of solutions: A1 is water A2 is vinegar A3 is sodium hydroxide solution

1 (a) (i)

liquid	colour after adding universal indicator	pH	acid-base nature if liquid
A1	Green	7	neutral
A2	Yellow	6	(weak) acid
A3	Purple	14	(strong) base

accuracy - 3 marks
pH values are compared to the supervisor's results and 1 mark is deducted for a 0.5 deviation

NB: Answers in the table are general so the supervisor's results are used
To award accuracy marks [12]

(ii) green [1]

(b) red litmus paper and blue litmus paper are used

A1: no effect on both red and blue litmus paper

A2: turns blue litmus paper red (and no effect on red litmus paper)

A3: turns red litmus paper blue (and no effect on blue litmus paper) [5]

(c) (i) handling liquids with care/ putting on gloves/protective clothing [1]

(ii) colour blindness [1]

2 (a) marks are awarded as follows:

1 mark for each mass recorded in **Table 2.1** [6]

1 mark for all masses recorded to at least 1 decimal place [1]

accuracy marks are awarded as shown in the Table below

deviations from supervisor's results	mass of water	mass of cooking oil
no deviation	2	3
± 0.5 deviation	1	2
± 1.0 deviation	0	1
> ± 1.0deviation	0	0

[5]

(b) **(i)** density = mass ÷ volume / correct substitution should be given from the experimental results
answer should have g/cm^3 as unit [2]

(ii) density = mass ÷ volume / correct substitution
answer should have g/cm^3 as unit [2]

(c) cooking oil
less dense than cooking oil/using calculated values for the justification [2]

(d) **(i)** zero error
or parallax error [1]

(ii) zero the balance
or read volume of water or cooking oil from the meniscus/ at eye level/ from a flat surface [1]

NB: link improvement to error mentioned in **(d)(i)**

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Ordinary Level

COMBINED SCIENCE 4003/1

PAPER 1 Multiple Choice

JUNE 2019 SESSION 1 hour

Additional materials:
Multiple Choice answer sheet
Soft clean eraser
Soft pencil (type B or HB is recommended.)
Calculator (Optional)

INSTRUCTIONS TO CANDIDATES

Do **not** open this booklet until you are told to do so.
Write your name, centre number and candidate number on the answer sheet in the spaces provided unless this has already been done for you.
Read very carefully the instructions on the answer sheet.

INFORMATION FOR CANDIDATES

Each correct answer will score **one** mark. A mark will **not** be deducted for a wrong answer.
Any rough working should be done in this booklet.

There are **forty** questions in this paper. Answer **all** questions. For each question, there are four possible answers, **A**, **B**, **C** and **D**. Choose the one you consider correct and record your choice in soft pencil on the separate answer sheet provided.

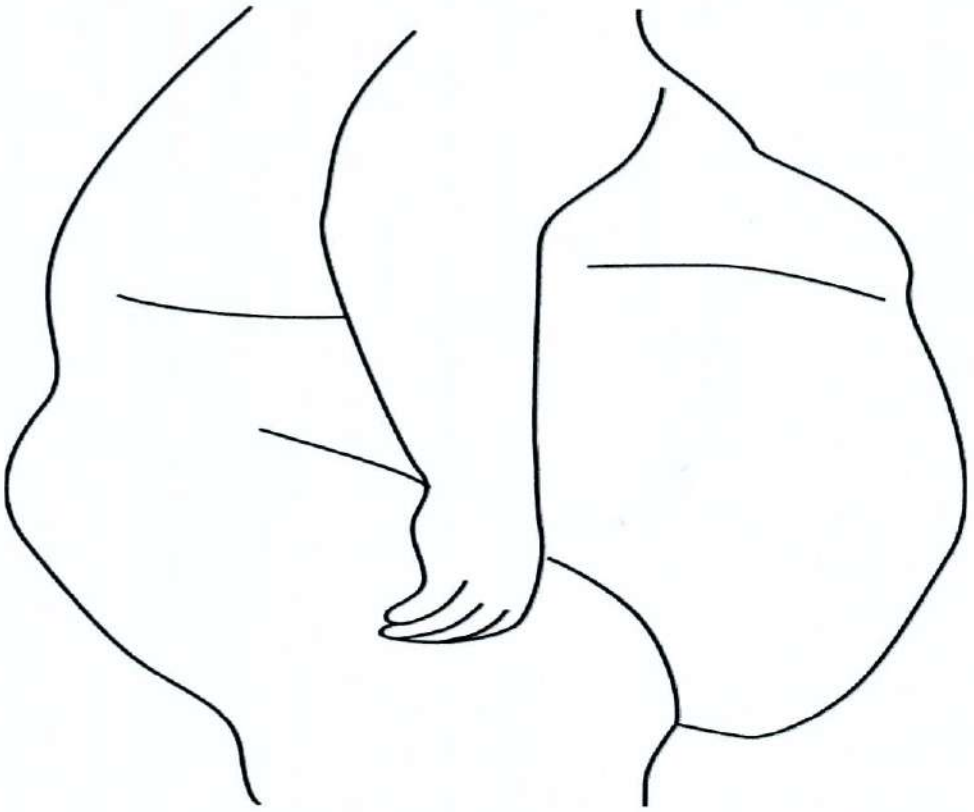
1 Which nutrient provides energy?

A carbohydrate
B vitamin C
C fibre
D iron

2 What is the function of the gall bladder?

A stores bile
B stores urine
C produces bile
D produces urea

3 The photograph shows a condition due to malnutrition.



What is the name of the condition?

A obesity
B diabetes
C kwashiorkor
D anorexia nervosa

4 Benedict's solution was added to a food sample. The mixture was heated. A brick-red colour was observed.

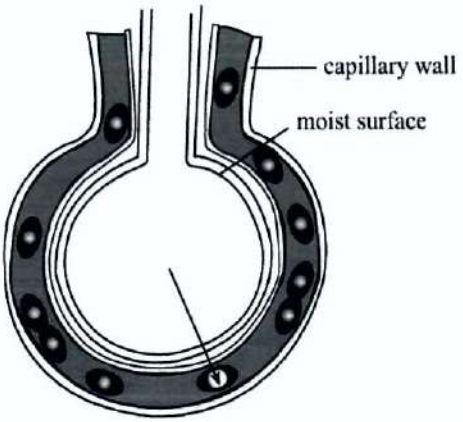
Which food component was present?

A fat
B starch
C protein
D glucose

5 During anaerobic respiration,

A oxygen is used.
B alcohol is produced.
C lactic acid is produced in plant cells.
D a large amount of energy is released.

6 The diagram shows the structure of an alveolus.

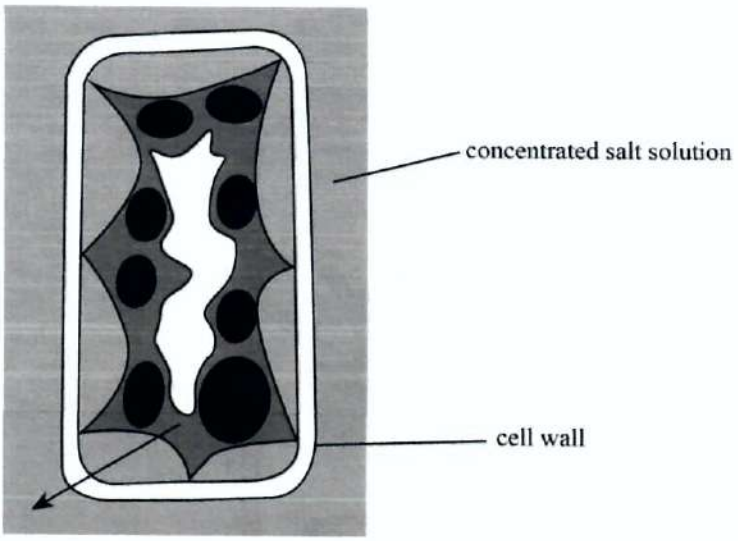


Which gas moves in the direction of the arrow?

A carbon monoxide
B carbon dioxide
C nitrogen
D oxygen

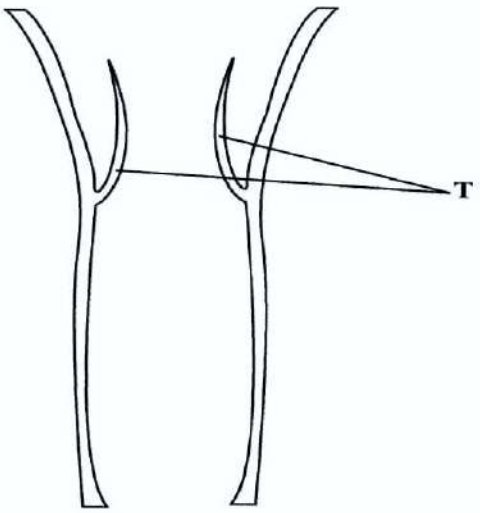
7 The diagram shows a plant cell after it has been placed in a concentrated salt solution.

Which substance moves in the direction of the arrow?



A salt
B ions
C water
D cytoplasm

8 The diagram shows the internal section of a blood vessel.

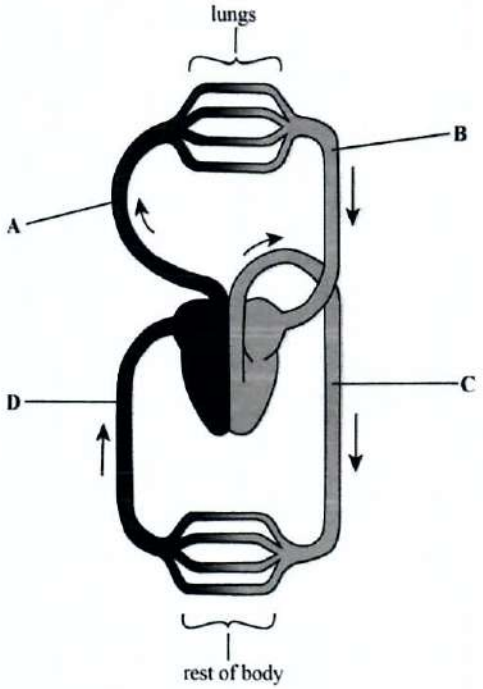


What is the function of T?

A to increase blood flow towards the heart
B to increase the lumen of the blood vessel
C to push blood towards the heart
D to prevent back flow of blood

9 The diagram shows the human circulatory system.

Which blood vessel, **A**, **B**, **C** or **D**, has blood under highest pressure?



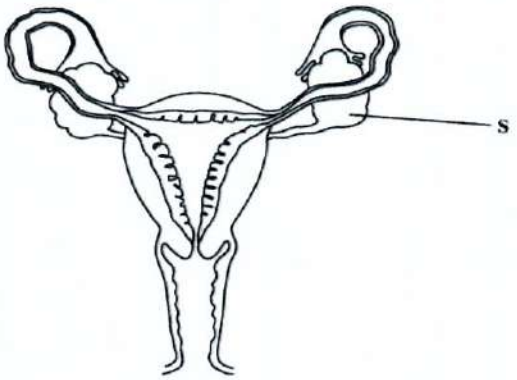
10 A woman starts her menstrual flow on the 2nd of April. When is she expected to ovulate?

A 7 April
B 12 April
C 16 April
D 2 May

11 Which part of the male reproductive system stores sperms?

A prostate gland
B sperm duct
C epididymis
D testis

12 The diagram shows the reproductive system of a woman.



What is part **S**?

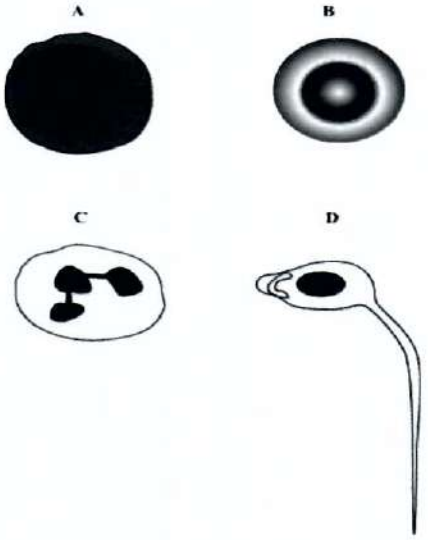
A cervix
B ovary
C uterus
D oviduct

13 Which disease is spread by drinking contaminated water?

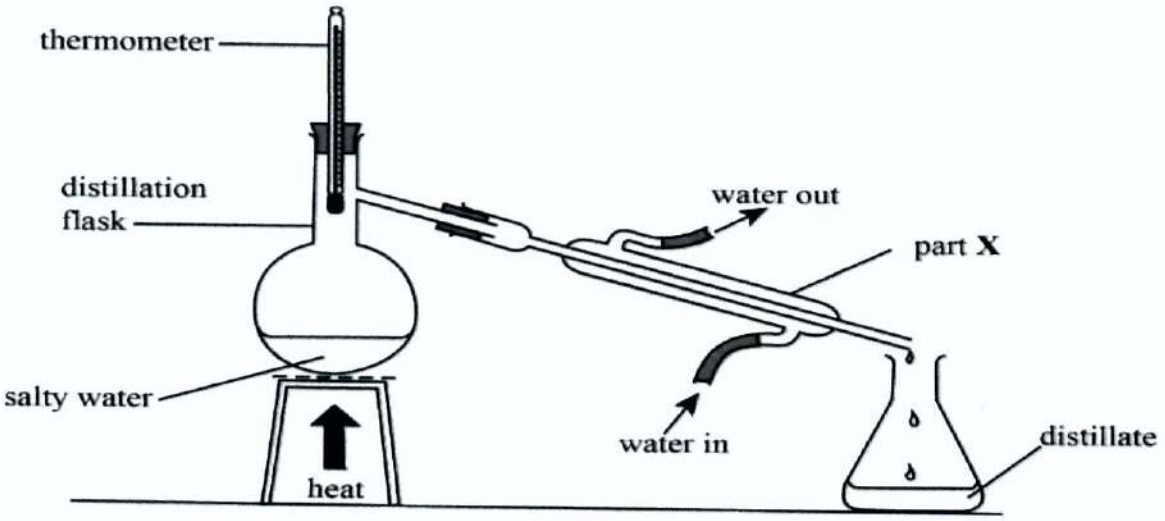
A ebola
B typhoid
C malaria
D chancroid

14 The diagram shows some specialised human cells.

Which cell, **A**, **B**, **C** or **D**, is the target of HIV?



15 The diagram shows a simple distillation apparatus.



What happens in part X?

A the distillate is warmed
B vapour is converted to liquid
C vapour is directed into the container
D salt and the distillate are separated

16 Element X has an electronic configuration of 2, 8, 2.

What is the charge of an ion of **X**?

A X^{2+}
B X^{2-}
C X^{6+}
D X^{6-}

17 Which statement is true about the atom $^{37}_{17}X$?

A It has 37 neutrons.
B It has 37 protons.
C It has 20 protons.
D It has 20 neutrons.

18 Which formula is used to calculate the concentration of a solution?

A number of moles X volume
B mass X volume
C $\frac{\text{number of moles}}{\text{volume}}$
D $\frac{\text{volume}}{\text{mass}}$

19 Which **one** is a property of a molten ionic compound?

A It is an electrolyte.
B It is insoluble in water.
C It has a low melting point.
D It is a non conductor of electricity.

20 Chlorine gas is used in

A food preservation.
B electric light bulbs.
C soap making.
D water purification.

21 The reaction between sodium hydroxide and hydrochloric acid produces a salt and

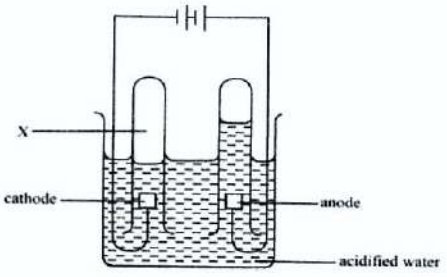
A water.
B a base.
C an acid.
D hydrogen.

22 Iron, copper, zinc and magnesium are all metals.

Which **one** is the least reactive?

A magnesium
B copper
C zinc
D iron

23 The diagram shows the electrolysis of water.



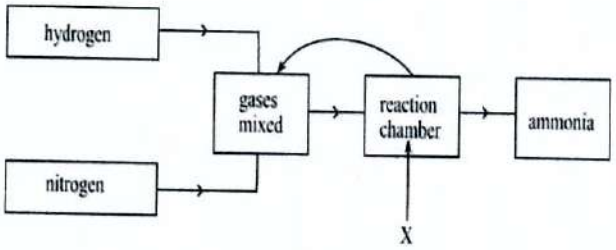
What is gas X?

A oxygen
B chlorine
C nitrogen
D hydrogen

24 Which process is prevented by galvanising?

A decomposition
B neutralisation
C reduction
D rusting

25 The diagram shows stages in the manufacture of ammonia.



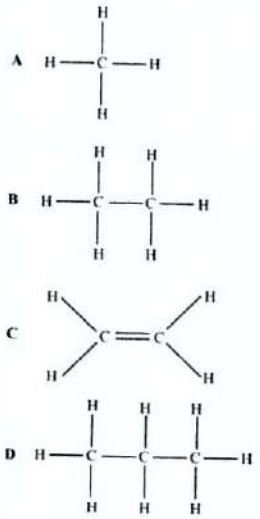
What is the pressure required at X?

A 8 – 10 atm
B 100 – 150 atm
C 200 – 300 atm
D 450 – 500 atm

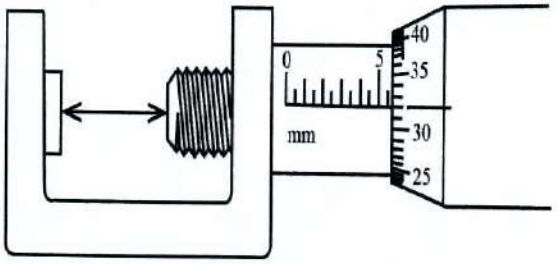
26 Iron is extracted from its ore in the blast furnace by the process of

A oxidation.
B reduction.
C electrolysis.
D neutralisation.

27 Which one is the correct structural formula of ethane?



28 What is the reading shown by the micrometer screw gauge?



A 5.50 mm
B 5.32 mm
C 5.82 mm
D 6.32 mm

29 What is the unit of force?

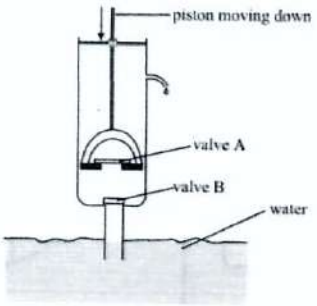
A watt
B joule
C ampere
D newton

30 A load of 900 N is raised 1 m by an effort of 300 N along an inclined plane. The inclined plane is 4 m long.

What is the efficiency of the inclined plane?

A 25%
B 33%
C 67%
D 75%

31 The diagram shows a lift pump.



What happens to the valves during the downward stroke? 4003/1 J2019

A valve A opens, valve B closes
B valve B opens, valve A closes
C valves A and B open
D valves A and B close

32 Solids transfer heat by

A convection.
B absorption.
C conduction.
D radiation.

33 The tubes inside solar heating panels use the sun's heat energy to warm water.

Why are the tubes painted black?

A The black colour is a bad emitter of heat.
B The black colour is a bad conductor of heat.
C The black colour is a good absorber of heat.
D The black colour is a good reflector of heat.

34 Which energy conversion takes place in a thermal power generator?

A chemical $\longrightarrow$ kinetic $\longrightarrow$ electrical
B chemical $\longrightarrow$ heat $\longrightarrow$ kinetic $\longrightarrow$ electrical
C gravitational potential $\longrightarrow$ kinetic $\longrightarrow$ electrical
D gravitational potential $\longrightarrow$ heat $\longrightarrow$ kinetic $\longrightarrow$ electrical

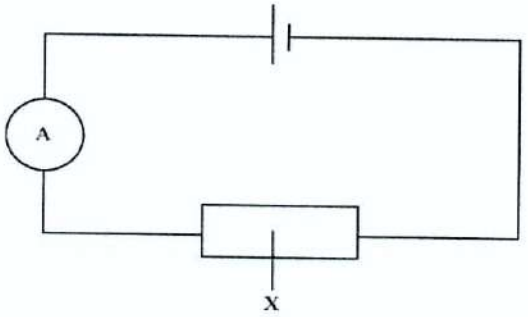
35 The speed of an electric motor can be increased by

A using a thinner wire.
B reducing the size of current.
C increasing the number of turns on the coil.
D reversing the direction of the magnetic field.

36 Messages are sent through cellphones in the form of

A heat waves.
B longitudinal waves.
C electrostatic waves.
D electromagnetic waves.

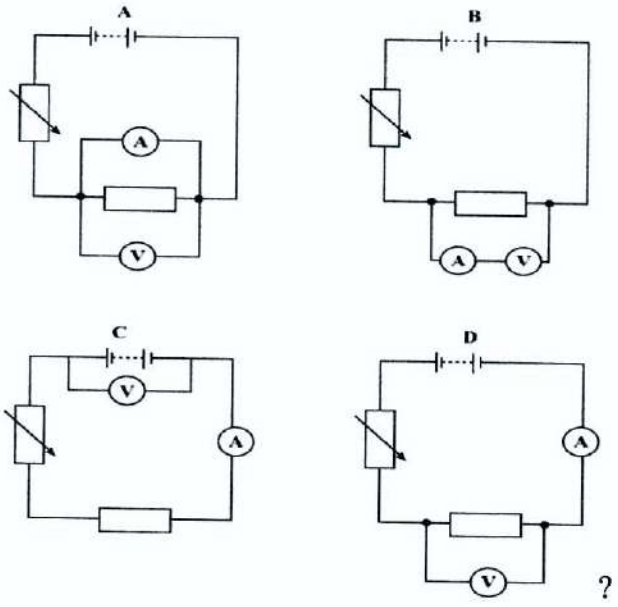
37 The diagram shows an electric circuit.



What is component X?

A fuse
B switch
C resistor
D ammeter

38 Which circuit, **A**, **B**, **C** or **D**, is used to verify Ohm's law



?

39 What is the power of a lamp rated 12 V, 2 A?

A 24 W
B 14 W
C 10 W
D 6W

40 What might cause an electric shock?

A touching electrical appliances with wet hands
B overheating of cables for various reasons
C using thick electrical wires
D connecting an earth wire

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Ordinary Level

COMBINED SCIENCE: 4003/1

MARKING SCHEME : JUNE 2019

1	A	21	A
2	A	22	B
3	A	23	D
4	D	24	D
5	B	25	C
6	D	26	B
7	C	27	B
8	D	28	C
9	C	29	D
10	C	30	D
11	C	31	A
12	B	32	C
13	B	33	C
14	A	34	B
15	B	35	C
16	A	36	D
17	D	37	C
18	C	38	D
19	A	39	A
20	D	40	A

REVISION NOTES FOR 4003/01

1. Carbohydrates are energy rich foods that are largely made up of starch and sugars.
2. Bile is made by the liver and stored in the gall bladder.
3. Obesity is caused by high intake of carbohydrates which result in the excess being stored as fat under the skin.
4. Glucose is a reducing sugar which is tested by using the Benedict solution. The solution turns from blue→ green→ yellow→ brick red depending on the concentration.

   Fats are tested using the emulsion test where alcohol is mixed with the food sample and water is poured into the mixture or the translucent test where the food sample leaves a transparent mark on a filter paper.

   Proteins are tested using the Biuret test where a mixture of potassium hydroxide/sodium hydroxide and copper sulphate is added to the food sample. The Biuret solution changes from blue to purple.

   Starch is tested using iodine solution. Drops of iodine solution are added to a food sample and the iodine solution changes from brown to blue-black.
5. Anaerobic respiration takes place in the absence of oxygen. In plants, it results in the formation of alcohol and carbon dioxide. In animals, it results in the formation of lactic acid. Low energy is released during anaerobic respiration.
6. Oxygen diffuses from its region of higher concentration which is the alveolus to its region of lower concentration which is the red blood cells. Carbon dioxide diffuses from cells to the alveolus.
7. Water moves by osmosis from a region of its higher concentration, that is, from the cell to a region of its lower concentration (into the concentrated salt solution).
8. The internal cross section of the vein shows the presence of valves, T. Valves prevent the backflow of blood since the blood will be flowing at low pressure.
9. C is the aorta and it carries blood under very high pressure to reach all parts of the body.

   A is the pulmonary artery which carries deoxygenated blood from the heart to the lungs (short distance).

   B is the pulmonary vein which carries oxygenated blood from the lungs to the heart(short distance).

   D is the vena cava (a vein) which carries deoxygenated blood from the rest of the body to the heart and blood flow under low pressure.
10. Ovulation takes place 14 days from the first day of the menstrual cycle. Therefore 2 + 14 gives 16 April as the expected day of ovulation.

11. Sperms are stored in the epididymis.Prostate gland produces serminal fluid.

    Sperm duct is a passage for sperms from the epididymis to the urethra. The testis produces the sperms.

12. The ovary protects the ova as they mature within it.

13. Typhoid, cholera and dysentery are water borne diseases which are spread by drinking contaminated water. Ebola and chancroid are spread by contact. Malaria is spread by a vector.

14. HIV destroys lymphocytes. Lymphocytes are identified by a large nucleus.

    B is a red blood cell and has no nucleus.

    C is a phagocyte and has a loop shaped nucleus.

    D is a sperm cell and has a tail.

15. Part X is the condenser and it cools down the vapour and converts it into a liquid.

16. Element X has to lose 2 electrons to reach noble gas configuration hence it will have an excess of two protons compared to electrons, therefore a charge of +2 [X^{2+}].

17. The nuclide notation gives the mass number/relative atomic mass (37) and proton number (17). 37 is the total of protons and neutrons. 17 is the number of protons and it is equal to the number of electrons in an atom.

    number of neutrons = mass number – proton number/ 37 – 17 = 20.

18. Concentration no of moles/volume (mol/dm^3).

19. Ionic compounds can dissolve in water, conduct electricity and have high melting and boiling points.

20. Chlorine gas kills microorganisms found in water so it is used for water purification.

21. Sodium hydroxide is a base/alkali and hydrochloric acid is an acid and their reaction produces a salt and water.

    $NaOH_{(aq)} + HCl_{(aq)} \longrightarrow NaCl_{(aq)} + H_2O_{(l)}$

22. Copper is the least reactive as it does not react with dilute acids except with concentrated acids.

23. Ratio of reaction of hydrogen to oxygen is 2 : 1. Water (H_2O) is decomposed to give same ratio of gases by volume as indicated in the formula. From the diagram, the volume of gas X is double the volume of the gas produced at the anode. H_2O ionizes in acidic conditions to produce H^+ ions and OH^- ions. The H^+ ions are attracted to the cathode where they are discharged to form hydrogen gas. The OH^- ions are attracted to the anode where they are discharged as oxygen and water.

24. Iron rusts in the presence of water and oxygen. Galvanising is a process of coating iron objects with zinc. The coating covers iron so that it no longer reacts with water and oxygen thus the iron is protected from rusting.

25. Production of ammonia takes place at a pressure of 200-300 atm. Other conditions used are the presence of a catalyst (iron) and a temperature of 450 °C – 500 °C.

26. Carbon monoxide converts iron (III) oxide to iron. The process is called reduction because iron changes the oxidation state from +3 to 0.
27. Ethane is a hydrocarbon (an alkane), with 2 carbon atoms and single C-C bonds. Ethane has a general formula of C_nH_{2n+2}.
28. The reading on the sleeve scale is 5.5 mm and the reading on the thimble scale is 32×0.01 mm = 0.32 mm. Adding the two readings gives 5.82 mm.
29. The unit of force is a newton (N), a derived unit from F=ma.
30. Efficiency $= \frac{\text{load} \times \text{load distance}}{\text{effort} \times \text{effort distance}} \times 100\%$ **or**

$= \frac{900\ \text{N} \times 1\ \text{m}}{300\ \text{N} \times 4\ \text{m}} \times 100\%$

$= 75\%$

$\text{MA} = \frac{\text{load}}{\text{effort}} = \frac{900\ \text{N}}{300\ \text{N}} = 3$

$\text{VR} = \frac{\text{distance moved by effort}}{\text{distance moved by load}}$

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

$\%\ \text{efficiency} = \frac{\text{MA}}{\text{VR}} \times 100$

$= \frac{3}{4} \times 100$

$= 75\%$

31. During the downward stroke/downstroke, the piston moves down exerting pressure on valve B and forcing it to close. The volume between the piston and valve B decreases and the pressure of water increases forcing valve A to open.
32. Conduction: heat is transferred through solids by vibrations of particles.
33. Black surfaces are good absorbers of heat that is why the tubes are painted black.
34. Chemical energy (stored in coal) → heat energy (of steam)→kinetic energy(of rotating turbines) → electrical energy.
35. The speed of an electric motor can be increased by increasing the number of turns on the coil, increasing the strength of the magnet and using higher voltage.
36. Electromagnetic waves are waves that are created as a result of vibrations between an electric field and a magnetic field.
37. The symbol for a resistor is 
38. The voltmeter is always connected across a resistor and all other components are connected in series.
39. Power = Voltage X Current or P = VI

    = 12 V X 2 A

    = 24 W
40. Water is a good conductor of electricity so a person can get electric shock if he/she touches an electrical appliance with wet hands.

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Ordinary Level

COMBINED SCIENCE 4003/2

PAPER 2 Theory

JUNE 2019 SESSION 2 hours

Candidates answer on the question paper

Additional materials: Calculator (Optional)

Allow candidates 5 minutes to count pages before the examination.
This booklet should not be punched or stapled and pages should not be removed.

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces at the top.
Write your centre and candidate number in the boxes on the top right corner of every page of this paper.
Check if the booklet has all the pages and ask the invigilator for a replacement if there are duplicate or missing pages.
Write your answers in the spaces provided on the question paper.

Section A
Answer **all** questions.

Section B
Answer any **two** questions.

Section C
Answer any **two** questions.

Section D
Answer any **two** questions.

INFORMATION FOR CANDIDATES

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

Answer all questions in this section in the spaces provided on the question paper.

1. **(a)** State any **two** differences between the structure of an insect pollinated flower and a wind pollinated flower.

1.....

.....

2.....

..... [2]

(b) **(i)** During photosynthesis, carbon dioxide and **X** react to produce glucose and oxygen.

Name the reactant **X.**

..... [1]

(ii) State any **one** condition needed for photosynthesis to take place.

..... [1]

(iii) Describe what happens to the glucose after its production.

.....
.....
.....
..... [2]

2. **(a)** State any **two** differences between sexual and asexual reproduction.

1.....
.....
2.....
..... [2]

(b) **(i)** Distinguish between passive and active immunity.

.....
.....
..... [2]

(ii) Explain the term *natural immunity*.

.....
....
..... [2]

(c) Name the organism which causes malaria.

..... [1]

3. **(a)** Methane is an alkane.

(i) Name the **two** elements found in methane.

1.....

2..... [2]

(ii) State the type of bond formed between the elements named in **(i)**.

..... [1]

(iii) Draw a dot and cross diagram to show the bonding in methane.

[2]

(b) Explain why alkenes are more reactive than alkanes.

.....

.....

..... [1]

4. Iron is produced in the blast furnace.

(a) Write the chemical formulae of any two raw materials which are fed into the blast furnace.

[2]

(b) Stainless steel is an alloy of iron and two other metals.

(i) State the other **two** metals in stainless steel.

1.....
2..... [2]

(ii) State **one** property of stainless steel and relate it to the use of stainless steel.

property.....
use.....
..... [2]

(c) State **one** way of protecting iron from rusting other than alloying it.

..... [1]

5. **(a)** **Fig.5.1** shows a current carrying conductor.

Draw, on **Fig.5.1**, the magnetic field lines around the conductor.

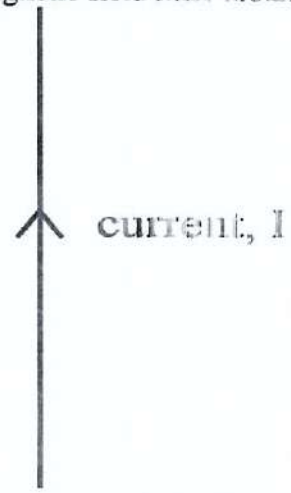


Fig.5.1

[2]

(b) The current carrying conductor is then placed between two magnets and connected to a circuit as shown in **Fig.5.2**.

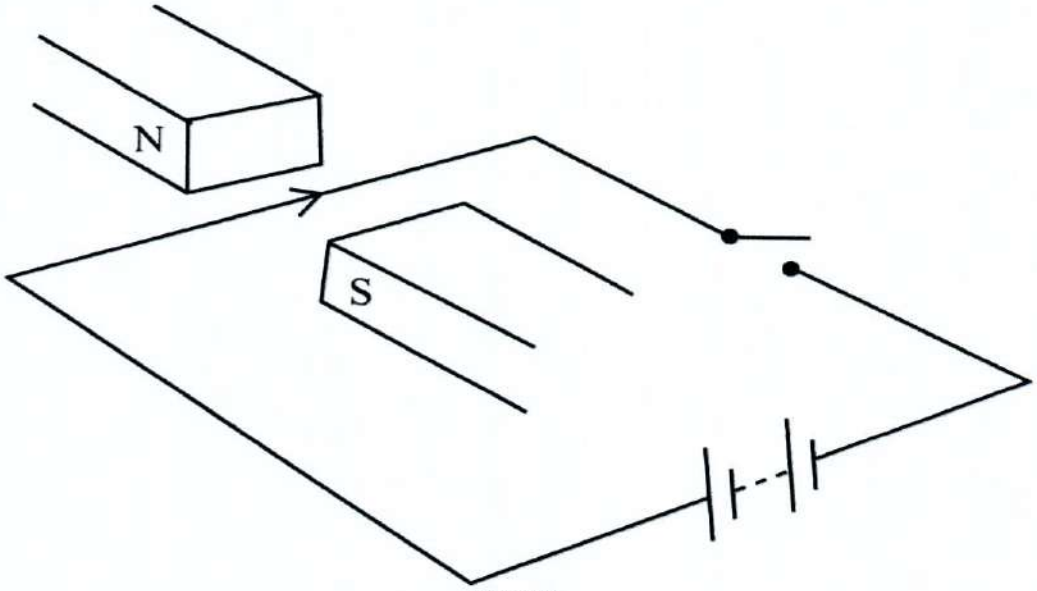


Fig.5.2

(i) State, with a reason, what happens when the

1. switch is closed, ...
.....
.....

2. battery terminals are reversed and switch is closed.

..... [4]

(ii) Give **one** application of the principle illustrated in **Fig.5.2**.

..... [1]

6. **(a)** A box measuring 0.3 m wide, 0.5 m long and 0.6 m high has a weight of 20 N. The box rests on a table.

(i) Define the terms *weight* and *pressure*.

weight.....
.....
pressure.....
..... [2]

(ii) Calculate the pressure exerted by the box when it rests on the 0.5 m and 0.6 m face.

[2]

(iii) Explain how the pressure calculated in **(ii)** compares with the pressure exerted when the same box rests on the 0.3 m by 0.5 m face.

.....

.....

.....

..... [2]

(b) Name the instrument used to measure fluid pressure.

..... [1]

Section B

*Answer any **two** questions. Write your answers in the spaces provided on the question paper.*

7. **(a)** **(i)** State any **two** sexually transmitted infections.

1.....

2..... [2]

(ii) Give the causative agent for each sexually transmitted infection named in **(i).**

.....

.....

..... [2]

(b) Describe and explain how cholera is treated.

.....
.....
.....
..... [4]

(c) State any **two** effects of tobacco smoke on health.

.....
..... [2]

8. **(a)** **(i)** State the **three** functions of blood.

1.....

2.....

3.....

[3]

(ii) Outline any **three** structural differences between arteries and veins.

.....
.....
.....
.....
.....
..... [3]

(b) Describe how plants are adapted to reduce water loss.

.....
.....
.....
.....
.....
..... [4]

9. **(a)** **Fig.9.1** shows the carbon cycle.

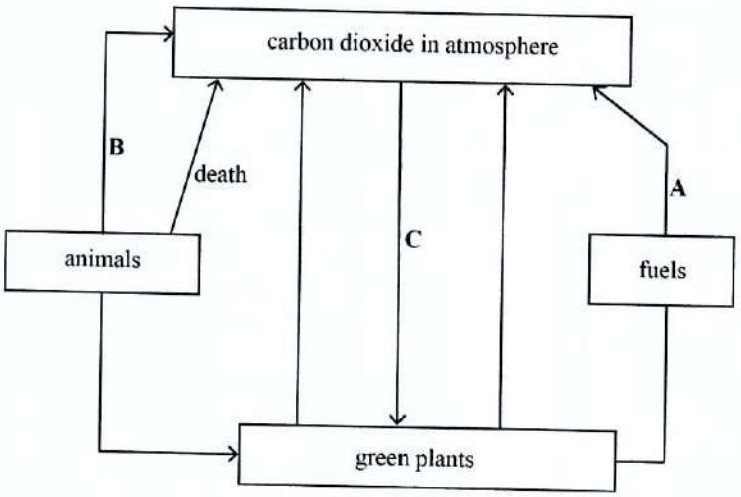


Fig.9.1.

(i) Identify the processes labelled **A** and **B**.

A.....
B..... [2]

(ii) Describe process **C.**

.....
..... [2]

(b) **(i)** State **one** process which increases the amount of nitrogen in the atmosphere.

..... [1]

(ii) State **two** processes which reduce the amount of nitrogen in the atmosphere.

.....
..... [2]

(c) **(i)** State any **two** problems caused by limited biodiversity.

[2]

(ii) Give any **one** advantage of biodiversity.

[1]

Section C

*Answer any **two** questions. Write your answers in the spaces provided on the question paper.*

10. Fermentation of glucose solution produces dilute ethanol (C_2H_5OH).

(a) **(i)** Name a physical process by which pure ethanol can be obtained from the dilute ethanol.

[1]

(ii) Describe the process named in **(i).**

[3]

(iii) State any **two** uses of ethanol.

1.....
.....
.....

[2]

(iv) Calculate the molecular mass of ethanol .

[2]

(v) Calculate the percentage of carbon in ethanol.

[2]

11. **(a)** The mass number of potassium is 39 and its proton number is 19.

(i) State the number of electrons in the potassium atom.

[1]

(ii) Determine the number of neutrons in the potassium atom.

[1]

(b) Potassium reacts with fluorine by donating electrons.

(i) State the number of electrons donated by potassium and the charge of the potassium ion.

number of electrons donated .....
charge of the potassium ion .....

[2]

(ii) Write the formula of potassium fluoride.

[1]

(iii) State any **one** physical property of potassium fluoride.

[1]

(c) Sodium hydroxide (NaOH) is dissolved in water to form a solution of concentration 0.5 mol/dm^3.

Calculate the number of moles of sodium hydroxide in 250 cm^3 of the solution.

[4]

12. **Table 12.1** shows the number of bubbles produced when metals **A**, **B**, **C** and **D** reacted with dilute sulphuric acid for three minutes.

Table 12.1

metal	number of bubbles after 3 minutes
A	6
B	3
C	0
D	14

(a) Name the gas produced.

[1]

(b) Identify, with a reason, the most reactive metal.

[2]

(c) The metals used were copper, calcium, lead and zinc.

(i) State, with a reason, the letter which represents copper.

[2]

(ii) State any **one** alloy of copper.

[1]

(iii) State the metal used for galvanising iron.

[1]

(d) **(i)** Define a compound.

[1]

(ii) Explain why copper does **not** react with zinc oxide.

[2]

Section D

*Answer any **two** questions. Write your answers in the spaces provided on the question paper.*

13. **(a)** **Fig.13.1** shows a pulley system used to lift a load of 600 N. The efficiency of the pulley system is 75%.

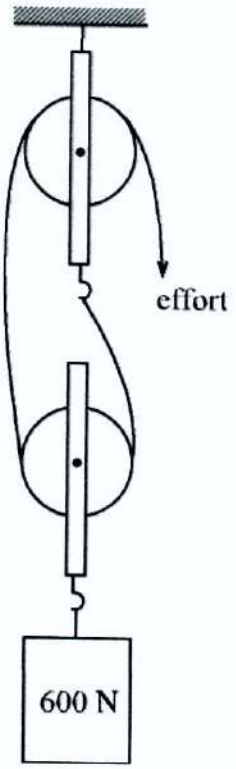


Fig.13.1

(i) Define the term *machine*.

[1]

(ii) Calculate the mechanical advantage (MA) of the pulley system.

[3]

(b) Electrical appliances which have a metal casing are usually fitted with an earth wire.

Explain how an earth wire acts as a safety device.

[3]

(c) Define the term

(i) mass,

[1]

(ii) weight,

[1]

(iii) momentum.

[1]

14. **(a)** **Fig.14.1** shows how the length of a glass rod was measured.

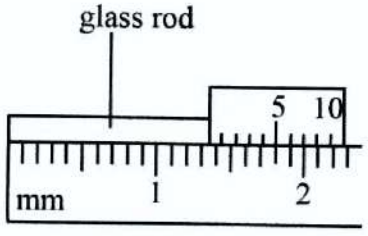


Fig.14.1

(i) Name the instrument used.

..... [1]

(ii) State the length of the glass rod.

..... [1]

(iii) State Newton's third law of motion.

..... [1]

(iv) Explain what happens when a person sits on a chair in terms of Newton's third law of motion.

.....

..... [1]

(b) A force of 300 N pulls an object of mass 60 kg along a horizontal surface.

(i) Calculate the acceleration of the object.

[2]

(ii) State whether the acceleration value in **(c)(i)** is higher or lower than the practical value.

..... [1]

(c) **Fig.14.2** shows a circuit used to determine the resistance of a wire.

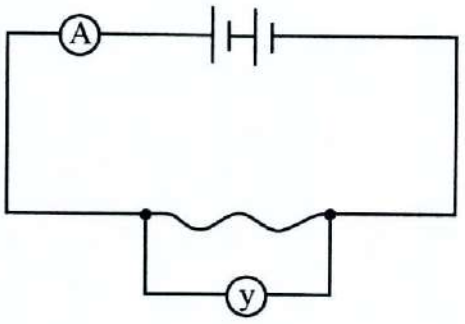


Fig.14.2

(i) Name the instrument **y**.

..... [1]

(ii) State the effect of using a longer wire of the same material and thickness.

..... [1]

15. **(a)** **(i)** Name any **three** types of media for signal transmission.

1.....

2.....

3..... [3]

(ii) Describe how signals are transmitted in any **one** of the media named in **(i)**.

[3]

(b) State the function of a decoder.

..... [1]

(c) Describe **three** advantages of e-mail over ordinary mail.

1.....

2.....

3..... [3]

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Ordinary Level

MARKING SCHEME

JUNE 2019

COMBINED SCIENCE 4003/02

1 **(a)** Insect pollinated flowers have smaller anthers/
wind pollinated flowers have larger anthers;

insect pollinated flowers have nectaries/
insect pollinated flowers have no nectaries/

insect pollinated flowers have large petals/
wind pollinated flowers have small/no petals/ max [2]

(b) **(i)** water [1]

(ii) sunlight/light
chlorophyll [1]

(iii) translocated

converted to starch/cellulose

stored as starch

used in respiration

used to form other nutrients

used in structure formation [2]

Notes: Glucose is converted to starch in leaf cells for temporary storage to prevent osmotic effects on the leaf cells during the day.
During the night, starch is converted to sucrose in leaves. Sucrose is translocated through phloem vessels to storage organs e.g. roots, stem tubers or fruits.
Some carbohydrates are converted to:

1. amino acids which are used to make proteins
2. cellulose for cell wall formation
3. lipids for cell membranes

2 **(a)**

Sexual reproduction	**Asexual reproduction**
offspring develop from seeds;	offsprings develop from vegetative propagation
genetic variation	no genetic variation
fertilization occurs	no fertilization

max [2]

(b) **(i)**

Passive immunity	**Active immunity**
short lived	long lived
no antibody production by body	antibody production by body

max [2]

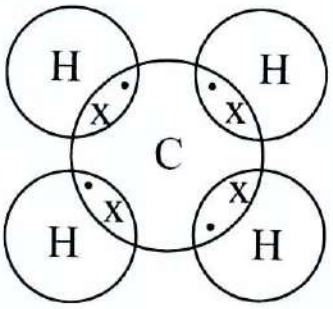
(ii) resistance to infection due to body processes
independent of man's influence examples are accepted [2]

(c) plasmodium [1]

3 **(a)** **(i)** carbon
Hydrogen [2]

(ii) covalent (bond) [1]

(iii)



[2]

Notes: Covalent bonding- takes place when non metals share electrons so that each atom attains a stable configuration. When elements combine to form covalent compounds, the valence of each element determines how many of each atom combine. In CH_4, carbon has 4 valence electrons so to reach noble gas configuration it needs 4 electrons. When bonded with 4 hydrogen atoms, it receives the 4 electrons it requires.

(b) alkenes have a double carbon = carbon bond/they are unsaturated/
alkanes are saturated/they have single carbon-carbon bonds [1]

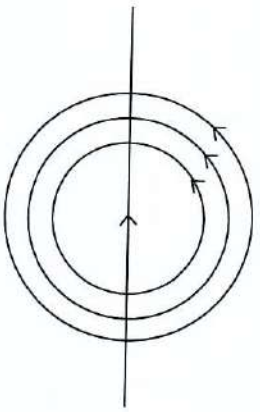
4. **(a)** Fe_2O_3
$CaCO_3$ max [2]

(b) **(i)** chromium
nickel [2]

(ii) property: resistant to corrosion
use: water sinks/tanks/medical instruments (kitchen utensils) [2]

(c) painting/electroplating/galvanising/oiling [1]

5 **(a)**



[2]

(b) **(i)** 1. conductor moves downwards
current carrying conductor
has a magnetic field around
the field interact with the magnetic field due to permanent magnets

2. conductor moves upwards/in opposite direction to that in 1
direction of magnetic field changed due to current reversed [2]

(ii) electric motor [1]

6 **(a)** **(i)** weight: gravitational force exerted on a body
pressure: force per unit area [2]

(ii) $P = \frac{F}{A}$

$A = L \times W$

$(0.5 \times 0.6)m$

$= 0.3\ m^2$

$P = \frac{20N}{0.3m^2}$

$= 66.7\ N/m^2$ or Pa [2]

(iii) Pressure becomes greater due to decrease in surface area [2]

(b) manometer [1]

7 (a) (i) gonorrhoea
syphilis
chancroid
genital herpes
genital warts
HIV/AIDS any two correct STIs any two [2]

(ii) gonorrhoea: bacteria
syphillis: bacteria
chancroid: bacteria
(genital) herpes: virus
genital warts: virus
HIV/AIDS: virus any two [2]

(b) oral re-hydration/saline drip transfusion
replaces lost fluids
antibiotics
kill the pathogens [4]

Notes: ORS is prepared by mixing; 750ml of clean boiled water, 6 level teaspoonfuls of sugar and half level teaspoonful of table salt

(c) emphysema
bronchitis
lung cancer
low birth weight for pregnant woman/miscarriage
hypertension/heart disease
internal bleeding/thrombosis
reduced oxygen carrying capacity any two [2]

8 (a) (i) transport
defence
homeostasis [3]

Notes: The defence is done by white blood cells destroying pathogens by engulfing action and antibody production and platelets by clotting.

Red blood cells transport oxygen and plasma transport dissolved substances

Homeostasis: maintaining an internal body environment e.g. temperature

(ii)

arteries	**veins**
narrow lumen	large lumen
no valves	have valves
thick walled	thin walled

[3]

(b) leaf surface area reduced;
less stomata on (upper) leaf surface;
thick cuticle;
presence of hairs; [4]

9 **(a)** **(i)** A: burning/combustion;
B: respiration; [2]

Notes: Candidates should consider the direction of the arrow to identify the processes.

(ii) its photosynthesis. Carbon dioxide combines with water to form carbohydrates [2]

(b) **(i)** denitrification [1]

Notes: if aeration is poor, denitrifying bacteria use oxygen in the nitrates releasing nitrogen gas into the air

(ii) lightning
nitrogen fixation by bacteria [2]

Notes: the high temperature of a lightning bolt can break the bonds of atmospheric nitrogen molecules. Free nitrogen atoms in the air bond with oxygen in the air to create nitrogen oxide which dissolves in moisture to form nitrates that are carried to the earth by precipitation.

Nitrogen fixation by bacteria is a result of nitrogen in the air being converted into nitrates by nitrogen fixing bacteria which lives in root nodules of leguminous plants.

(c) **(i)** soil infertility
pests
diseases
any two [2]

Notes: Biodiversity is the variability within species between species and between organisms. Some problems caused by limited biodiversity are: the ecosystem becomes unstable and unbalanced, little or no recycling of nutrients, overgrazing, deterioration of the natural ecosystem and pollution.

(ii) wide variety of food sources/self sustenance of an ecosystem/interdependence/ less spread of disease [1]

10 **(a)** **(i)** fractional distillation [1]

Notes: . fractional distillation separates miscible liquids with different boiling points. This method is ideal when one of the liquids is more volatile (evaporates more easily) than the other.

(ii) ethanol solution is heated to 78 °C
water vapour and ethanol vapour rise to fractionating column
water vapour condenses at the beads/at a temperature of 78 °C and falls back
ethanol vapour rises and enters condenser where it condenses
ethanol collects as the distillate max [3]

(iii) as a solvent, beverage, fuel,
medical purpose, thermometric liquid, [2]

(iv) $(12 \times 2) + (1 \times 6) + (16 \times 1) = 46$ [2]

(v) $\frac{24}{46} \times 100\% = 52.17\ \%$ [2]

11 **(a)** **(i)** 19 [1]

(ii) $39 - 19 = 20$ neutrons [1]

(b) **(i)** Number of electrons donated = 1

Charge of potassium ion = +1 [2]

(ii) KF

Notes: Potassium has a valence of 1 and fluorine has a valence of 7. Potassium gives away its electron to fluorine in a 1:1 ratio so formula is KF. [1]

(iii) soluble in water/has high melting point [1]

(c) n = CV

$V = \frac{250}{1000} = 0.25\ dm^3$

$= 0.5\ (mol/dm3) \times 0.25\ (dm^3)$

n = 0.125 moles [4]

12 **(a)** hydrogen [1]

Notes: metal + acid→ salt + hydrogen.

Test for hydrogen: use a burning splint, it will explode giving a pop sound.

(b) D
produced greatest number of bubbles [2]

(c) **(i)** C because copper does not react with dilute acids so no gas is produced [2]

Notes: copper does not react with dilute acids except with concentrated acids.

(ii) brass/bronze [1]

(iii) zinc [1]

(d) **(i)** a substance made up of two or more elements which are chemically combined [1]

(ii) copper is less reactive than zinc so it cannot displace zinc [2]

13 **(a)** **(i)** a device which makes work easier; [1]

(ii) VR = 2

MA = E× VR/0.75 × 2

1.5 [3]

Notes: The formula for calculating MA was derived from the efficiency formula by making MA the subject of the formula $E = \frac{MA}{VR} \times 100\%$

VR = number of pulleys/number of times the rope goes round moving pulley = 2 (from the diagram)

NB: efficiency, VR and MA are all ratios hence have no units

(b) if live wire breaks or comes into contact with appliance casing the current passes to the ground through earth wire instead of through the user as current chooses a path of least resistance max [3]

(c) **(i)** amount of matter in a body [1]

(ii) force of gravity on a body [1]

(iii) product of mass and velocity [1]

14 **(a)** **(i)** vernier calipers [1]

(ii) 1.35 cm [1]

(iii) for every action, there is an equal and opposite reaction [1]

(iv) the person exerts a force on the chair (action) and

the chair exerts an equal and opposite force on the person(reaction) balancing his/her weight [2]

(b) **(i)** $a = F/m$

$= 300/60$

$= 5\ ms^{-2}$ [2]

(ii) higher [1]

(c) **(i)** voltmeter [1]

Notes: a voltmeter is always connected across a resistor e.g. across a bulb, ammeter, cell/battery or variable resistor.

(ii) resistance increases [1]

Notes: Factors affecting resistance are length of the conductor, thickness of the conductor (cross sectional area) and temperature. High resistance is favoured by a big length, small cross sectional area and high temperature.

15 **(a)** **(i)** optical fibre
coaxial cables
wifi
sheathed pair cables
twisted wire cables any three [3]

(ii) Optic fibre: original signal converted to light pulses
light pulses transmitted through optic fibre
light pulses changed to original signal at receiver

Wifi: original signal converted to radio waves
radio waves transmitted through space
radio waves changed to original signal

Coxial cables: original signal converted to electrical pulses
electrical pulses transmitted through the cable
electrical pulses are changed to original signal (via antenna) at the receiver

Sheathed pair cables: original signal / sound converted to electrical and twisted wire pulses
electrical pulses transmitted through cables
electrical pulses converted to sound/original signal at receiver any three [3]

(b) separates carrier signal from actual signal [1]

(c) speed of delivery: mail reaches destination within seconds opposed to days or weeks
cost: cheapest / cost is the same throughout all distances
accessibility: accessible wherever there is network as opposed to same local address [3]

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Ordinary Level

COMBINED SCIENCE 4003/3

PAPER 3 (Practical Test)

JUNE 2019 SESSION 1 hour 30 minutes

Candidates answer on the question paper

Additional materials:
As listed in instructions to Supervisors
Calculator (optional)

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **both** questions.

Write your answers in the spaces provided on the question paper.

Use a sharp pencil for your drawings. Coloured pencils or crayons should not be used.

You should record all experimental results and show the essential steps in any calculation in the spaces provided in the question paper.

INFORMATION FOR CANDIDATES

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

FOR EXAMINER'S USE	
1	
2	
TOTAL	

1 You are required to identify nutrients present in juice **X**.
You are provided with three boiling tubes, a test tube rack, a pair of tongs, a graduated syringe, Benedict's solution, hot water bath, juice X, solution P, solution R and access to a clock.

(a) (i) Carry out the tests described in Table 1.1 below and record the observations and deductions in the table.

Table 1.1

test	**observations**	**conclusions**
Add about 2 cm^3 of juice **X** into a boiling tube and add two drops of solution **R** to the juice.		
Place about 2 cm^3 of juice **X** into a clean boiling tube and add about 2 cm^3 of Benedict's solution to the juice. Heat the mixture in a water bath.		
Place about 3 cm^3 of juice X into a clean boiling tube and add about 4 cm^3 of solution P to the juice. Place the test tube in the hot water bath and leave it for about 3 minutes. After the 3 minutes, pour about half of the contents into another clean boiling tube. Add two drops of solution R to one of the portions.		
Add about 2 cm^3 of Benedict's solution to the other portion and heat in the water bath.		

..... [10]

(ii) Identify solution **R**.

..... [1]

(iii) State the colour of Benedict's solution.

..... [1]

(iv) State the nutrients contained in juice **X**.

.....

..... [2]

(v) Suggest **one** advantage of drinking juice **X**.

.....

..... [1]

(vi) Suggest a possible identity of solution **P**.

..... [1]

(vii) State the process responsible for the change that occurred when solution **P** was added to the juice and the mixture heated.

..... [1]

(viii) Name the part of the alimentary canal where the process mentioned in **(vii)** occurs.

..... [1]

(b) State any two precautions that should be taken when carrying out the experiment.

.....

.....

.....

2 (a) You are required to determine the resistance of a wire, **R**. **Fig.2.1** shows the circuit diagram for the circuit which the supervisor set for you.

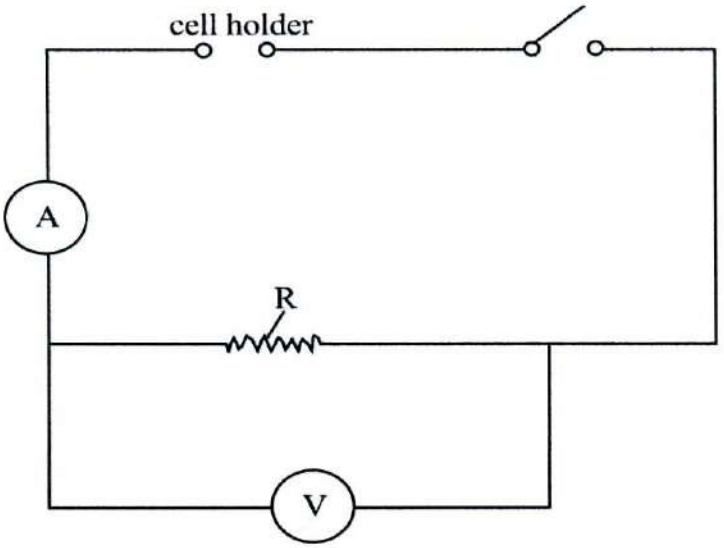


Fig.2.1

(i) Place one cell in the cell holder, close the switch and record the voltmeter and ammeter readings in **Table 2.1**.

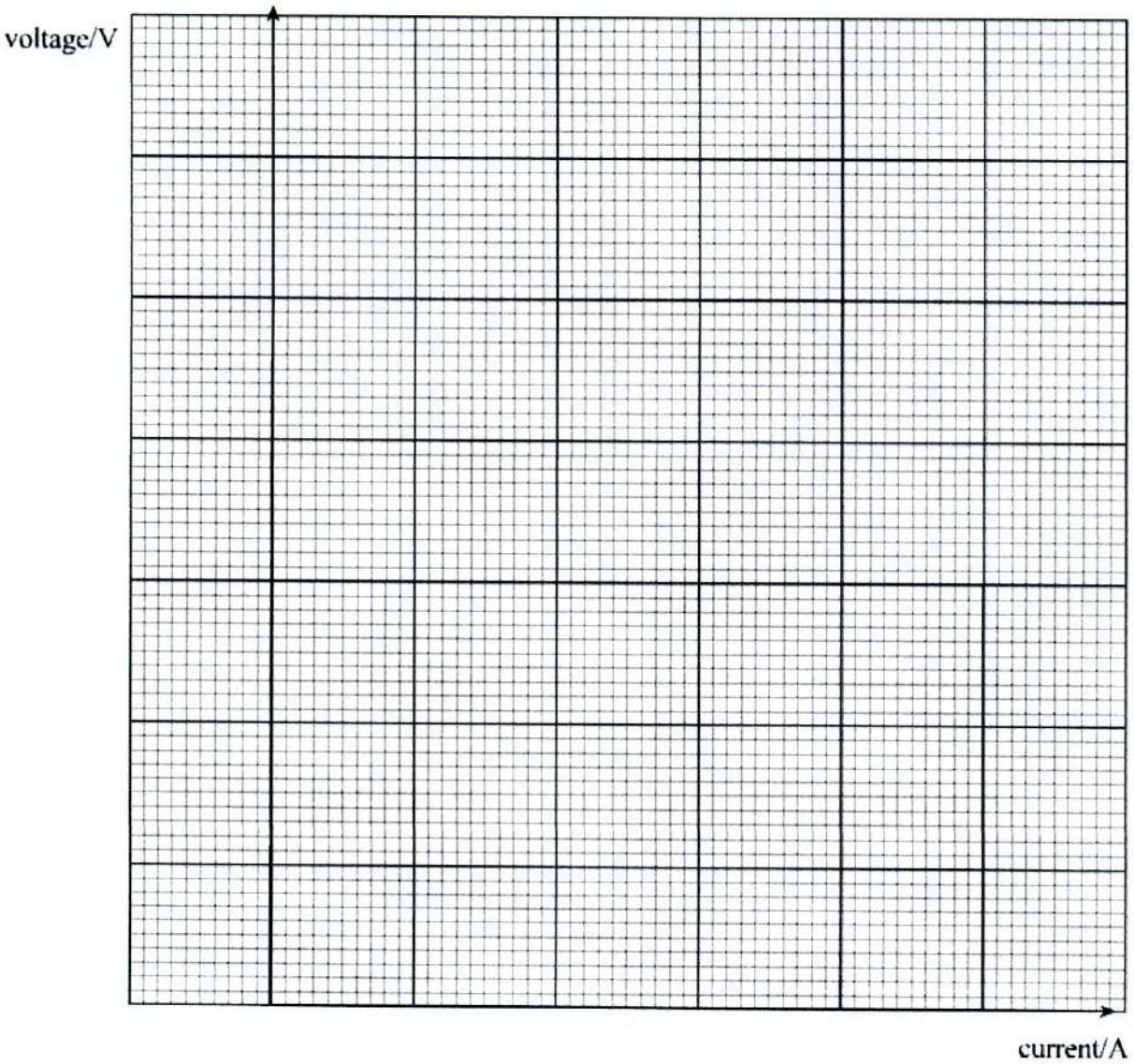
Repeat the procedure adding one cell at a time until you use four cells.

Table 2.1

number of cells	voltage/V	current/A

[10]

(ii) Plot a graph of voltage (y-axis) against current (x-axis).



[3]

(iii) State the relationship between voltage and current.

.....

..... [1]

(iv) Calculate, using the graph, the resistance of wire **R**.

[2]

(v) Determine, clearly showing on the graph, the current when the voltage is 3.5 V.

..... [2]

(b) State any two sources of error in the experiment.

.....
.....
..... [2]

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Ordinary Level

MARKING SCHEME

JUNE 2019

COMBINED SCIENCE 4003/03

Juice X is freshly prepared orange juice (not orange crush bought from a supermarket)

1 (a) (i)

test	observations	conclusions
	brown to blue-black	starch present
	orange/ brick-red	reducing sugar present
	brown	no starch
	(blue) to green	little sugar present

[10]

Notes: Other colour changes may be considered to be correct after comparing to the supervisor's report which is aligned to the chemicals used at the centre

(ii) iodine [1]

(iii) blue [1]

(iv) starch
reducing sugar
vitamin C any two [2]

(v) it provides energy/ rehydrates/prevents diseases any one [1]

(vi) P could be an enzyme or hydrochloric acid [1]
Notes: P caused starch to be converted to a reducing sugar hence it could be an enzyme/amylase or hydrochloric acid

(vii) digestion / hydrolysis [1]

(viii) mouth/duodenum / ileum / small intestines [1]

(b) handle chemicals with care
wear protective clothes/use gloves/avoid spillage
handle hot water with care
use tongs to handle hot test tube/use a peg to handle hot test tube
any two [2]

2 (a) (i) **Table 2.1**

Number of cells	Voltage/V	Current/A
1		
2		
3		
4		

Marks are awarded a follows:

Table completely recorded 1 mark for each column [3]

voltage recorded to at least one decimal place (all values) [1]

all current values recorded to 1 decimal place [1]

correct trend of voltage being directly proportional to current
(at least 3 correct values down the column) [1]

accuracy of current in relation to the number of cells [± 0.1] [2]

accuracy of voltage in relation to the number of cells [± 0.2] [2]
[10]

(ii) good scale continuity and spread (covers 50 % of space)

plotting all 4 points correctly

line of best fit [3]

(iii) current is directly proportional to voltage [1]

(iv) gradient = change in voltage/change in current
answer with the correct unit, that is ohms or Ω [2]

(v) extrapolation/marking on the graph

value according to candidate's graph [2]

(b) loose connections
parallax error
zero error any two [2]

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Ordinary Level

COMBINED SCIENCE 4003/1

PAPER 1 Multiple Choice

NOVEMBER 2019 SESSION 1 hour

Additional materials:
Multiple Choice answer sheet
Soft clean eraser
Soft pencil (type B or HB is recommended.)
Calculator (Optional)

INSTRUCTIONS TO CANDIDATES

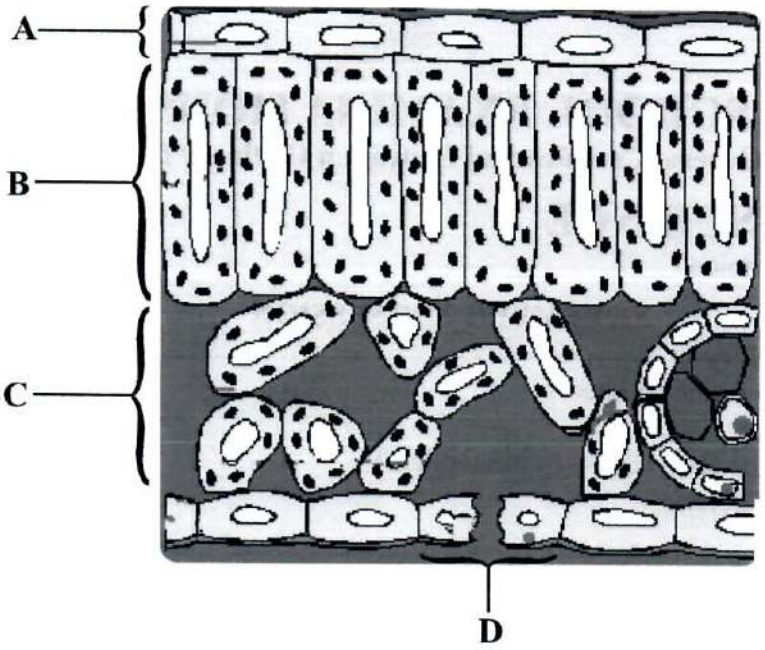
Do **not** open this booklet until you are told to do so.
Write your name, centre number and candidate number on the answer sheet in the spaces provided unless this has already been done for you.
Read very carefully the instructions on the answer sheet.

INFORMATION FOR CANDIDATES

Each correct answer will score **one** mark. A mark will **not** be deducted for a wrong answer. Any rough working should be done in this booklet.

There are **forty** questions in this paper. Answer **all** questions. For each question, there are four possible answers, **A**, **B**, **C** and **D**. Choose the one you consider correct and record your choice in soft pencil on the separate answer sheet provided.

1. The diagram shows the internal structure of a leaf.
In which tissue, **A**, **B**, **C** or **D**, does most photosynthesis take place?



2. Which cell is specialised for contraction?

A sperm cell

B muscle cell

C red blood cell

D white blood cell

3. Overfeeding causes

A goitre.

B scurvy.

C obesity.

D anorexia nervosa.

4. Which teeth are used for cutting food?

A premolars

B molars

C canines

D incisors

5. The equation for respiration is given below:
glucose + oxygen $\rightarrow$ carbon dioxide + **P** + energy
Product **P** is

A lactic acid.

B alcohol.

C starch.

D water.

6. What is the function of the enzyme amylase in digestion?

A to break down fats to fatty acids and glycerol

B to break down proteins to amino acids

C to break down starch to sucrose

D to break down starch to maltose

7. As compared to the aorta, the vena cava

A has no valves.

B has a wider lumen.

C has a wall with more elastic fibres.

D carries blood under high pressure.

8. The rate of transpiration is low when there is high

A humidity.

B wind speed.

C temperature.

D light intensity.

9. Wind pollinated flowers have

A exposed anthers.

B enclosed stigma.

C coloured petals.

D sweet nectar.

10. Which part of the male reproductive system produces sperms?

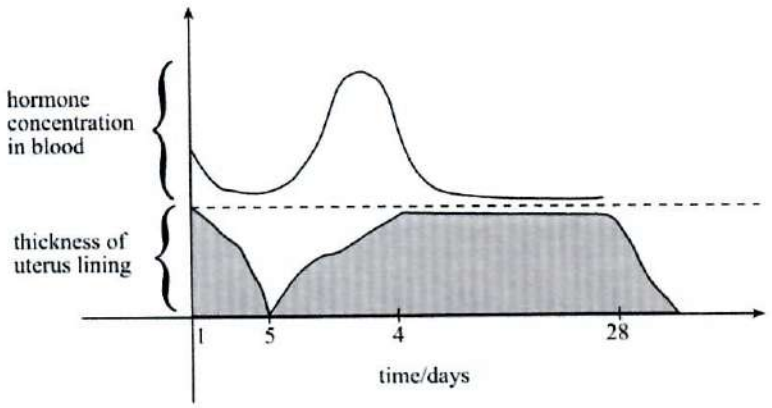
A epididymis

B sperm duct

C urethra

D testis

11. The graph shows some of the changes during the 28 day menstrual cycle.



What is the function of the hormone?

A causes ovulation

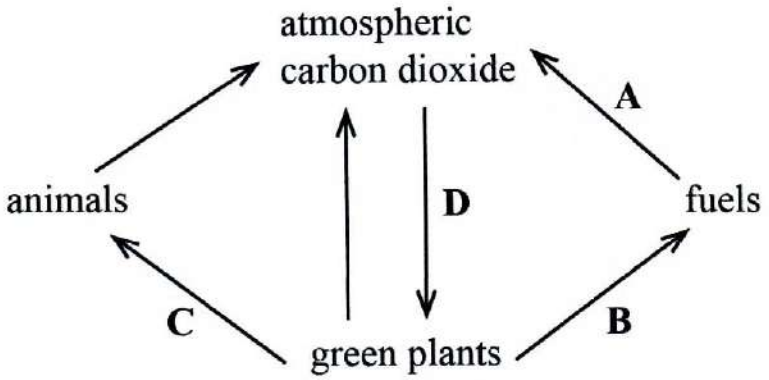
B prevents ovulation

C rebuilds the uterus lining

D maintains the uterus lining

12. The diagram shows the carbon cycle.

Which process, **A**, **B**, **C** or **D**, causes global warming?



13. Which statement is true about the blood circulatory system?

A It is composed of systemic circulation only.

B It is composed of pulmonary circulation only.

C The blood moves twice into the heart in one cycle.

D The left side of the heart receives deoxygenated blood.

14. Which organism causes malaria?

A virus

B fungus

C bacterium

D plasmodium

15. An element ***X*** has the nuclide notation ${}^{p}_{q}X$.

What does p represent?

A mass number

B proton number

C neutron number

D electron number

16. The electronic configuration of a sodium atom is 2, 8, 1 and that of an oxygen atom is 2, 6.
What is the formula of the compound formed between sodium and oxygen?

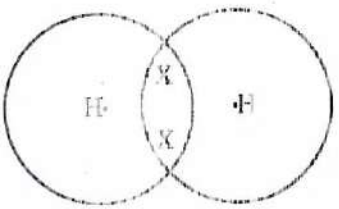
A NaO

B Na_2O

C NaO_2

D NaO_6

17. The diagram shows the type of bonding in a molecule. H represents an atom and X represents an electron.



What is the type of bonding shown in the diagram?

A ionic because electrons are shared

B ionic because electrons are transferred

C covalent because electrons are shared

D covalent because electrons are transfered

18. Which method is used to separate a mixture of dyes?

A filtration

B decanting

C evaporation

D chromatography

19. Which gas is produced when a metal reacts with an acid?

A carbon dioxide

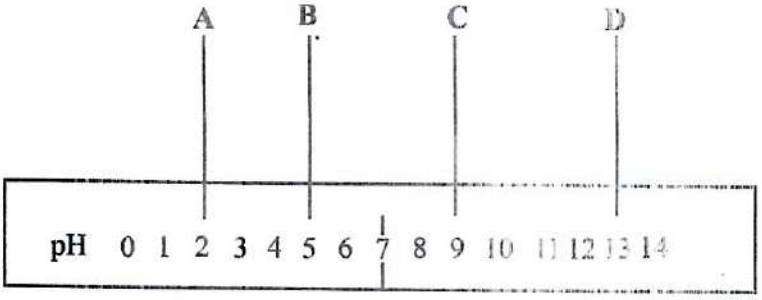
B hydrogen

C oxygen

D nitrogen

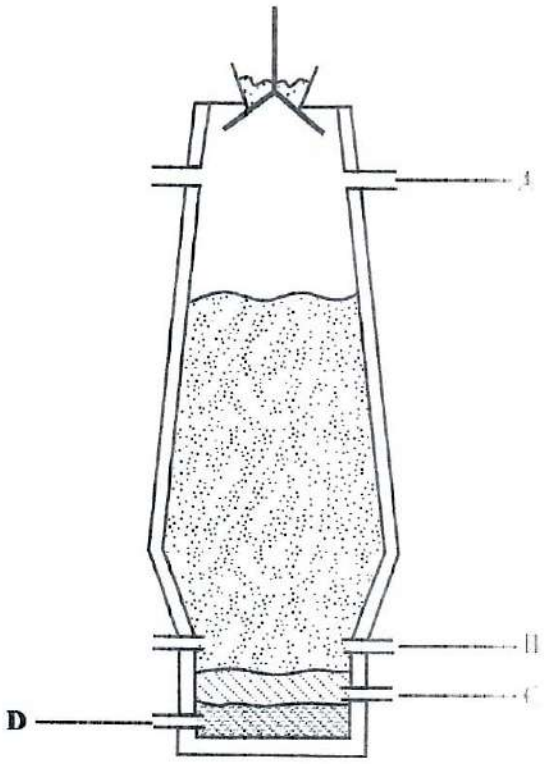
20. Substances **A**, **B**, **C** and **D** have pH values shown in the diagram.

Which substance is a strong acid?



21. The diagram shows the blast furnace.

At which point, **A**, **B**, **C** or **D**, is iron collected?



22. Which gas is produced during the electrolysis of molten lead bromide?

A hydrogen

B oxygen

C bromine

D chlorine

23. Which one is a raw material needed to produce sulphuric acid?

A oleum

B nitrogen

C sulphur dioxide

D sulphur trioxide

24. What is the correct ratio of nitrogen to hydrogen in the production of ammonia?

A I : I

B 3 : 2

C I : 3

D 2 : 3

25. Ethene is used to make

A explosives.

B fertilisers.

C plastics.

D soap.

26. Which gas is used in the manufacture of margarine?

A chlorine

B hydrogen

C nitrogen

D oxygen

27. A hydrocarbon is a molecule which contains atoms of

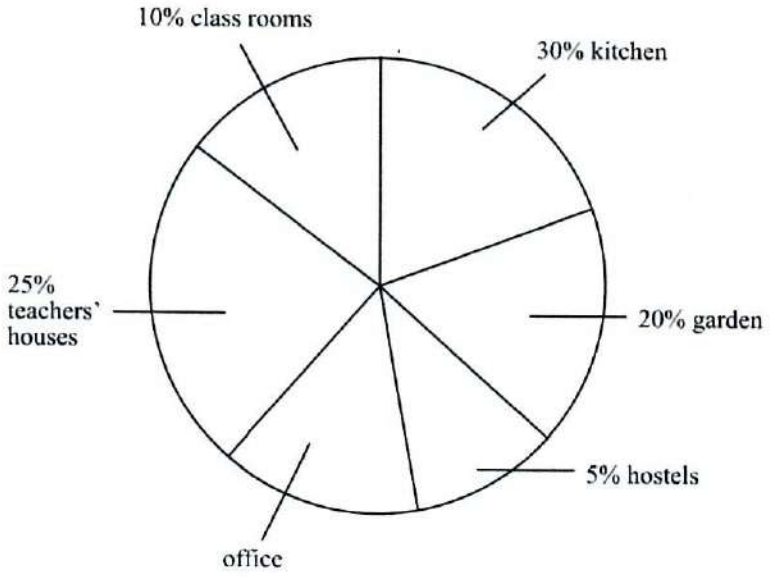
A carbon and oxygen.

B carbon and hydrogen.

C hydrogen and oxygen.

D carbon, hydrogen and oxygen.

28. A boarding school uses \$10 000. 00 per month on its running costs.
The pie chart shows the percentages of the costs at the school per month.



How much money is spent in running the office?

A \$500.00

B \$900.00

C \$1 000.00

D \$2 500.00

29. Which one is a derived unit?

A metre

B second

C newton

D kilogram

30. The mass of 25 cm^3 of liquid **K** is 50 g.

What is the density of liquid **K**?

A 0.5 g / cm^3

B 2.0 g / cm^3

C 25.0 g / cm^3

D 1250.0 g / cm^3

31. What is the pressure when a force of 100 N acts on an area of 25 m^2?

A 2500.00 Pa

B 75.00 Pa

C 4.00 Pa

D 0.25 Pa

32. What is the correct formula for calculating pressure in liquids?
[h represents the height of the liquid, ρ represents the density of the liquid and g represents the acceleration due to gravity]

A $P = \frac{h\rho}{g}$

B $P = h\rho g$

C $P = \frac{hg}{\rho}$

D $P = \frac{\rho g}{h}$

33. Heat from the sun reaches the earth through

A conduction.

B convection.

C radiation.

D absorption.

34. Why are black pots used on solar cookers?

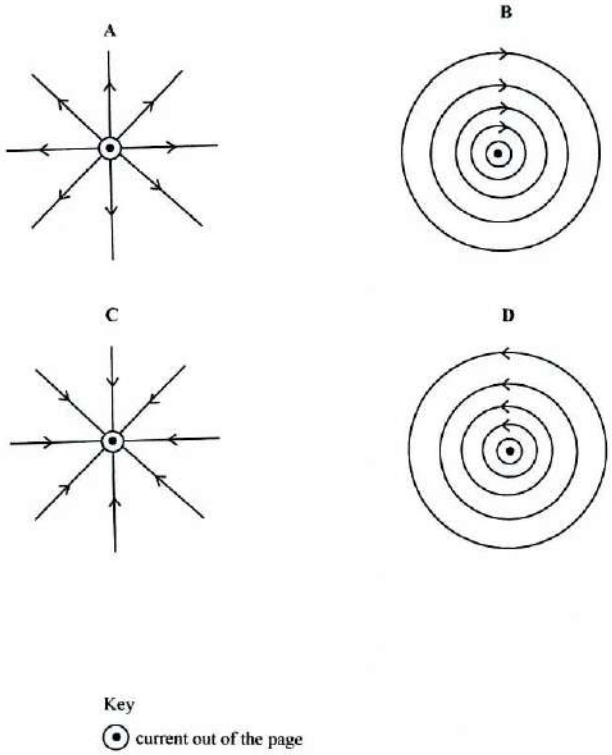
A Black is a good reflector of heat.

B Black is a good absorber of heat.

C Black is a good insulator of heat.

D Black focuses heat to a point.

35. Which diagram, **A**, **B**, **C** or **D**, represents the pattern and the direction of the magnetic field around a straight wire carrying a current out of the page?



36. Why are electric cables insulated?

A to prevent loss of electricity

B to prevent over heating

C to prevent short circuits

D to prevent over loading

37. Which statement, about a fuse, is correct?

A An electric circuit only works if it has a fuse.

B A fuse protects the appliance from high current.

C A fuse should be connected to the neutral wire in a plug.

D An earth wire is needed to prevent the fuse from blowing up.

38. A household uses 250 kWh of electricity per month. The unit cost of electricity is 20 c.

What is the total cost of the electricity used by the household per month?

A $125.00

B $50.00

C $12.50

D $5.00

39. Sound signal in an optic fibre is transmitted as

A heat energy.

B light energy.

C sound energy.

D electrical energy.

40. Which one is a function of an antenna?

A to receive signals

B to produce the carrier wave

C to shorten the range of the signals

D to separate the carrier signals and information signals

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Ordinary Level

COMBINED SCIENCE 4003/1

MARKING SCHEME : NOVEMBER 2019

1.	B
2.	B
3.	C
4.	D
5.	D
6.	D
7.	B
8.	A
9.	A
10.	D
11.	C
12.	A
13.	C
14.	D
15.	A
16.	B
17.	C
18.	D
19.	B
20.	A
21.	D
22.	C
23.	C
24.	C
25.	C
26.	B
27.	B
28.	C
29.	C
30.	B
31.	C
32.	B
33.	C
34.	B
35.	D
36.	C
37.	B
38.	B
39.	B
40.	A

REVISION NOTES FOR 4003/01

1. The tissue which has cells containing the highest number of chloroplasts is the most photosynthesising tissue.
2. The muscle cells are made up of long and thin fibres that have the ability to change shape when they contract. They also have numerous mitochondria to provide energy for muscle contraction.

   The sperm cell is adapted for movement/for it to swim up to the oviduct when it is released into the vagina. The red blood cell is adapted for transportation of oxygen. The white blood cells are either phagocytes or lymphocytes. The phagocytes are adapted for engulfing bacteria while the lymphocytes are adapted for producing antibodies.
3. Obesity is caused by high intake of carbohydrates. Goitre is caused by lack of iodine, scurvy is caused by lack of vitamin C while anorexia nervosa is caused by self starvation.
4. Incisors are eight teeth in the front centre of the mouth (4 on top jaw and 4 on the bottom jaw). They are chisel shaped teeth (teeth with flat edges) to provide a cutting surface. Canine are for gripping and tearing while molars and premolars are for crushing and grinding.
5. The equation for respiration is

   glucose + oxygen → carbon dioxide +water +energy hence P represents water
6. Enzyme amylase can be the salivary amylase or the pancreatic amylase. Salivary amylase is produced by the salivary gland while the pancreatic amylase is produced by the pancreas. Both convert starch to maltose.

7. The vena cava is the master vein which transports blood from the rest of the body to the heart and the aorta is the master artery which transports blood from the heart to the rest of the body. The question requires candidates to differentiate an artery and a vein.

Artery(aorta)	Vein(vena cava)
Has no valves	Has valves
small lumen	Large lumen
Thick muscle and elastic fibre	Thin muscle and elastic fibre

8. Transpiration is the loss of water in the form of vapour from plants to the atmosphere. It is low when there is high humidity, low wind speed, low temperature and low light intensity.
9. Wind pollinated flowers have exposed anthers, feathery and exposed stigma and have smaller or no petals. They do not produce nectar.
10. Sperms are produced by the testis and stored in the epididymis.
11. Hormone oestrogen rebuilds the uterus lining while progesterone maintains the thickened uterus lining during pregnancy.
12. Global warming is a gradual increase in the average temperature of the lower atmosphere due to the concentration of green house gasses.
13. Circulation from the heart to the lungs and back to the heart is called pulmonary circulation. Circulation from the heart to the rest of the body and back to the heart is called systemic circulation.
14. Malaria is caused by a single celled protozoa called plasmodium.

15. The nuclide notation is ${}^{p}_{q}X$ where X represent the atomic symbol, p represents relative atomic mass /mass number and q represent proton number/atomic number.

16. The valence of oxygen is 6, so it needs 2 electrons to reach octet state. Sodium needs to lose 1 electron to reach octet state. 2 sodium atoms need to each lose 1 electron to oxygen for both to reach octet. Oxygen by gaining 2 electrons will have a charge of 2 – and sodium ion will have a charge of +1.

17. A hydrogen atom has 1 electron in the outermost shell. To become stable, the hydrogen atom needs 1 more electron. When 2 hydrogen atoms share their electrons they attain a noble gas electronic configuration.

18. Chromatography separates mixtures of dyes through the use of a solvent which places the dyes at different points.

19. Acid + metal⟶ salt + hydrogen gas.

20.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 pH scale 1-3 strong acid, 3-6 weak acid,7 neutral, 8-10 weak alkali/base 11-14 strong alkali/base

21. Iron is more dense than slag hence it is taped through the bottom hole.

22. Lead bromide ($PbBr_2$) is an ionic compound in solid form(white powder) which contains positively charged ions(Pb^{2+}) and negatively charged bromide ions (Br^-). When $PbBr_2$ is heated, it melts and dissociates leaving Pb^{2+} and Br^- ions now free to move.

Pb^{2+} ions are attracted to the negative electrode as unlike charges attract and Br – ions are attracted to the positive electrode.

Cathode reaction

$Pb^{2+}_{(aq)} + 2^-_e \rightarrow Pb_{(l)}$

Anode reaction

$2Br^-_{(aq)} \rightarrow Br_{2(g)} + 2_e^-$

23. Sulphur dioxide which is obtained from roasting iron pyrites in air or burning sulphur in air is used as a raw material. The second raw material is oxygen.

24. The simple ratio of combining nitrogen and hydrogen is 1:3 to give the formula NH_3.

25. Ethene is used to make polythene (a plastic).

26. Hydrogen is used to make margarine. Hydrogen is also a raw material in the manufacture of ammonia. Hydrogen is also used as a fuel.

27. A hydrocarbon is a molecule which contains atoms of carbon and hydrogen only.

28. How much money is spent in running the office

    100% − (10+30+20+5+25)%
    100% − 90%=10%
    10% of \$10 000 = \$1000

29. Newton is a derived unit from the formula F=ma

30. Density $= \frac{mass}{volume}$

    $= \frac{50g}{25\ cm3}$

    $= 2\ g/cm^3$

31. Pressure $= \frac{force}{area}$

    $= \frac{100\ N}{25\ m^2}$

    $= 4.00\ Pa(\ N/m^2)$

32. Pressure =height above a point×density×gravity

    P =hρg

33. Radiation is when heat travels in form of waves.

34. Black surfaces are good absorbers and good emitters of heat.

35. The magnetic field of a current carrying current always move from right to left.

36. The cables are insulated to prevent the current in the wire from coming into contact with users.

37. A fuse melts and breaks the circuit when excess current flows into the circuit.

38. Cost of electricity = VIt× unit cost

= kWh× unit cost

= 250 kWh × 20 c = 5000 c = $50.00

39. Optic fibre sends information coded in a beam of light down a glass pipe in modes.

40. Antenna is used for transmission of signal and reception of signal.

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Ordinary Level

COMBINED SCIENCE 4003/2

PAPER 2 Theory

NOVEMBER 2019 SESSION 2 hours

Candidates answer on the question paper

Additional materials: Calculator (Optional)

Allow candidates 5 minutes to count pages before the examination.
This booklet should not be punched or stapled and pages should not be removed.

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces at the top.
Write your centre and candidate number in the boxes on the top right corner of every page of this paper.
Check if the booklet has all the pages and ask the invigilator for a replacement if there are duplicate or missing pages.
Write your answers in the spaces provided on the question paper.
Section A
Answer **all** questions.
Section B
Answer any two questions.
Section C
Answer any **two** questions.
Section D
Answer any **two** questions.

INFORMATION FOR CANDIDATES

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

Section A

*Answer **all** the questions in the spaces provided.*

1. **(a)** State any **two** differences between inhaled and exhaled air.

1 .....

.....

2 .....

.....

[2]

(b) Transpiration is the loss of water through plant leaves.

(i) State any **one** advantage of transpiration to the plant.

.....

.....

[1]

(ii) State **one** disadvantage of excessive transpiration.

.....

.....

[1]

(iii) State any **two** factors which increase the rate of transpiration.

1 .....

.....

2 .....

.....

[2]

2. (a) Describe a natural ecosystem.

.....

.....

.....

[2]

(b) (i) Define the term *balanced diet*.

.....

.....

.....

[2]

(ii) Describe the importance of calcium to a pregnant woman.

.....

.....

.....

[2]

(iii) State the advantage of eating liver.

.....

.....

.....

[1]

3. (a) Chlorine gas has two types of atoms as shown:

$$^{35}_{17}Cl \quad and \quad ^{37}_{17}Cl$$

(i) State the name given to the two types of the chlorine atoms.

.....

[1]

(ii) Calculate the number of neutrons in $^{35}_{17}Cl$.

.....

[1]

(b) Chlorine reacts with sodium to form sodium chloride, NaC*l*.

(i) Name the type of bonding in sodium chloride.

.....

[1]

(ii) Draw a dot and cross diagram to show the bonding in sodium chloride.

[2]

(c) State any **two** physical properties of sodium chloride.

1 .....

2 .....

[2]

4. **(a)** Indigestion is caused by too much dilute hydrochloric acid in the stomach. It is cured by ingesting anti-acid tablets.

State, with a reason, the acid-base nature of the chemical present in the anti-acid tablets.

acid-base nature .....

reason .....

.....

[2]

(b) Iron is extracted from an iron compound found in haematite.

Name the iron compound in haematite.

.....

[1]

(c) Two other solid raw materials are fed into the blast furnace together with haematite.

Name the **two** raw materials and state a function for each of these materials.

raw material .....

function .....

raw material .....

function .....

[4]

5. **(a)** **Fig.5.1** shows a stroke in the operation of an engine.

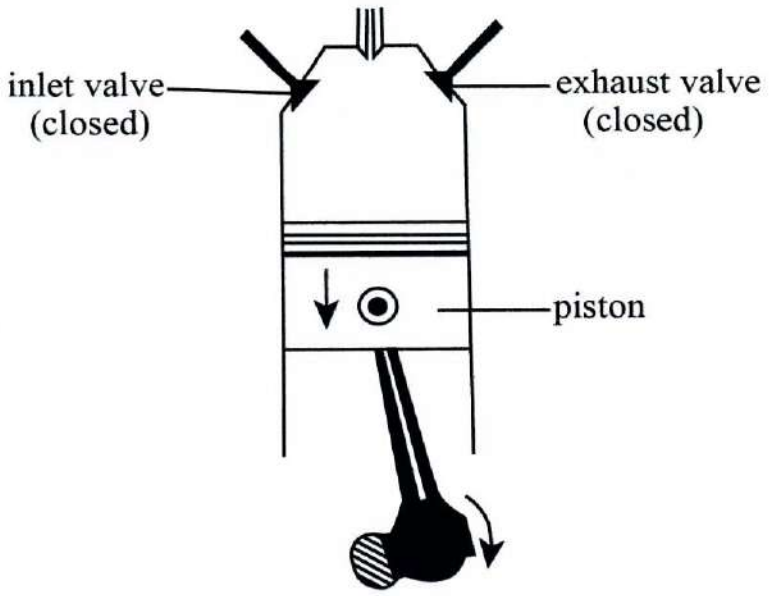


Fig.5.1

(i) Identify, giving **two** reasons, the stroke shown.

stroke .....

reasons: 1 .....

.....

2

.....

.....

(b) **(i)** State the role of a fuel injector in a petrol engine.

.....

.....

.....

[1]

(ii) State the role of a carburettor.

.....

.....

[1]

(iii) Explain the advantage of a fuel injector over a carburettor.

.....

.....

.....

[2]

6. **Fig.6.1** shows part of the design of a solar water heater.

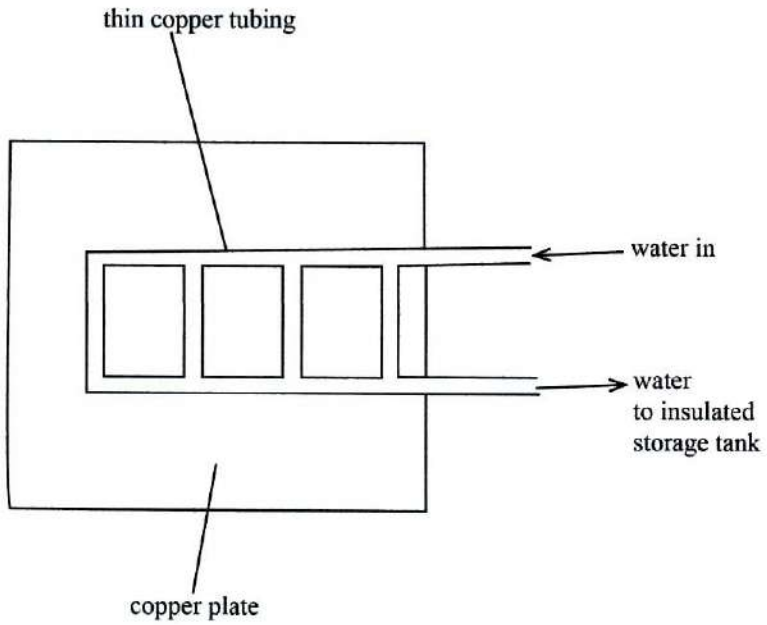


Fig.6.1

(a) State, with a reason, the most suitable place for placing the solar water heater for best results.

place .....

reason .....

[2]

(b) State, with a reason, the paint colour on the copper plate.

colour .....

reason .....

[2]

(c) Explain why

(i) a thin copper tubing is used, ...

.....

[1]

(ii) the storage tank is insulated. .....

.....

[1]

Section B

*Answer any **two** questions in the spaces provided.*

7. **(a)** **Fig.7.1** shows a sketch diagram to represent double circulation in mammals.

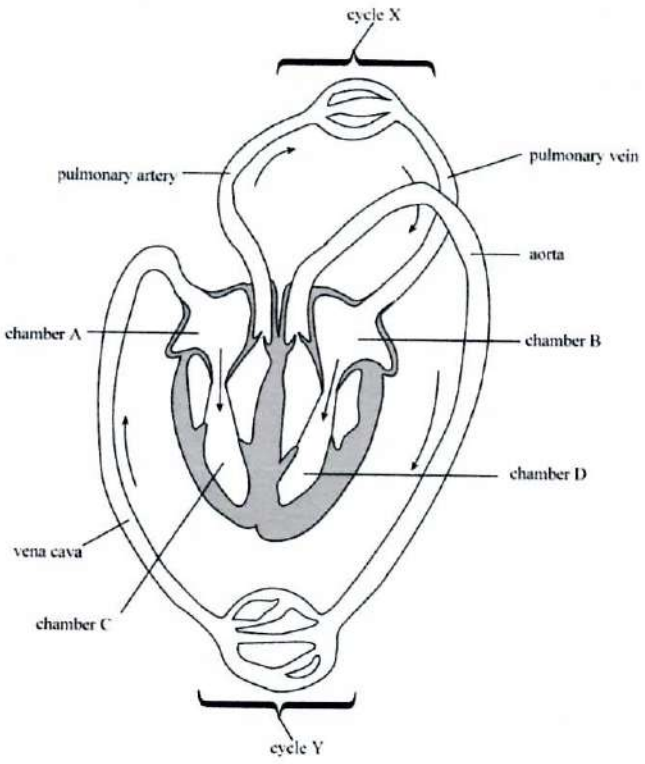


Fig.7.1

(i) Deduce the types of circulation represented by cycles X and Y.

cycle X .....

cycle Y .....

[2]

(ii) Suggest the reason for differences in the thickness of the walls of chambers C and D.

.....

.....

[2]

(iii) State any **three** symptoms of malaria.

1 .....

2 .....

3 .....

[3]

(iv) State a symptom of ebola which is different from symptoms of malaria.

.....

[1]

(v) State any **two** effects of inhaling glue.

1 .....

2 .....

[2]

8. (a) **Fig.8.1** shows a child suffering from a deficiency disease.

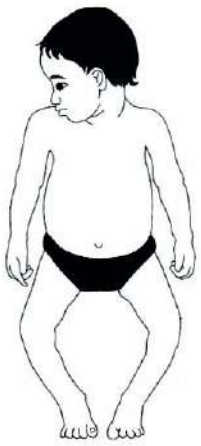


Fig.8.1

(i) Name the deficiency disease which the child is suffering from.

.....

[1]

(ii) Describe how the disease named in (i) could be prevented.

.....

.....

[2]

(b) Describe the route of the sperm from the testis to the oviduct.

.....

.....

.....

[4]

(c) State **one** advantage of using condoms during sexual intercourse.

.....

[1]

(d) Define the term *fertilisation*.

.....

.....

[2]

9. **(a)** **Fig.9.1** shows gaseous exchange in the alveolus of a mammal.

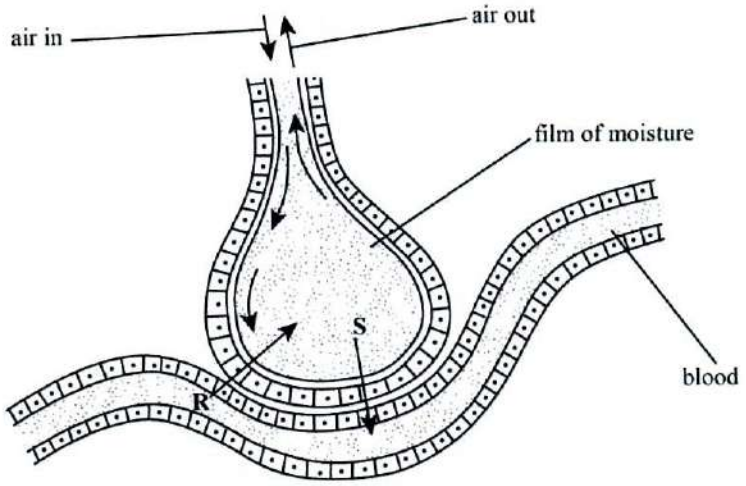


Fig.9.1

(i) Name the gases moving in the directions shown by the arrows **R** and **S**.

R .....

S .....

[2]

(ii) Describe and explain how the alveolus is adapted for gaseous exchange.

.....

.....

.....

.....

[4]

(b) Define the terms *plasmolysis* and *turgidity*.

plasmolysis .....

.....

turgidity .....

.....

[4]

Section C

*Answer any **two** questions in the spaces provided.*

10. **(a)** **(i)** Define the term *atom*.

.....

[1]

(ii) State the **two** sub-atomic particles found in the nucleus of an atom.

1 .....

2 .....

[2]

(b) Determine the empirical formula of a compound made up of 75% by mass carbon and 25% by mass hydrogen.

[4]

(c) Sodium hydroxide solution reacts with dilute nitric acid acid to form a salt and water.

(i) State the type of reaction that occurs.

.....

[1]

(ii) Determine the chemical formula of the salt.

.....

.....

[2]

11. (a) Outline the stages involved in the extraction of nitrogen from air.

.....

.....

.....

.....

.....

[4]

(b) Oxygen can be obtained from the electrolysis of acidified water.

(i) Name the acid used to acidify the water.

.....

[1]

(ii) Explain why the water is acidified.

.....

.....

[2]

(iii) Explain why the volume of oxygen obtained during the electrolysis process is half that of hydrogen.

.....

.....

[2]

(iv) State any **one** use of oxygen.

.....

[1]

12. **Fig.12.1**shows the production of sulphuric acid by the contact process.

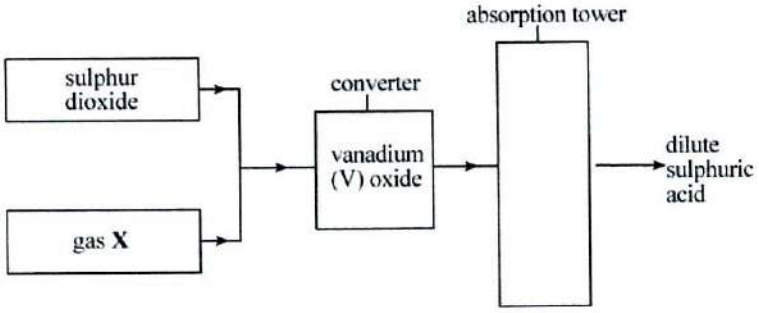


Fig.12.1

(a) **(i)** Name gas **X**.

.....

[1]

(ii) State the role of vanadium (V) oxide.

.....

[1]

(iii) Explain why sulphur trioxide is **not** directly added to water.

.....

.....

[2]

(iv) Define the terms *exothermic* and *reversible*.

exothermic .....

.....

reversible .....

.....

[2]

(v) Name the substance which is formed in the absorption tower.

.....

[1]

(b) Ammonium sulphate, $(NH_4)_2SO_4$, is a fertilizer produced from sulphuric acid.
Calculate the percentage composition by mass of nitrogen in ammonium sulphate.

[3]

Section D

*Answer any **two** questions in the spaces provided.*

13. (a) **Fig.13.1** shows an alternating current (a.c) generator.

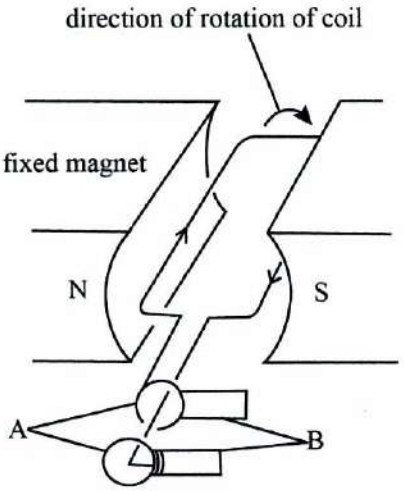


Fig.13.1

(i) Name the parts labelled **A** and **B.**

A .....

B .....

[2]

(ii) Describe how the a.c. generator produces electricity.

.....

.....

.....

.....

[4]

(iii) Sketch a graph of output voltage of the generator against time.

[2]

(b) Explain the effect of using stronger magnets on the magnitude of the output voltage.

.....

.....

[2]

14. (a) A gear system has ten teeth in the driving gear and thirty teeth in the driven gear.

(i) Calculate the velocity ratio, VR, of the gear system.

[2]

(ii) Determine the efficiency of the system if its mechanical advantage, MA, is 2.

[2]

(iii) Give any **two** reasons why the efficiency of a machine is always less than 100 %.

1 .....

2 .....

[2]

(iv) State any **two** ways by which the efficiency of a machine can be improved.

1 .....

2 .....

[2]

(b) State any **two** types of machines apart from gears.

.....

.....

[2]

15. (a) Describe how electricity is generated at a thermal power station.

.....

.....

.....

.....

[4]

(b) State any **two** disadvantages of using coal as a source of fuel for a thermal power station.

.....

.....

[2]

(c) Give the main difference between a thermal power station and a hydroelectric power station.

.....

.....

[2]

(d) State the type of energy possessed by water which is in a dam.

.....

[1]

(e) State the Standard International (S.I) unit of energy.

.....

[1]

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Ordinary Level

MARKING SCHEME

NOVEMBER 2019

COMBINED SCIENCE 4003/2

1. (a)

inhaled air	exhaled air
more oxygen	less oxygen
less carbon dioxide	more carbon dioxide
cooler	warmer
less water vapour	more water vapour

any two [2]

Notes: oxygen in exhaled air decreases because some is used for respiration. Carbon dioxide increases in exhaled air because it is produced during respiration as a waste gas. Water vapour increases in exhaled air because it is a waste product of respiration. Temperature of exhaled air is higher as air in the body is warmed to body temperature.

(b) (i) enhances water/mineral uptake from the soil

maintaining turgor pressure

cools the plant

any two [2]

(ii) leads to wilting (if water loss exceeds water gain)

[1]

(b) (iii) high temperature

low humidity

large surface area

high light intensity

greater number of stomata

high wind speed

any two [2]

2. (a) community of organisms and their physical environment

not controlled by human activities

[2]

(b) (i) correct type of nutrients in required proportions/quantities

Notes: a diet containing all types of nutrients in their correct proportions i.e. carbohydrates, proteins, vitamins, fats, mineral salts, water and fibre/roughage [2]

(ii) foetus requires the calcium for bone formation

[2]

(iii) provides iron/vitamin A/D/E/K

[1]

3. (a) (i) isotopes

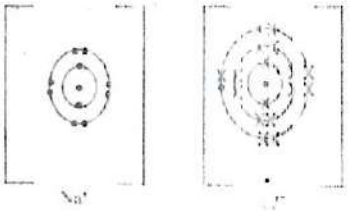
Notes: isotopes are atoms of the same element with different number of neutrons but with the same number of protons e.g. $_{8}^{16}O$ and $_{8}^{18}O$, $_{6}^{12}C$ and $_{6}^{14}C$ [1]

(ii) 35-17 = 18 neutrons

Notes: number of neutrons = relative atomic mass/mass number – proton(atomic) number [1]

(b) (i) ionic bond / electrovalent bond [1]

(ii)



[2]

Notes: candidates are required to draw the full electronic configuration of at least the valence shells and give the correct charges of the ions.

(c) soluble in water

has high melting point/boiling point

conducts electricity in molten state/in solution

solid at room temperature any two [2]

4. (a) base/alkali

it neutralises acids [2]

(b) iron (III) oxide [1]

(c) coke is oxidised to carbon monoxide which reduces iron (III) oxide to iron

limestone decomposes to form calcium oxide. The calcium oxide reacts with impurities. [4]

Notes: chemical name for coke is carbon and for limestone is calcium carbonate.

5. (a) (i) Stroke is power/ignition

reason 1: both valves are closed

reason 2: piston is moving down [3]

Notes: to identify correctly the stroke shown, the candidate should identify the position of the piston, whether it is moving upwards or downwards and then check whether the valves are open or closed

(b) (i) injects petrol into the inlet manifold/port/combustion chamber [1]

Notes: the inlet manifold is also known as the combustion chamber

(ii) mixes air with (a fine spray of liquid) fuel [1]

(iii) provides same amount of petrol to all cylinders leading to more efficient/powerful engine [2]

6. (a) place: roof top

reason: captures maximum heat

Notes: rooftop is the ideal position since there are no obstacles [2]

(b) colour: black

reason: good absorber of heat [2]

(c) (i) thin copper tubing: easily pass heat to the water [1]

(ii) insulation: reduces heat loss (from the water) [1]

7. (a) (i) X: pulmonary circulation

Y: systemic circulation [2]

(ii)

chamber C	chamber D
pumps blood under a lower pressure over a shorter distance/to the lungs	pumps blood under higher pressure over a longer distance/ to the whole body

[2]

(iii) shaking chills/shivering
high fever
excessive sweating
headache
nausea
vomiting
diarrhoea
anaemia;
muscle pain
convulsions
bloody stool
coma any three [3]

Notes: muscle pain can also refer to aching joints

(iv) external bleeding

[1]

(v) damage muscles
damage heart
causes addiction
damaged liver
seizures
vomiting
brain damage
breathing problems [2]

8. (a) (i) rickets

Notes: rickets develop due to the softening and weakening of bones in children which makes them bend under the weight of the child due to lack of vitamin D or calcium [1]

(ii) provide food rich in calcium/vitamin D
such as eggs/ milk/fish/ broccoli [2]

(c) reduced unwanted pregnancy/ reduce HIV transmission/ reduces transmission of STIs [1]

(d) fusion of male and female sex cell nuclei to form a zygote [2]

9. (a) (i) R: carbon dioxide
S: oxygen [2]

(ii) well ventilated to maintain concentration gradient of diffusing gases
dense network of blood capillaries to increase blood supply
folded/large surface area for maximum diffusion
film of moisture for easy diffusion of gases
thin walled for gases to have short diffusion distance [4]

(b) plasmolysis is the shrinking/contraction of protoplasm due to osmosis/exosmosis
turgidity is a state of fully expandedness /swollenness due to fullness with water [4]

10. (a) (i) the smallest particle of an element that can take part in a chemical reaction [1]

(ii) protons and neutrons [2]

(b)

C	H
$\frac{75}{12}$	$\frac{25}{1}$
$\frac{6.25}{6.25}$	$\frac{25}{6.25}$

$1 : 4 / CH_4$ [4]

Notes: write down the % mass of each element (this is equal to the mass of elements in a 100 g mass of the compound).

C	H
75	25

divide % mass by relative atomic mass

$\frac{75}{12}$	:	$\frac{25}{1}$
= 6.25		= 25

divide by the smallest number on your answers

$\frac{6.25}{6.25}$	:	$\frac{25}{6.25}$
1	:	4

CH_4

(c) (i) neutralisation [1]

(ii) $NaNO_3$

Notes: the salt formula, that is $NaNO_3$, must have correct symbols and a 1:1 balancing ratio [2]

11. (a) air is filtered to remove dust
air is cooled to remove water vapour and carbon dioxide
air is repeatedly compressed and expanded rapidly
to liquify it at –200 °C
liquid air is pumped into the fractioning column
liquid air is warmed to –196 °C
nitrogen boils off any four points [4]

(b) (i) sulphuric acid [1]

(ii) to ionise water for conduction of electricity [2]
Notes: pure water does not conduct electricity

(b) (iii) ratio of reaction of hydrogen to oxygen is 2:1 from the H_2O formula [2]
water is decomposed to give same ratio of gases by volume

(iv) making steel/medical use/welding [1]

12. (a) (i) oxygen [1]

(ii) It is a catalyst/it speeds up the reaction/it increases the speed of the reaction [1]

(iii) reaction is violent/explosive/dangerous/ highly exothermic/ forms a mist of sulphuric acid droplets which are difficult to condense [2]

(iv) exothermic refers to a reaction which produces heat energy
Notes: an example of exothemic reaction is when sulphuric acid is added to water and heat is produced

reversible refers to a reaction that can proceed in either direction depending on the conditions [2]
Notes: examples of a reversible reaction
nitrogen + hydrogen $\rightleftharpoons$ ammonia

sulphur dioxide + oxygen $\rightleftharpoons$ sulphur trioxide

(v) oleum [1]

(b) Total mass of nitrogen = $14 \times 2 = 28$

Molecular mass of $(NH_4)_2SO_4 = 2(14 + 4) + 32 + (16 \times 4) = 132$

Percentage $= \frac{28}{132} \times 100\%;$

[3]

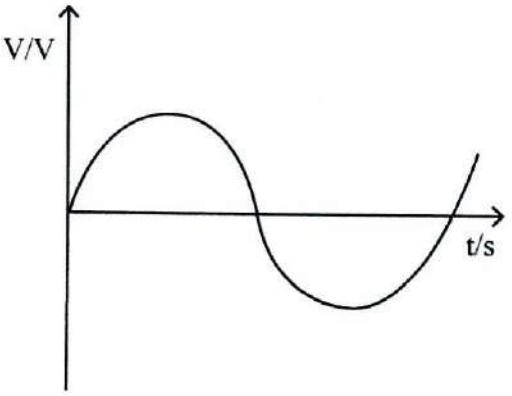
$=21.2\ \%;$

13. (a) (i) A: slip rings

B: carbon brushes [2]

(ii) coil rotates in magnetic field due to permanent magnets and cuts magnetic lines of force. Current is induced in the coil. Kinetic energy is converted to electrical energy. The induced current direction changes after every half rotation [4]

(iii)



[2]

(b) The voltage increases as more magnetic lines of force are cut [2]

14. (a) (i) $VR = \frac{number\ of\ teeth\ in\ driven\ wheel}{number\ of\ teeth\ driving\ wheel} / \frac{30}{10}$

$= 3$ [2]

(ii) Efficiency = $\frac{MA}{VR} \times 100\% / \frac{2}{3} \times 100$

= 66.7 % [2]

(iii) there is friction between moving parts which needs to be overcome

mass of moving parts of machine also needs to be overcome [2]

(iv) lubrication/oiling/greasing

use of ball bearings/rollers

use light material for the moving parts of the machine any two [2]

(b) levers

pulleys

inclined planes

wheel and axle any two [2]

15. (a) boilers are heated to produce steam under high pressure

the steam turns turbines connected to a coil

which is in a magnetic field [4]

current is induced as magnetic field cuts across the turns of the coil

(b) non-renewable
causes air pollution
use of cooling towers is expensive
leads to global warming any two [2]

(c) In a hydroelectric power station, the turbines are turned by force of water while in a thermal power station the turbines are turned by a force from steam [2]

(d) gravitational energy /potential energy [1]

(e) joule [1]

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Ordinary Level

COMBINED SCIENCE 4003/3

PAPER 3 Practical Test

NOVEMBER 2019 SESSION 1 hour 30 minutes

Candidates answer on the question paper.

Additional materials:
As listed in instructions to Supervisors
Calculator (optional)

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **both** questions.

Write your answers in the spaces provided on the question paper.

Use a sharp pencil for your drawings. Coloured pencils or crayons should **not** be used.

You should show the essential steps in any calculation and record all experimental results in the spaces provided in the question paper.

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

FOR EXAMINER'S USE	
1	
2	
TOTAL	

1. You are required to compare energy values of two food samples.

You are provided with 1.0 g mealie meal in a crucible, 1.0 g sugar in a crucible, a thermometer, a boiling tube and a graduated syringe.

Method

Using a graduated syringe, measure 5.0 cm^3 of water and pour it in the boiling tube.

Measure the initial temperature of the water and record it in **Table 1.1**.

Heat the mealie meal as shown in **Fig.1.1(a)**.

Heat the mealie meal until it turns brown.

Remove the burner and ignite the mealie meal.

Support the boiling tube using a pair of tongs as shown in **Fig.1.1(b)** and immediately start a stop watch.

Heat the water for 15 seconds.

Stir the water in the boiling tube with a thermometer and record the temperature in **Table 1.1**.

Complete **Table 1.1** by calculating the temperature change.

Repeat the experiment using the 1.0 g of sugar.

Fig 1.1 (a)

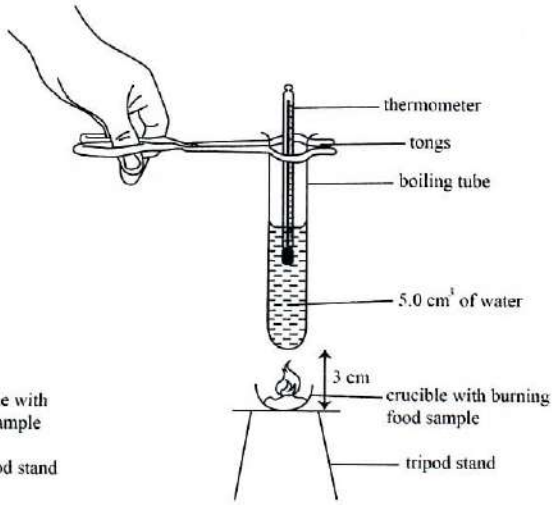


Fig 1.1 (b)

(a) (i)

Table 1.1

	mealie meal	sugar
final temperature of water/°C		
initial temperature of water/°C		
temperature change/°C		

[12]

(ii) State a reason for stirring the water before taking the temperature reading.

.....

[1]

(iii) Identify, with a reason, the food sample with a higher energy value.

food sample

.....

reason .....

[2]

(iv) Explain the difference in the energy values of the food samples.

.....

[1]

(v) Write a word equation for the burning of sugar.

.....

[2]

(b) **(i)** Suggest any **one** source of error in the experiment.

.....

.....

[1]

(ii) State any **one** precaution that needs to be taken during the experiment.

.....

.....

[1]

2. You are required to compare the reactivity of two metals based on their reaction with dilute hydrochloric acid. A liquid soap has been added to the dilute hydrochloric acid.

You are provided with two metals labelled M1 and M2, a test tube, a graduated syringe, dilute hydrochloric acid and a 30 cm ruler.

(a) **(i)** Measure 5.0 cm^3 of the dilute hydrochloric acid using a graduated syringe and place the acid into a test tube.

Place metal M1 into the test tube and immediately start the stop watch.

Measure the depth of the foam produced after 3 minutes and record it in **Table 2.1**.

Rinse the test tube.

Repeat the experiment using dilute hydrochloric acid and metal M2.

Measure and record the depth of the foam produced for metal M2 in **Table 2.1**.

Note: The metals used have the same number of moles.

Table 2.1

metal	depth of the foam/ mm
M1	
M2	

[10]

(ii) Identify, with a reason, which metal, M1 or M2, is more reactive.

metal .....

reason .....

[2]

(iii) Explain why copper **cannot** be one of the metals used in the experiment.

.....

.....

.....

[2]

(iv) Write a general word equation for the reaction of a metal and an acid.

.....

[2]

(v) State, with a reason, another way of comparing the reactivity of M1 and M2 when reacting with an a dilute acid.

.....

.....

.....

[2]

(b) (i) State **one** precaution that should be taken during the experiment.

.....

.....

[1]

(ii) Suggest **one** possible source of error during the experiment.

.....

.....

[1]

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Ordinary Level

MARKING SCHEME

NOVEMBER 2019

COMBINED SCIENCE 4003/3

2. 1. Marks are awarded as follows:

Table completely recorded [2]

temperature recorded to one decimal place [1]

correct temperature change calculations [2]

correct trend of sugar giving a higher temperature change than mealie meal [1]

accuracy marks are 3 per experiment [6]

Table 1.1

(a) (i)

	mealie meal	sugar
final temperature of water/°C		
initial temperature of water/°C		
temperature change/°C		

[12]

Accuracy for mealie meal and sugar as compared to the supervisor's results will be awarded according to the following ranges i.e. accuracy per experiment scores 3 marks, minus 1 mark for each deviation of 0.5 °C

temperature range/ °C	marks awarded
± 3	3
± 3.5	2
± 4.0°	1
> ± 4.0	0

(ii) to distribute the heat [1]

(iii) sugar

a higher temperature change was observed [2]

(iv) mealie meal contains starch or polysaccharides/sugar contains simple sugars or disaccharides

or starch bonds require more energy to break so less energy will be available for heating the water [1]

(v) sugar/sucrose/carbohydrate + oxygen $\rightarrow$ carbon dioxide + water + energy [2]

(b) (i) heat lost to the surroundings/parallax error [1]

(ii) handle hot substances with care/wear goggles [1]

2. Table 2.1

Metal	Depth of foam/mm
M1	
M2	

[10]

Table 2.1 marks are awarded as follows:

(a) (i) Table completely recorded (2 marks)

Depth of form recorded to 1 decimal place (1 mark)

Trend M2 giving a higher depth of form than M1 (1 mark)

Accuracy marks are 3 per experiment [6]

NB M1 is zinc and M2 is magnesium and magnesium is more reactive than zinc.

Accuracy for M1 and M2 from the supervisor's results will be awarded according to the following ranges.

1 mark is deducted for every 2 mm deviation from the supervisor's values

depth of form/mm	marks awarded
± 2	3
± 4	2
± 6	1
>± 6	0

NB these ranges are not fixed and may be adjusted due to the sensitivity of the experiment.

(ii) M2 because it produced a bigger depth of foam/more bubbles [2]

(iii) no foam produced

since copper does not react with dilute acids [1]

(iv) metal + acid $\rightarrow$ salt + hydrogen

[2]

(v) recording temperature changes

the more reactive metal releases more heat [2]

(vi) to ensure that differences in the results are due to the metals used

[1]

(b) (i) wear protective clothing/handle solutions with care

[1]

(ii) parallax error/ systematic error

[1]