



BOTSWANA EXAMINATIONS COUNCIL  
Botswana General Certificate of Secondary Education

CANDIDATE  
NAME

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CENTRE  
NUMBER

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CANDIDATE  
NUMBER

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**PHYSICS**

**0571/03**

Paper 3

**October/November 2017**

**1 hour 15 minutes**

Candidates answer on the Question Paper.

Additional Materials:    Electronic calculator  
                                  300 mm ruler

**READ THESE INSTRUCTIONS FIRST**

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

Answer **all** questions.

Write your answers in the spaces provided on the Question Paper.

You may lose marks if you do not show your working or if you do not use appropriate units.

Do not use staples, paper clips, highlighters, glue or correction fluid.

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

Take the weight of 1 kg to be 10 N (i.e. acceleration of free fall = 10 m/s<sup>2</sup>).

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
<b>TOTAL</b>	

This document consists of **16** printed pages.

**[Turn over**

1 (a) (i) State the difference between a vector and a scalar quantity.

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

(ii) Give **one** example of a scalar quantity.

..... [1]

(b) (i) A parachutist falls vertically at a constant velocity of 4.8 m/s. Wind blows and moves the parachutist horizontally at a velocity of 3.0 m/s as he continues to fall.

Using a suitable scale, draw a vector diagram to determine the resultant velocity of the parachutist. State the scale used.

scale used = .....

resultant velocity = ..... [4]

(ii) State the angle between the vertical velocity and the resultant velocity of the parachutist.

angle = ..... [1]



2 Fig. 2.1 shows a metal rod RS being heated at end R.

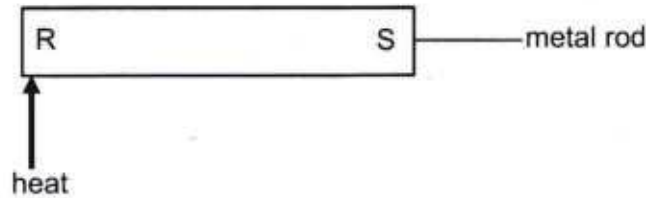


Fig. 2.1

(a) Name the process by which thermal energy moves from R to S.

..... [1]

(b) Describe the process by which thermal energy moves from R to S.

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

(c) Fig. 2.2 shows metal rods P and Q of the same dimensions with similar pins attached at each end using candle wax.

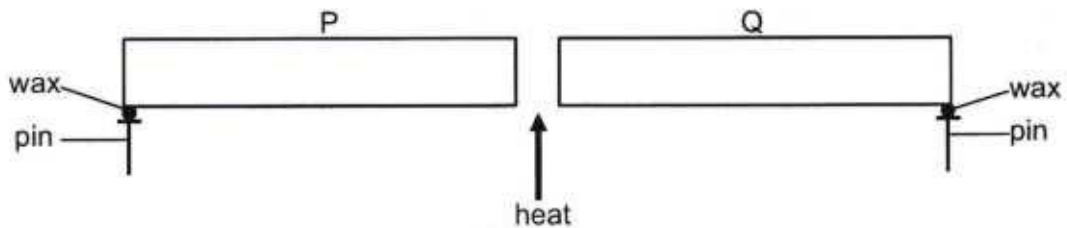


Fig. 2.2

When the metal rods are heated, the heated end of rod Q becomes red hot but the heated end of rod P does not change colour for some time. The same amount of heat per second is given to the end of each rod.

State which rod the pin falls off first. Explain your answer.

rod .....

explanation .....

..... [2]



- 3 Fig. 3.1 shows ball A and ball B at height  $h$  above the ground.

Ball A is moving vertically upwards at a velocity of  $15 \text{ m/s}$ .  
Ball B has just been released from rest to fall to the ground.  
Ignore air resistance.

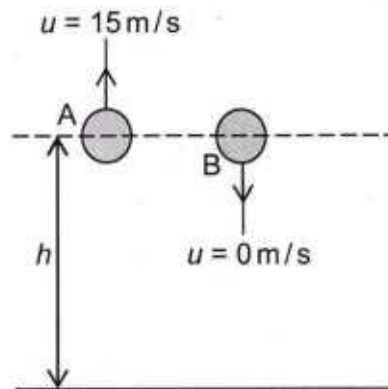


Fig. 3.1

- (a) State the speed of ball A at its maximum height.

speed = ..... [1]

- (b) Explain why ball A eventually returns to the ground.

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

- (c) Calculate the time taken for ball A to reach its maximum height from height  $h$ .

time = ..... [2]

(d) Ball A reaches its maximum height before ball B reaches the ground.

Calculate

(i) the maximum height of ball A above the position shown in Fig. 3.1,

height = ..... [2]

(ii) the velocity of ball B when ball A reaches its maximum height,

velocity = ..... [1]

(iii) the distance between ball A and ball B when ball A reaches its maximum height.

distance = ..... [1]



4 (a) Define the term *specific heat capacity*.

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

(b) An iron ball of mass 0.030 kg is transferred from boiling water at 100 °C to 0.120 kg of cold water at 24 °C. The final temperature of the water is 26 °C.

The specific heat capacity of water is 4200 J/(kg °C).

Assume that the thermal energy lost by the iron ball is equal to the thermal energy gained by the water and that no evaporation occurs.

Calculate

(i) the temperature decrease of the iron ball,

temperature decrease = ..... [1]

(ii) the thermal energy gained by the cold water,

thermal energy = ..... [2]

(iii) the specific heat capacity of the ball.

specific heat capacity = ..... [2]

(iv) Explain why the actual amount of thermal energy lost by the iron ball is more than the actual amount of thermal energy gained by water.

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



- 5 Fig. 5.1 shows a thin converging lens.  
The principal focus  $F$ , is marked on both sides of the lens.

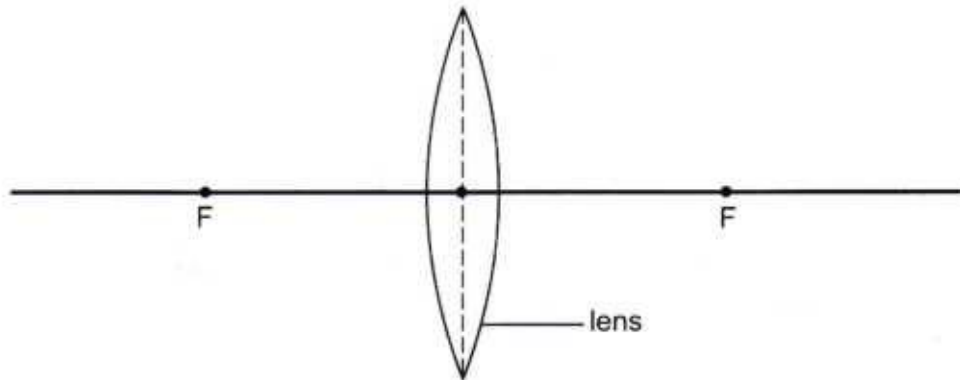


Fig. 5.1

- (a) On Fig. 5.1,
- (i) use an arrow to draw an object at a position where the lens will form a virtual image of the object.  
Label the object  $O$ . [1]
  - (ii) draw two complete rays to show how the virtual image is formed, draw the image and label it  $I$ . [2]

- (b) The image is virtual.

State **two** other characteristics of the image formed.

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

- 6 Fig. 6.1 shows water wavefronts in a pool of water. The wavefronts are moving from a region of shallow water to a region of deep water.

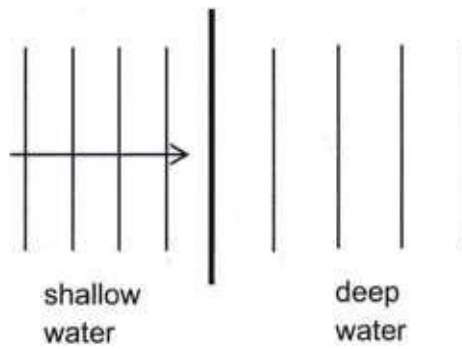


Fig. 6.1

- (a) State what happens to the **frequency**, the **speed** and the **wavelength** of the wave when the wavefronts enter the deep water region.

frequency .....

speed .....

wavelength .....

[3]

- (b) The waves have a speed of 0.21 m/s in the deep water region. The wavefronts are 0.060 m apart.

Calculate the frequency of the waves.

frequency = ..... [2]

(c) Fig. 6.2 shows wavefronts moving towards deep water at an angle to the boundary.

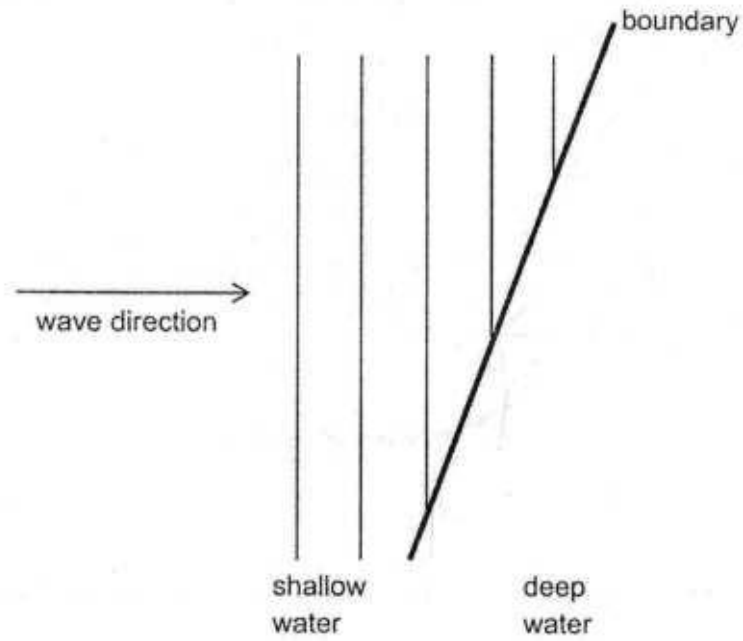


Fig. 6.2

On Fig. 6.2, draw the wavefronts after crossing the boundary into deep water.

[3]



- 7 Fig. 7.1 shows a fuel tanker delivering petrol at a filling station. As the petrol is pumped out of the tanker, negative electrostatic charges build up on the petrol and positive electrostatic charges build-up on the body of the tanker as shown.

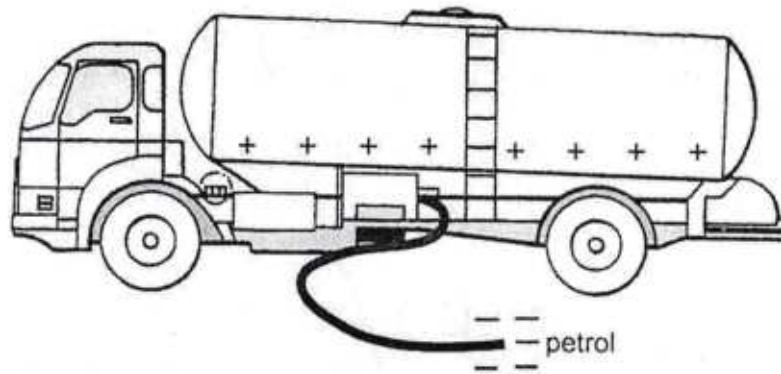


Fig. 7.1

- (a) State the name of the particle that is transferred during electrostatic charging.

..... [1]

- (b) Suggest a reason why a build-up of electrostatic charges can be dangerous when petrol is pumped out of the tanker.

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

- (c) State and explain what can be done to control the build-up of charge on the tanker.

control .....

explanation .....

..... [2]



- 8 Fig. 8.1 shows a step-down transformer with 1000 turns in the primary coil and 50 turns in the secondary coil. The diagram is not drawn to scale.

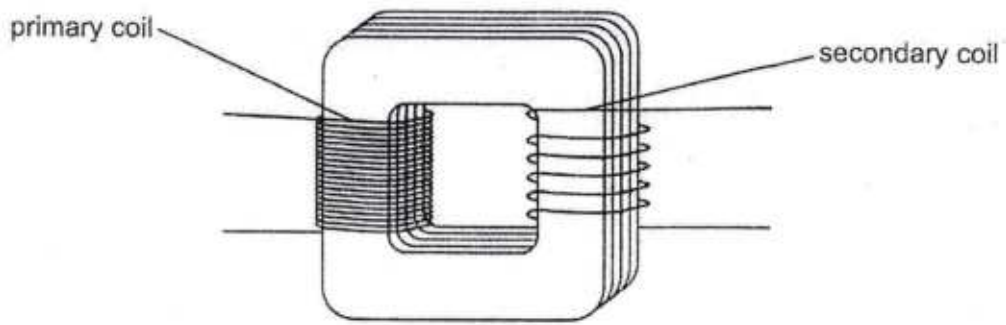


Fig. 8.1

- (a) The primary coil is connected to an alternating current of 0.15 A.  
Calculate the current in the secondary coil.

*Handwritten notes:*  

$$\frac{V_p}{V_s} = \frac{N_p}{N_s}$$

$$\frac{0.15}{I_s} = \frac{1000}{50}$$

current = ..... [3]

- (b) State the assumption you made in calculating the current in (a).

..... [1]

- (c) Step-down transformers are made using thick copper wires for the secondary coil.

Suggest reasons for this.

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



- 9 Fig. 9.1 shows an electric circuit.

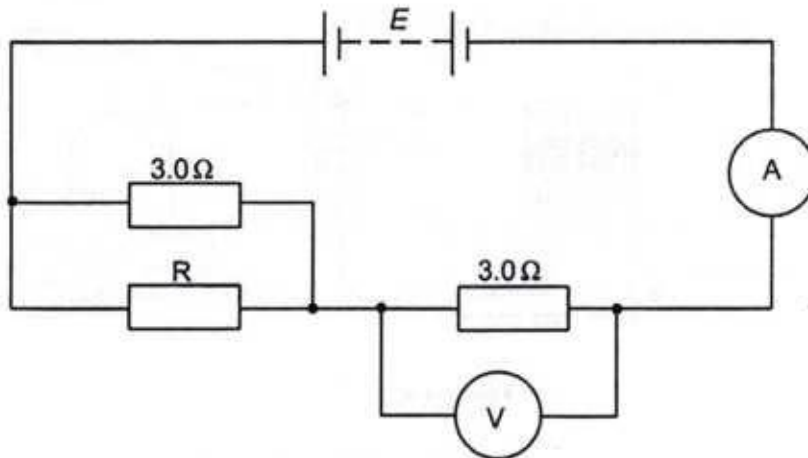


Fig. 9.1

The power supply uses 45 J of electrical energy to drive 3.0 C of charge around the circuit. The voltmeter reading is 9.0 V.

Calculate

- (a) (i) the electromotive force  $E$  of the power supply,

$$E = \dots\dots\dots [2]$$

- (ii) the current through the ammeter.

$$\text{current} = \dots\dots\dots [2]$$

- (b) Determine the resistance of R.

$$\text{resistance of R} = \dots\dots\dots [2]$$



10 Fig. 10.1 shows a current-carrying conductor placed between the poles J and K of a magnet.

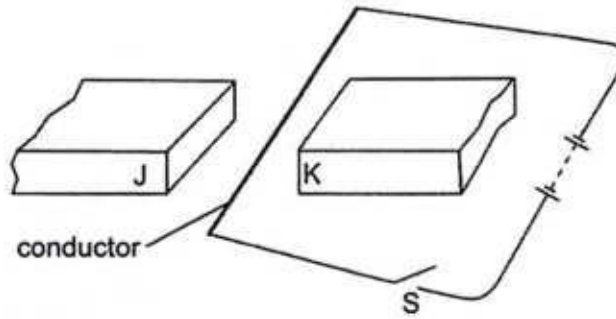


Fig. 10. 1

(a) When switch S is closed, the conductor deflects upwards.

State the polarity of the pole J and the pole K?

pole J.....

pole K .....

[1]

(b) Fig. 10.2 shows a moving coil loudspeaker.

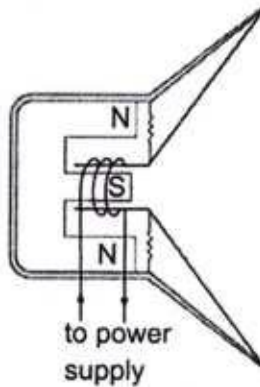


Fig. 10.2

Describe how the loudspeaker converts electrical energy to sound.

.....

.....

.....

.....

.....

.....

.....

.....

[4]



(c) Explain how reducing the current, reduces the loudness of the sound produced.

.....

.....

.....

..... [2]



11 (a) The equation shows a nuclear reaction.



(i) State the values of P, Q and R.

P = .....

Q = .....

R = .....

[2]

(ii) The reaction takes place in a nuclear reactor.

How does the equation show that a chain reaction can take place?

.....

..... [1]

(b) A radioactive source of strontium-90 has a half-life of 28 years.  
The source had  $2.4 \times 10^{13}$  atoms in 2015.

Calculate the number of atoms the source will have in 2155.

number of atoms = ..... [2]

