



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education

CANDIDATE  
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**PHYSICS**

Paper 3 Extended

**0625/31**

**May/June 2012**

**1 hour 15 minutes**

Candidates answer on the Question Paper.

No Additional Materials are required.

**READ THESE INSTRUCTIONS FIRST**

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

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

**DO NOT WRITE IN ANY BARCODES.**

Answer **all** questions.

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

Take the weight of 1 kg to be 10 N (i.e. acceleration of free fall =  $10 \text{ m/s}^2$ ).

At the end of the examination, fasten all your work securely together.

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

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

This document consists of **12** printed pages.



1 The period of the vertical oscillations of a mass hanging from a spring is known to be constant.

(a) A student times single oscillations with a stopwatch. In 10 separate measurements, the stopwatch readings were:

1.8s, 1.9s, 1.7s, 1.9s, 1.8s, 1.8s, 1.9s, 1.7s, 1.8s, 1.8s.

What is the best value obtainable from these readings for the time of one oscillation? Explain how you arrive at your answer.

best value = .....

explanation .....

.....

..... [1]

(b) Describe how, using the same stopwatch, the student can find the period of oscillation more accurately.

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 5]

2 A girl rides her bicycle along a straight level road. Fig. 2.1 shows a graph of her distance moved against time.

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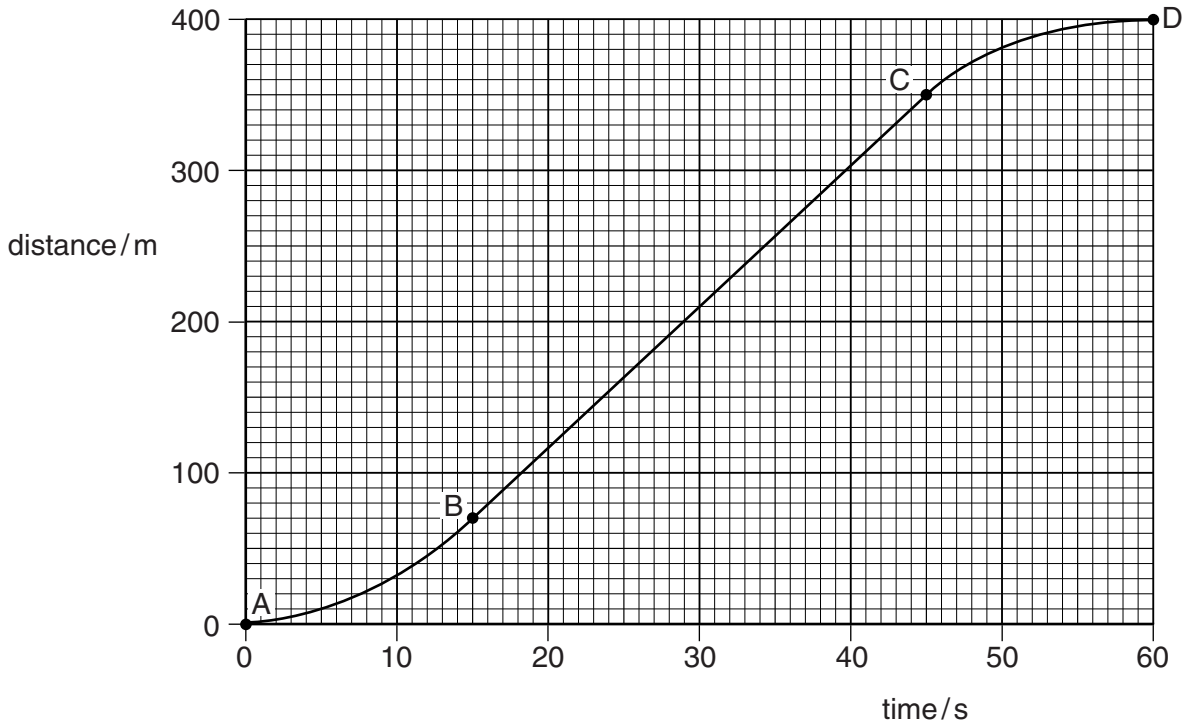


Fig. 2.1

(a) Describe her motion

- (i) from A to B, .....
- (ii) from B to C, .....
- (iii) from C to D. ....

[3]

(b) Calculate

- (i) her average speed from A to D,

average speed = ..... [2]

- (ii) her maximum speed.

maximum speed = ..... [3]

[Total: 8]

- 3 (a) State an example of the conversion of chemical energy to another form of energy.

example .....

energy conversion ..... [1]

- (b) The electrical output of a solar panel powers a pump. The pump operates a water fountain. The output of the solar panel is 17 V and the current supplied to the pump is 0.27 A.

- (i) Calculate the electrical power generated by the solar panel.

power = ..... [2]

- (ii) The pump converts electrical energy to kinetic energy of water with an efficiency of 35%.

Calculate the kinetic energy of the water delivered by the pump in 1 second.

kinetic energy = ..... [2]

- (iii) The pump propels  $0.00014 \text{ m}^3$  of water per second. This water rises vertically as a jet. The density of water is  $1000 \text{ kg/m}^3$ .

Calculate

1. the mass of water propelled by the pump in 1 second,

mass = ..... [2]

2. the maximum height of the jet of water.

maximum height = ..... [2]

[Total: 9]

4 Fig. 4.1 represents part of the hydraulic braking system of a car.

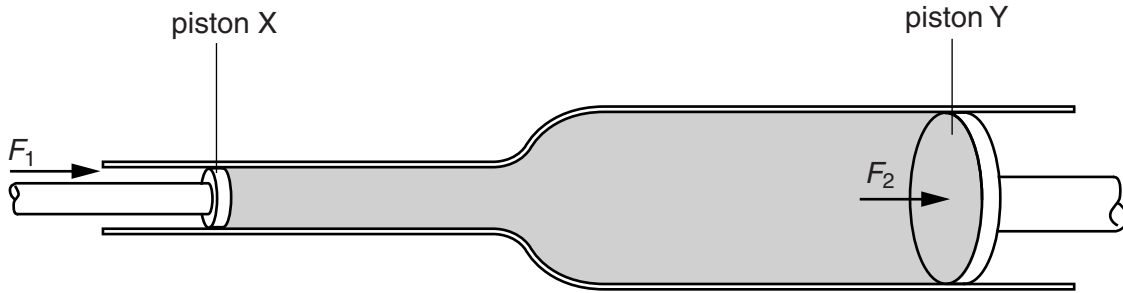


Fig. 4.1

The force  $F_1$  of the driver's foot on the brake pedal moves piston X. The space between pistons X and Y is filled with oil which cannot be compressed. The force  $F_2$  exerted by the oil moves piston Y. This force is applied to the brake mechanism in the wheels of the car.

The area of cross-section of piston X is  $4.8\text{ cm}^2$ .

(a) The force  $F_1$  is 90 N. Calculate the pressure exerted on the oil by piston X.

pressure = ..... [2]

(b) The pressure on piston Y is the same as the pressure applied by piston X. Explain why the force  $F_2$  is greater than the force  $F_1$ .

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

(c) Piston Y moves a smaller distance than piston X. Explain why.

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

(d) Suggest why the braking system does not work properly if the oil contains bubbles of air.

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

[Total: 7]

## 5 (a) Suggest

- (i) an example of a change of state resulting from the removal of thermal energy from a quantity of material,

..... [1]

- (ii) the effect of this change of state on the temperature of the material.

..... [1]

- (b) Define the *thermal capacity* of a body.

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

- (c) A polystyrene cup holds 250g of water at 20°C. In order to cool the water to make a cold drink, small pieces of ice at 0°C are added until the water reaches 0°C and no unmelted ice is present.

[specific heat capacity of water = 4.2J/(g°C), specific latent heat of fusion of ice = 330J/g]

Assume no thermal energy is lost or gained by the cup.

- (i) Calculate the thermal energy lost by the water in cooling to 0°C.

thermal energy lost = ..... [2]

- (ii) State the thermal energy gained by the ice in melting.

thermal energy gained = ..... [1]

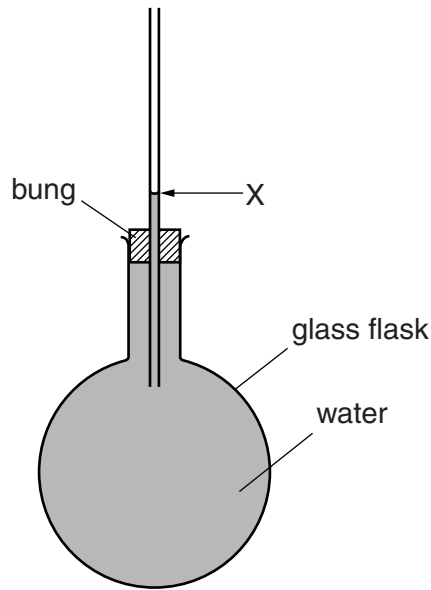
- (iii) Calculate the mass of ice added.

mass of ice = ..... [2]

[Total: 9]

- 6 Fig. 6.1 shows a glass flask full of water at 10°C and sealed with a bung. A long glass tube passes through the bung into the water. The water level in the tube is at X.

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**Fig. 6.1**

When the flask is placed in hot water, the water level initially falls a little below X, and then rises some way above X.

**(a)** Suggest why

**(i)** the water level initially falls,

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

**(ii)** the water level then rises,

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

**(iii)** the rise is greater than the fall.

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

**(b)** Suggest a change to the apparatus that would make the fall and rise of the water level greater.

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

[Total: 6]

- 7 (a) A wave passes along the surface of the water in a ripple tank. Describe the motion of a molecule on the surface as the wave passes.

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

- (b) Fig. 7.1 shows a view from above of water waves approaching a narrow gap in a barrier. The water on both sides of the barrier has the same depth.

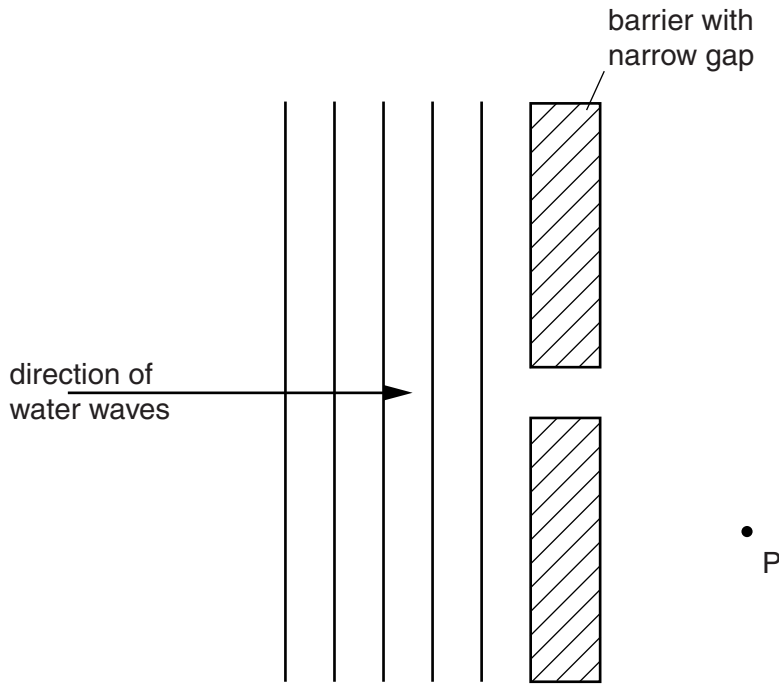


Fig. 7.1

- (i) On Fig. 7.1, sketch the pattern of waves in the region to the right of the barrier. [2]  
 (ii) State the process by which waves arrive at point P to the right of the barrier.

..... [1]

- (c) The waves approaching the barrier in Fig. 7.1 have a wavelength of 1.4 cm and travel at a speed of 12 cm/s.

Calculate the frequency of the waves.

frequency = ..... [2]

[Total: 6]



- 8 (a) In Fig. 8.1, S is a metal sphere standing on an insulating base. R is a negatively charged rod placed close to S.

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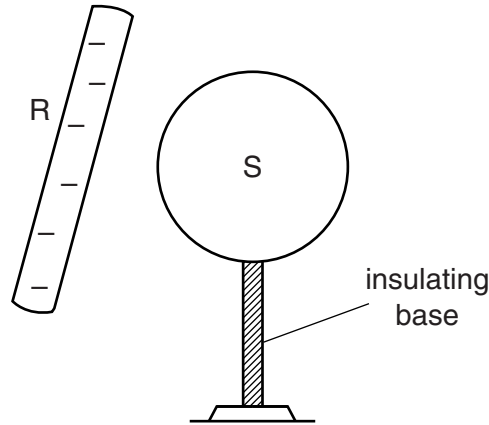


Fig. 8.1

- (i) Name the particles in S that move when R is brought close to S.

..... [1]

- (ii) On Fig. 8.1, add + signs and – signs to suggest the result of this movement. [1]

- (iii) Describe the actions which now need to take place so that S becomes positively charged with the charge distributed evenly over its surface. A positively charged object is **not** available.

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

- (b) During a thunderstorm, the potential difference between thunderclouds and the ground builds up to  $1.5 \times 10^6$  V. In each stroke of lightning, 30 C of charge passes between the thunderclouds and the ground. Lightning strokes to the ground occur, on average, at 2 minute intervals.

Calculate

- (i) the average current between the thunderclouds and the ground,

average current = ..... [2]

- (ii) the energy transferred in each stroke of lightning.

energy = ..... [2]

[Total: 9]

[Turn over

9 This question refers to quantities and data shown on the circuit diagram of Fig. 9.1.

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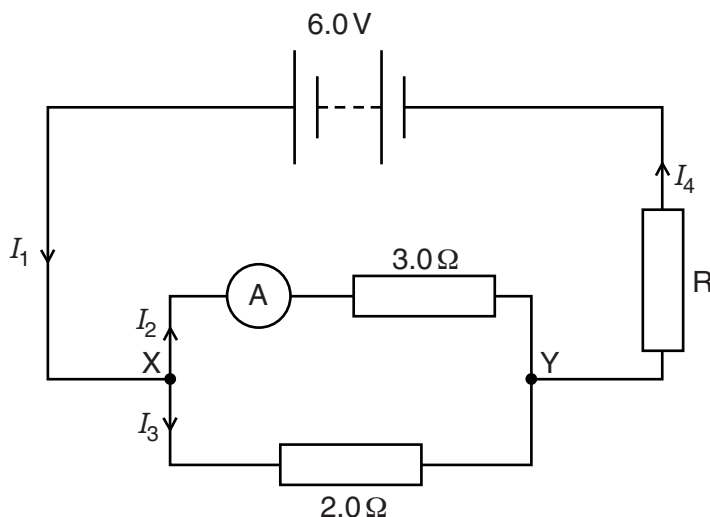


Fig. 9.1

(a) State the relationship between

(i) the currents  $I_1$ ,  $I_2$  and  $I_3$ , ..... [1]

(ii) the currents  $I_1$  and  $I_4$ . ..... [1]

(b) The ammeter reads 0.80 A. Assume it has zero resistance.

Calculate

(i) the potential difference between X and Y,

p.d. = ..... [1]

(ii) the current  $I_3$ ,

current = ..... [2]

(iii) the resistance of R.

resistance = ..... [4]

[Total: 9]

- 10 (a) Fig. 10.1 shows a wire PQ placed between the poles of a magnet. There is a current in wire PQ.

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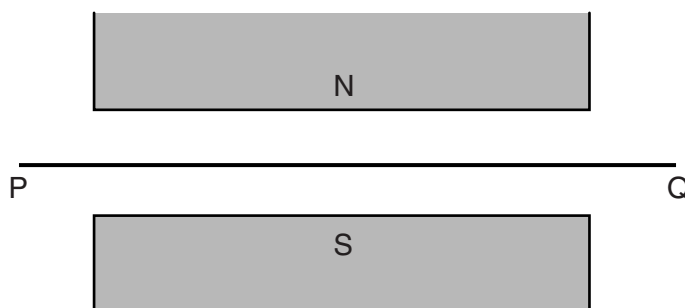


Fig. 10.1

- (i) On Fig. 10.1, sketch lines with arrows to show the direction of the magnetic field between the poles of the magnet. [1]
- (ii) The force on PQ is into the paper.  
Draw an arrow on PQ to show the direction of the current. [1]
- (b) The wire PQ in Fig. 10.1 is replaced by a narrow beam of  $\beta$ -particles travelling from left to right.
  - (i) Suggest a suitable detector for the  $\beta$ -particles.  
..... [1]
  - (ii) State the direction of the force on the  $\beta$ -particles.  
..... [1]
  - (iii) Describe the path of the  $\beta$ -particles in the space between the poles of the magnet.  
.....  
..... [1]
  - (iv) State what happens to the air molecules along the path of the  $\beta$ -particles.  
..... [1]

[Total: 6]

Question 11 is on the next page.

11 Fig. 11.1 shows part of a circuit designed to switch on a security lamp when it gets dark.

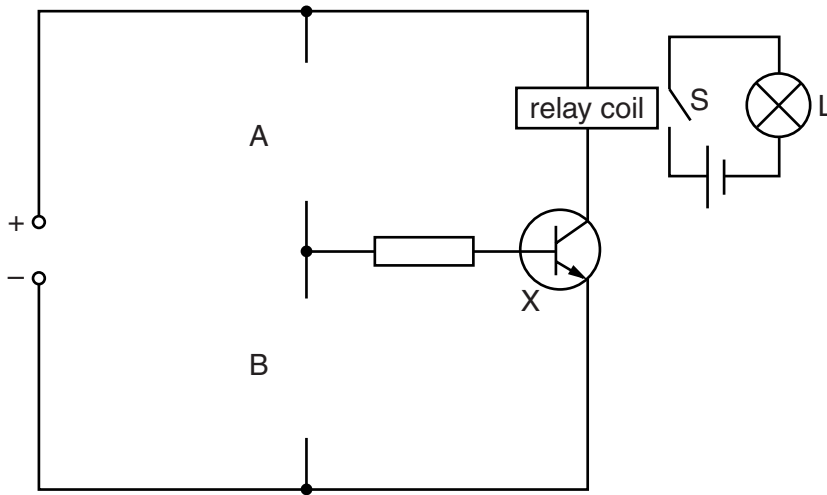


Fig. 11.1

When there is a current in the relay coil, switch S closes and the lamp L comes on.

(a) Write down the name of the component X. .... [1]

(b) The circuit has gaps at A and at B.

State the components that need to be connected into these gaps for the circuit to perform its required function.

gap A .....

gap B .....

[3]

(c) The circuit in Fig. 11.1 is modified. The function of lamp L is now to give a warning when the temperature becomes too high.

State any necessary changes of components in the circuit.

.....  
 .....  
 .....

[2]

[Total: 6]

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