BOTSWANA EXAMINATIONS COUNCIL
Botswana General Certificate of Secondary Education

**SCIENCE: DOUBLE AWARD** **0569/03**

Paper 3 Theory **October/November 2022**

**2 hours**

Candidates answer on the Question Paper.

No Additional Materials are required.

**CANDIDATE NAME**

**CENTRE NAME**

0406065

**INSTRUCTIONS**

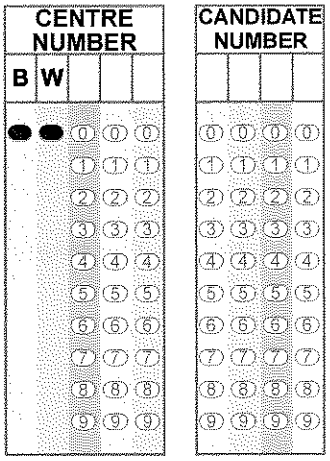
**Shade using an HB pencil, do not use ink.**

**Erase unwanted marks completely.**

**Do not use correction fluid.**

**Do not make any stray marks on this form.**

**Mark answers by shading the oval heavily, like this: -** ●




**INSTRUCTIONS**

- Answer **all** questions.
- Use black or dark blue pen.
- Write your candidate name, Centre number and candidate number in the spaces provided at the top of this page.
- Write your answer to each question in the space provided.
- Do not use an erasable pen or correction fluid.
- Do not write on any barcodes.
- You may use an HB pencil for any diagrams, graphs or rough working.

**INFORMATION**

- The total mark for this paper is 100.
- The number of marks for each question or part question is shown in brackets
- You may use a calculator.
- You may lose marks if you do not show your working.
- A copy of the Periodic Table is printed on last page.

This document consists of **18** printed pages and **2** blank pages.

**[Turn over**

1 An object falls from a tall tower and takes 4.0 s to reach the ground. ($g$ = 10 m / s$^2$)

**(a)** Calculate:

**(i)** the speed of the object when hitting the ground,

speed = ..... [2]

**(ii)** the height of the tower.

height = ..... [2]

**(b)** State the major energy change as the object falls.

..... to kinetic energy. [1]

**(c)** The kinetic energy of the object when hitting the ground is 1000 J.

Calculate the mass of the object.

mass = ..... kg [2]

2 Fig. 2.1 shows a child sitting near a fire place in a house.

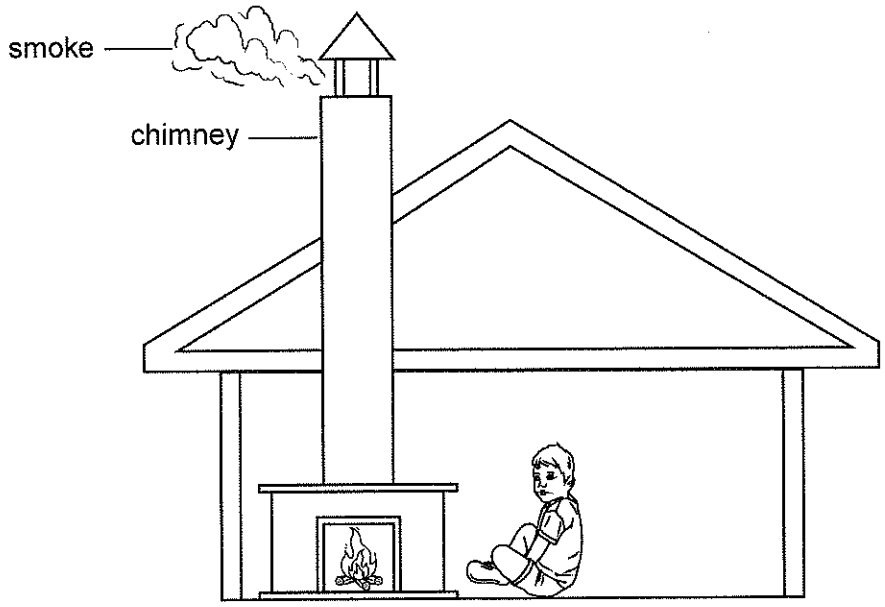



**Fig. 2.1**

**(a)** State the name of the process that enables heat to flow from the fire place to the child.

..... [1]

**(b)** The child touches the wall on the side of the fire place and feels warm.

State the name of the process that transferred heat through the wall.

..... [1]

**(c)** Describe the process that enables the smoke to leave the house through the chimney.

.....

.....

.....

..... [3]

3 Fig. 3.1 shows the displacement-time graph of a wave.

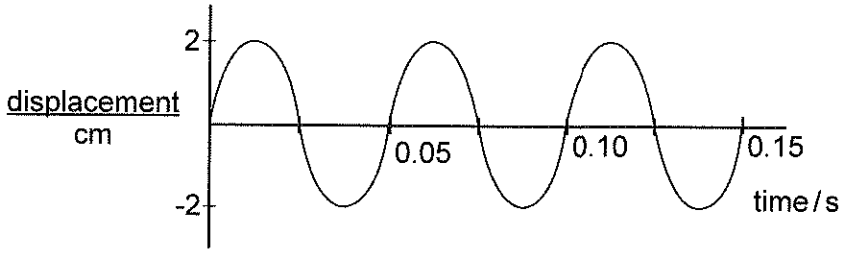



**Fig. 3.1**

**(a)** Define *amplitude*.

.....

..... [1]

**(b)** **(i)** Determine the frequency of the wave.

frequency = ..... Hz [2]

**(ii)** The speed of the wave is 2.0 m / s.

Calculate its wavelength.

wavelength = ..... [2]

4 An electrical kettle with a power rating of 2000 W is connected to the 240 V mains supply.

**(a)** Define *power*.

.....

..... [1]

**(b)** The kettle is switched on until the water boils in 300 s.

Calculate:

**(i)** the current in the kettle, using the equation

$$\text{current} = \frac{\text{power}}{\text{voltage}}.$$

current = ..... [1]

**(ii)** the energy supplied.

energy = ..... J [2]

**(c)** The cable of the kettle has a sticker with this symbol, 

State the meaning of the symbol.

..... [1]

7 A list of names of gases is given.

**propane** **ammonia** **nitrogen**

**carbon dioxide** **propene** **carbon monoxide**

Use the list to answer questions **(a)** to **(f)**.

Each name can be used **once**, **more than once** or **not at all**.

State the name of a gas which:

**(a)** contains only one type of atom,

..... [1]

**(b)** is an unsaturated hydrocarbon,

..... [1]

**(c)** dissolves in water to form an aqueous solution that gives a green precipitate when added to iron(II) chloride solution,

..... [1]

**(d)** reduces iron(III) oxide to iron in the blast furnace,

..... [1]

**(e)** is produced when a strong base is added to ammonium chloride,

..... [1]

**(f)** dissolves in water to form an acidic solution.

..... [1]

**8** A redox reaction occurs when iron filings are added to aqueous copper(II) sulphate solution.

The equation of the reaction is

$$Fe(s) + CuSO_4(aq) \rightarrow Cu(s) + FeSO_4(aq)$$

**(a)** **(i)** State **one** observation that would be made during the reaction.

..... [1]

**(ii)** Name an oxidising agent from the equation.

..... [1]

**(b)** In another experiment, excess iron filings are reacted with 30.0 $cm^3$ of 0.150 mol / $dm^3$ sulphuric acid as shown by the equation.

$$Fe(s) + H_2SO_4(aq) \rightarrow FeSO_4(aq) + H_2(g)$$

**(i)** Calculate the number of moles of sulphuric acid contained in 30.0 $cm^3$ of 0.150 mol / $dm^3$ solution.

moles = ..... [2]

**(ii)** Use the answer to **(b)(i)** and the equation to calculate the number of moles of iron(II) sulphate, $FeSO_4$, that were produced.

moles = ..... [1]

**(iii)** Calculate the mass of iron(II) sulphate produced during the reaction [*Mr*: $FeSO_4$, 152].

mass = ..... [2]

**(iv)** The percentage yield of iron(II) sulphate, $FeSO_4$, obtained was 80.3%.

Use the answer to (**b**)(**iii**) and the percentage yield to calculate the actual mass of iron(II) sulphate produced.

mass = ..... [2]

9 Naphtha is one of the fractions obtained from crude oil.

**(a)** State the name of the process used to obtain naphtha from crude oil.

..... [1]

**(b)** Naphtha contains a saturated hydrocarbon with formula $C_{12}H_{26}$.

**(i)** Describe a test to show that the hydrocarbon is saturated.

test:.....

result:.....

.....

[2]

**(ii)** One mole of the hydrocarbon, $C_{12}H_{26}$, can be cracked to form one mole of an alkane and 4 moles of ethene.

Deduce the formula of the alkane. Show your working.

[2]

**(iii)** Ethene reacts with chlorine to form an organic compound **X**.

Draw the structure of the organic compound **X**.

[2]

**(c)** Ethene can undergo addition polymerisation to form polyethene.

**(i)** Define the term *addition polymerisation*?

.....

..... [1]

**(ii)** State the property of polyethene that makes it a pollution problem.

.....

..... [1]

10 Fluorine is a group VII element. It can react with sodium metal to form sodium fluoride.

**(a)** Construct a balanced chemical equation for the reaction between fluorine and sodium metal. Include state symbols.

..... [3]

**(b)** Fluorine reacts with hydrogen to form hydrogen fluoride.

**(i)** State the name of the type of bonding in hydrogen fluoride.

..... [1]

**(ii)** Draw a 'dot and cross' diagram to show the bonding in hydrogen fluoride. Show all the electron shells.

[2]

**(iii)** Explain why the melting point of sodium fluoride compares with that of hydrogen fluoride.

.....

.....

.....

.....

..... [3]

11 The concentration of sugar in the blood is kept fairly constant in humans.

**(a)** State the name of the process of keeping blood sugar concentration constant in humans.

..... [1]

**(b)** State the name of the hormone responsible for lowering of blood sugar when it increases above normal.

..... [1]

**(c)** Fig.11.1 shows some of the endocrine glands of the human body.

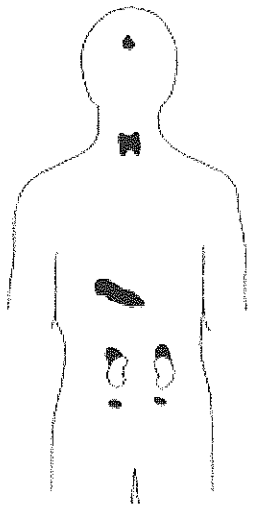


**Fig. 11.1**

On Fig. 11.1, use

**(i)** a label line and letter "W" to show where the hormone named in **(b)** is produced.

**(ii)** a label line and letter "X" to show where adrenaline is produced.

[2]

**(d)** Explain why the concentration of blood sugar increases when the concentration of adrenaline increases in the blood.

.....

.....

.....

.....

.....

..... [3]

**12** Fig.12.1 shows part of the kidney and associated structures.

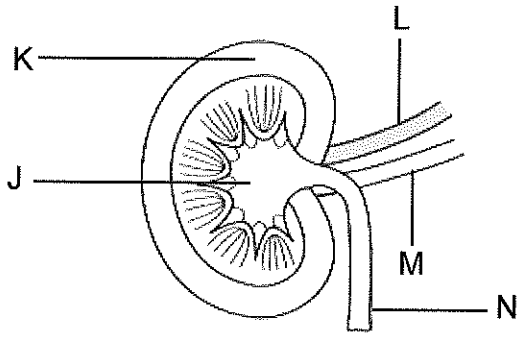



**Fig. 12.1**

**(a)** State the names of parts labelled J and K.

J .....

K ..... [2]

**(b)** State the functions of structures M and N.

**(i)** M: .....

..... [1]

**(ii)** N: .....

..... [1]

**(c)** Suggest an explanation of how the concentration of oxygen changes as blood flows in and out of the kidney.

change .....

explanation .....

.....

.....

[2]

**(d)** If the kidney fails, the patient may be put on a kidney machine.

Describe how the kidney machine removes urea from the blood.

.....

.....

.....

.....

..... [4]

**13** Fig.13.1 shows a foetus during pregnancy.

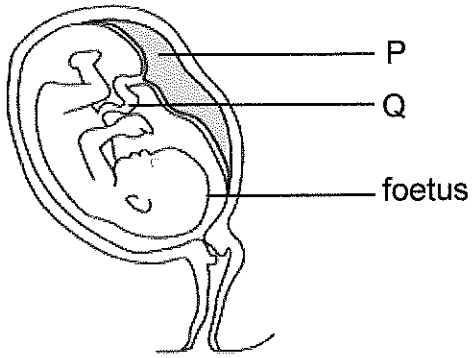



**Fig. 13.1**

**(a)** **(i)** State the names of structures labelled P and Q.

P .....

Q .....
[2]

**(ii)** Describe the role of structure P in the development of the foetus.

.....

.....

.....

..... [3]

**(iii)** Suggest how the developing foetus can be protected against contracting HIV during pregnancy when the mother is HIV positive.

.....

..... [1]

**(b)** A surgical method is one of the methods of birth control.

**(i)** Describe how the surgical method in women prevents pregnancy.

.....

..... [2]

**(ii)** State **one** disadvantage of the surgical method.

.....

..... [1]

14 Fig.14.1 is a graph showing the effects of humidity on the rate of transpiration.

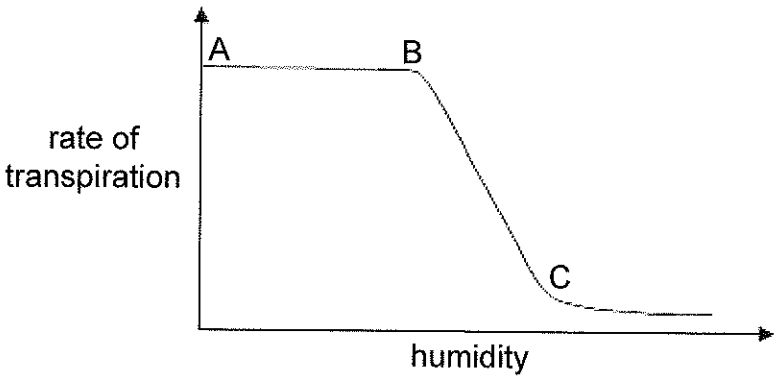



**Fig. 14.1**

**(a)** Define transpiration.

.....

..... [1]

**(b)** Describe and explain the shape of the graph between

**(i)** AB,

.....

.....

..... [2]

**(ii)** BC.

.....

.....

..... [2]

**(c)** Suggest an environmental condition, other than humidity, which can lead to the rate of transpiration

**(i)** at A,

.....

.....

**(ii)** at C.

.....

.....

[2]

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# DATA SHEET
## The Periodic Table of the Elements

| Group | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | II | | | | | | | | | | III | IV | V | VI | VII | 0 |
| | | | | | | | 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 † | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 |
| 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 |

*58-71 Lanthanoid series
†90-103 Actinoid series

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

The volume of one mole of any gas is 24 $dm^3$ at room temperature and pressure (r.t.p.).