BOTSWANA EXAMINATIONS COUNCIL
Botswana General Certificate of Secondary Education

CANDIDATE NAME			
CENTRE NUMBER		CANDIDATE NUMBER	

PHYSICS **0571/03**

Paper 3 Theory **October/November 2021**

1 hour 15 minutes

You must answer on the Question Paper.

Additional Materials: Electronic calculator
300 mm ruler

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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 IN ANY BARCODES.
- You may use an HB pencil for any diagrams, graphs or rough working.

INFORMATION

- The total mark for this paper is 70.
- The number of marks for each question or part question is shown in brackets [ ].
- You may lose your marks if you do not show your working.
- Take the weight of 1 kg to be 10 N (i.e. acceleration of free fall = 10 m / s^2)

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1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
TOTAL	

This document consists of **14** printed pages and **2** blank pages.

For Examiner's Use

1 **(a)** Define the term *acceleration*.

....

.... [1]

(b) Fig. 1.1 shows two cars A and B travelling towards each other along a straight, level and narrow road.

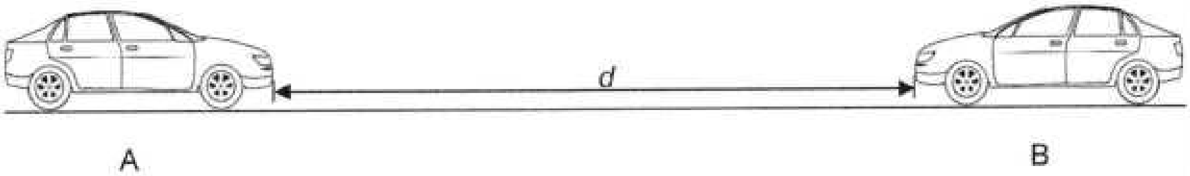

Fig. 1.1

Car A travels at 10 m / s and car B travels at 15 m / s.

When the distance *d* between the cars is 100 m both drivers apply the brakes.
Both cars decelerate uniformly at 2 m / s^2 until they stop.

Calculate the distance travelled by:

(i) car A after the brakes were applied until it stops,

distance = ... [2]

(ii) car B after the brakes were applied until it stops.

distance = ... [1]

(c) Suggest whether the cars collide or not. Justify your answer.

suggestion ....

justification ....

....

[2]

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2 **(a)** State **two** conditions for an object to be in equilibrium when parallel forces act on it.

1 ....

2 .... [2]

(b) Fig. 2.1 shows a boy and a girl sitting on a uniform beam of length 2.0 m and weight 50 N. The beam is suspended at points X and Y with ropes from a metal frame.
The diagram is not drawn to scale.

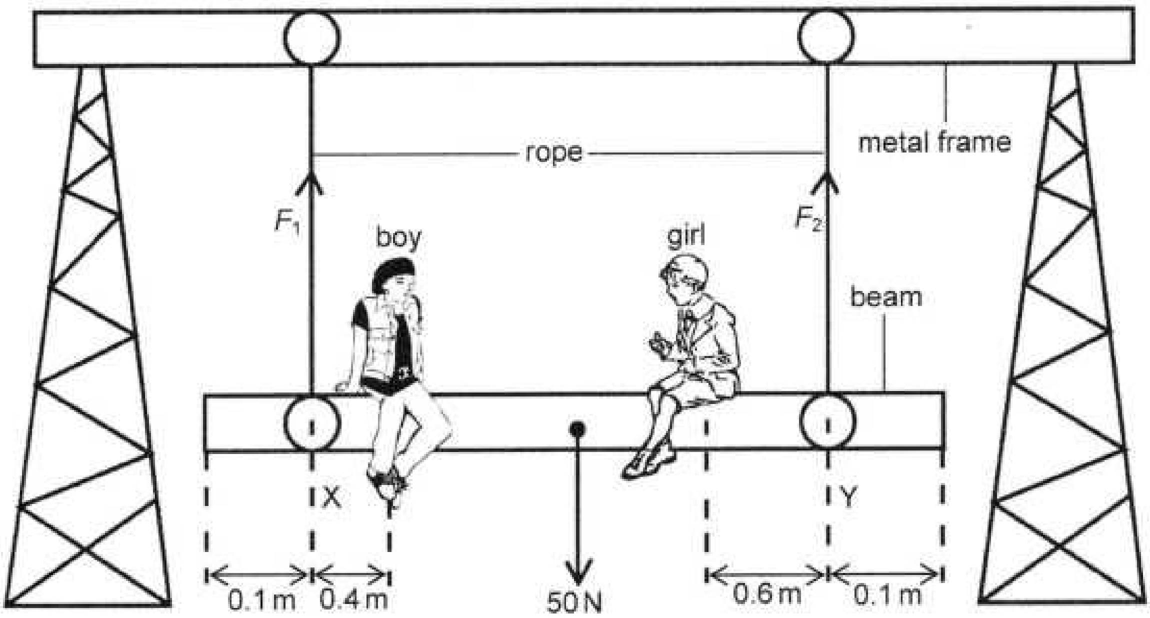

Fig. 2.1

The weight of the boy is 600 N and the weight of the girl is 500 N.
F_1 and F_2 are the tensions in the ropes.

(i) Taking moments about X, calculate F_2.

F_2 = ... [3]

(ii) Determine F_1.

F_1 = ... [1]

[Turn over

For Examiner's Use

3 The *specific latent heat of fusion* for ice is 330 000 J / kg.

(a) Explain the meaning of this statement.

....

.... [1]

(b) Fig. 3.1 shows an immersion heater of power rating 150 W used to heat crushed pure ice in a funnel. The temperature of the ice is 0 °C.

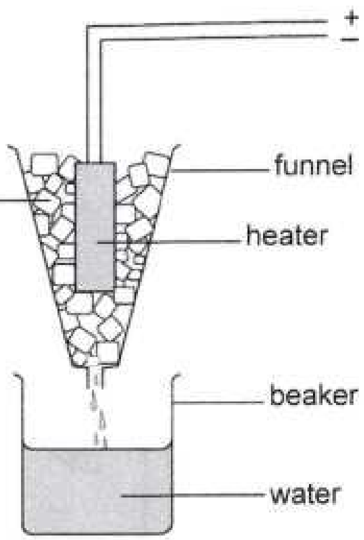

Fig. 3.1

The heater is switched on for 100 s and some of the ice melts.
The temperature of the ice remains constant.
The heater is fully submerged in ice and is 100% efficient.

(i) Explain why the temperature of the ice remains constant.

....

.... [1]

(ii) Calculate the mass of the ice that melts in 100 s.

mass = ... [2]

(iii) The actual mass of the water in the beaker is larger than the mass obtained in **(c)(ii)**.

Suggest why this is so.

....

.... [1]

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4 Fig. 4.1 shows a city that is located very close to the sea.

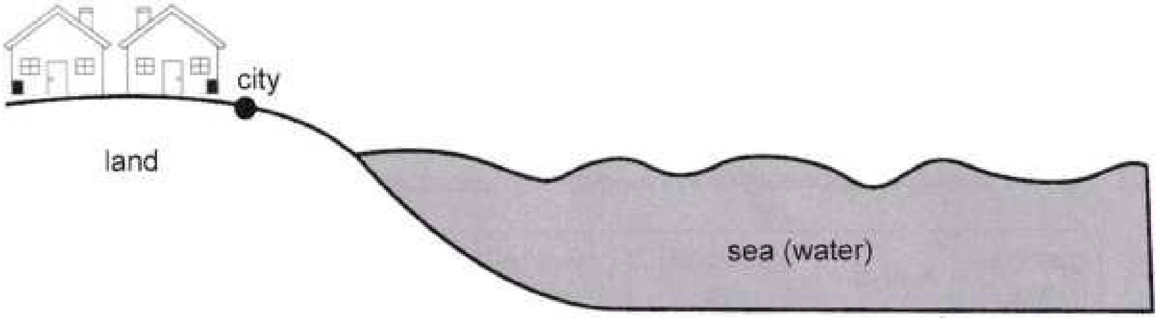

Fig. 4.1

(a) During a hot day, cool air moves from the sea towards the city.

(i) State the name of the process that produces this movement of air.

.... [1]

(ii) Explain what causes the movement of the air from the sea towards the city.

....

....

....

.... [3]

(b) During a hot day, elephants move into a pond of water.
The elephants draw water from the pond with their trunks and pour it onto their bodies.

Explain how the water on the bodies of the elephants helps them to cool down.

....

....

.... [2]

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5 **(a)** State **two** properties of electromagnetic waves.

1 ....

2 ....
[2]

(b) Fig. 5.1 shows components of the electromagnetic spectrum.

gamma rays	X-rays	ultraviolet rays	visible light	infrared rays	microwaves	radio waves

Fig. 5.1

State the name of the component of the spectrum that is:

(i) used in remote controls for television,

....

(ii) produced by white-hot objects.

....
[2]

(c) A radio station transmits radio waves at a frequency of 98 MHz.
The speed of the radio waves is 3.0×10^8 m/s.

Calculate the wavelength of the radio waves.

wavelength = ... [2]

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6 (a) Define the term *wavelength*.

....

.... [1]

(b) Fig. 6.1 shows wave fronts of water waves in deep water after crossing a boundary.

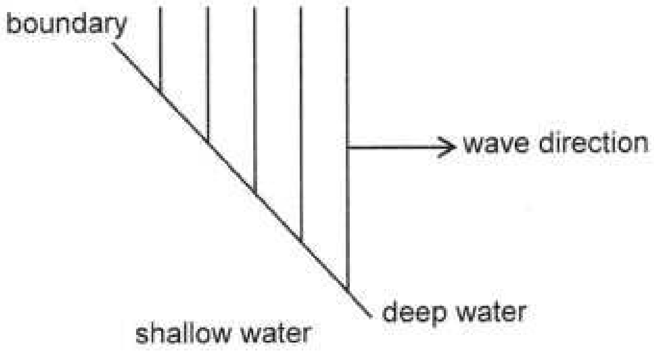

Fig. 6.1

On Fig. 6.1, draw the wave fronts in shallow water before crossing the boundary. [3]

(c) State the change, if any, on the frequency and the speed of the waves when they enter the deep water region.

frequency ....

speed ....
[2]

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7 **(a)** State **two** properties of magnets.

1 ....

2 ....
[2]

(b) Fig. 7.1 shows a permanent magnet freely suspended near an electric circuit.
The switch S is open.

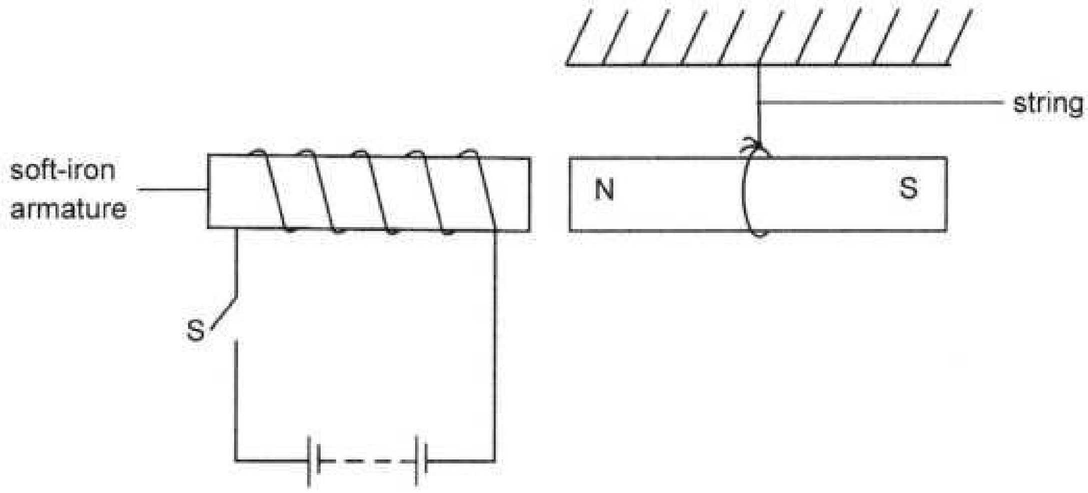

Fig. 7.1

The permanent magnet is observed to move towards the soft-iron armature.

(i) Explain why the permanent magnet moves towards the soft-iron armature.

....

.... [2]

(ii) The switch S is then closed.

State the observation made. Explain your answer.

observation ....

....

explanation ....

....

....
[3]

8 **(a)** Define the term *volt*.

....

.... [1]

(b) Fig. 8.1 shows an electric circuit. Resistors X and Y are identical.

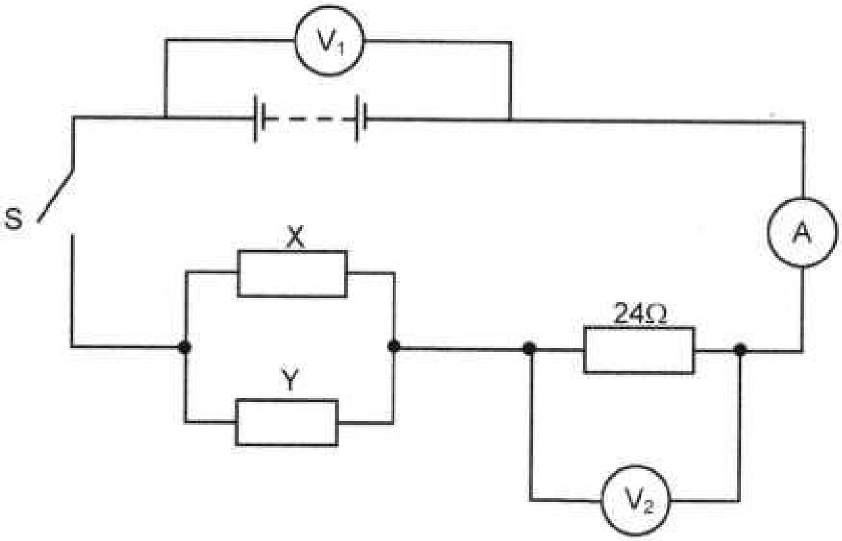

Fig. 8.1

The reading on voltmeter V_1 is 12.0 V and on voltmeter V_2 is 9.0 V.
The switch S is closed.

Determine:

(i) the ammeter reading,

ammeter reading = ... [2]

(ii) the resistance of resistor X,

resistance X = ... [3]

[Turn over

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(iii) the power dissipated in the 24 Ω resistor.

power = ... [2]

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9 Fig. 9.1 shows a straight conductor AB placed between unlike poles, X and Y, of two magnets.

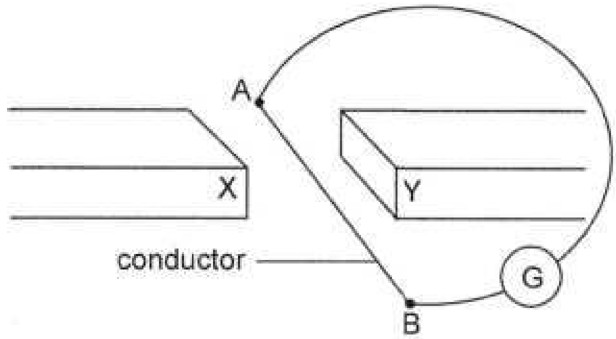

Fig. 9.1

The conductor AB is moved upwards and this motion induces current in the conductor.
The direction of the current in the conductor is from B to A.

(a) Identify the pole Y of the magnet.

Y .... [1]

(b) State **two** ways of increasing the size of the induced current in conductor AB.

1 ....

2 ....
[2]

(c) Fig. 9.2 shows how electricity is transmitted from a power station to a house.

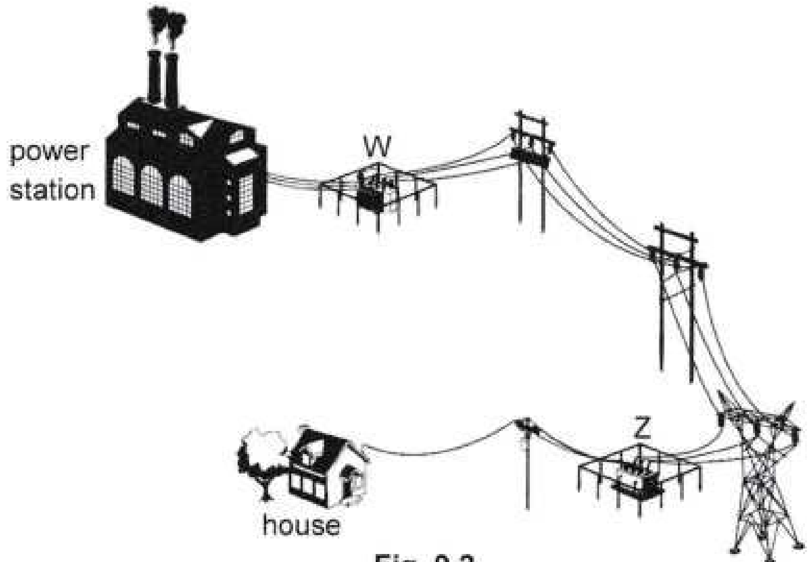

Fig. 9.2

W and Z are transformers.

(i) State the type of transformers labelled W and Z.

W ....

Z ....
[1]

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(ii) Explain why electricity from power stations is transmitted at high voltage.

....

....

....

.... [2]

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10 Fig. 10.1 shows an electric circuit used to operate a lamp.

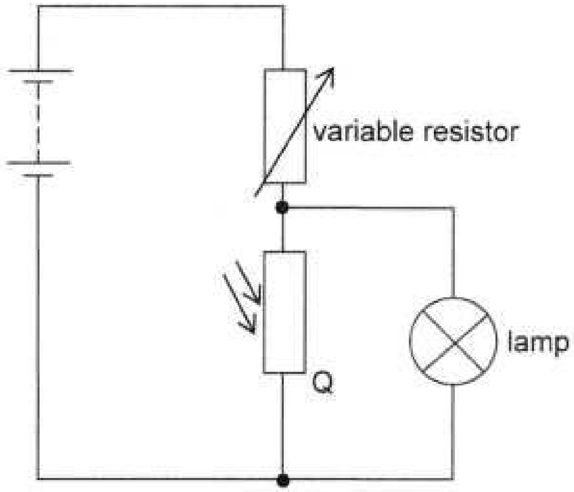

Fig. 10.1

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During the day the lamp switches off and at night it switches on.

(a) State the name of component Q.

.... [1]

(b) Explain how the lamp switches on at night.

....

....

....

.... [3]

(c) State the function of the variable resistor in the circuit.

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.... [1]

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11 Table 11.1 shows the names of three radioactive emissions.

Table 11.1

radioactive emission	nature
alpha	
beta	
gamma	

(a) Complete Table 11.1 by stating the nature of each radioactive emission. [2]

(b) State the name of the radioactive emission with the greatest ionising effect.

.... [1]

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(c) A radioactive nuclide $^{220}_{86}X$ decays into a stable nuclide Y by emitting an alpha particle.

The reaction is represented by the equation

$$^{220}_{86}X \rightarrow {}^{A}_{Z}Y + \alpha$$

Determine the values of A and Z.

A = ...

Z = ...
[2]

(d) A radioactive sample contains 20 mg of nuclide X.
Nuclide X has a half-life of 28 years.

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Determine the mass of nuclide X left in the sample after 112 years.

mass = ... [2]

(e) State **two** ways of handling radioactive sources safely.

1 ....

2 ....
[2]