Cambridge Assessment International Education

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PHYSICS **0625/42**

Paper 4 Theory (Extended) **October/November 2021**

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the 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 bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.
- Take the weight of 1.0 kg to be 10 N (acceleration of free fall = 10 m / s^2).

INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages. Any blank pages are indicated.

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1 Fig. 1.1 shows a space rocket accelerating away from a launch pad.

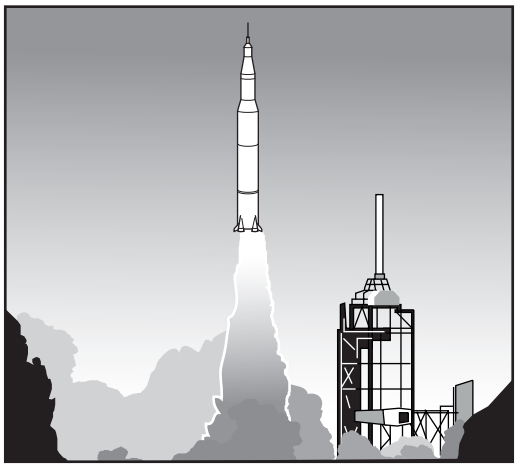

Fig. 1.1

Fig. 1.2 is a speed–time graph for the first 30 s of the rocket's flight.

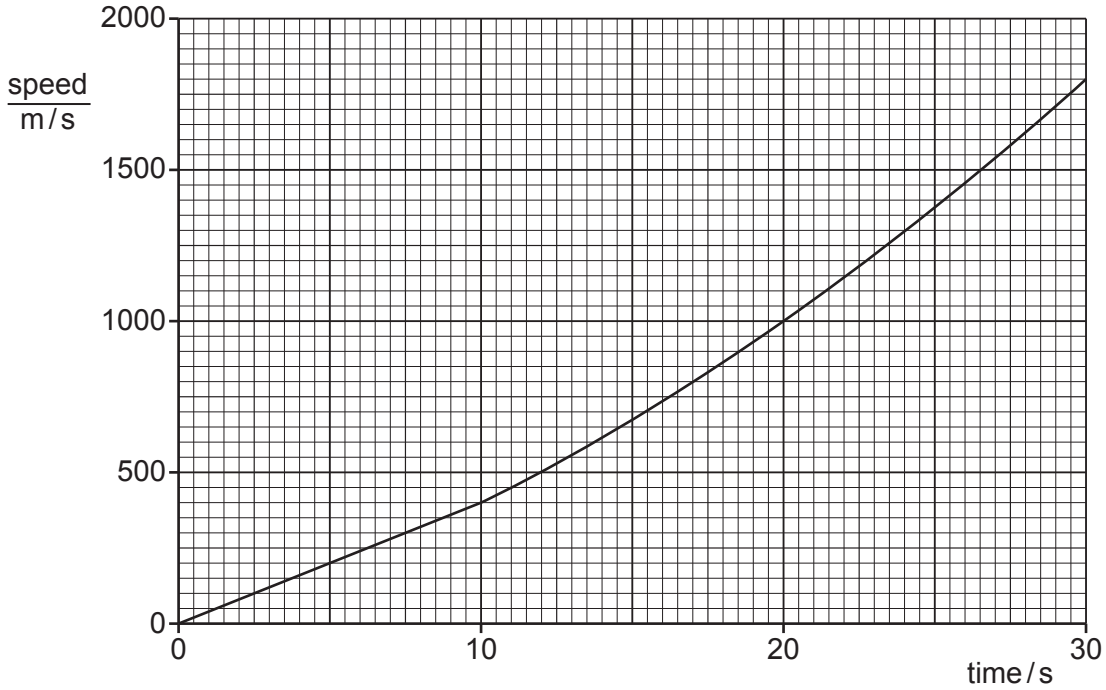

Fig. 1.2

(a) Describe how the acceleration of the rocket changes between time = 10 s and time = 30 s.

View solution

..... [1]

(b) By drawing a tangent to the graph, determine the acceleration of the rocket at time = 25 s.

View solution

acceleration = ... [2]

(c) Determine the distance travelled by the rocket between time = 0 and time = 10 s.

View solution

distance = ... [2]

[Total: 5]

2 **(a)** State Hooke's law.

View solution

.....

..... [1]

(b) Fig. 2.1 shows the extension–load graph for a spring.

View solution

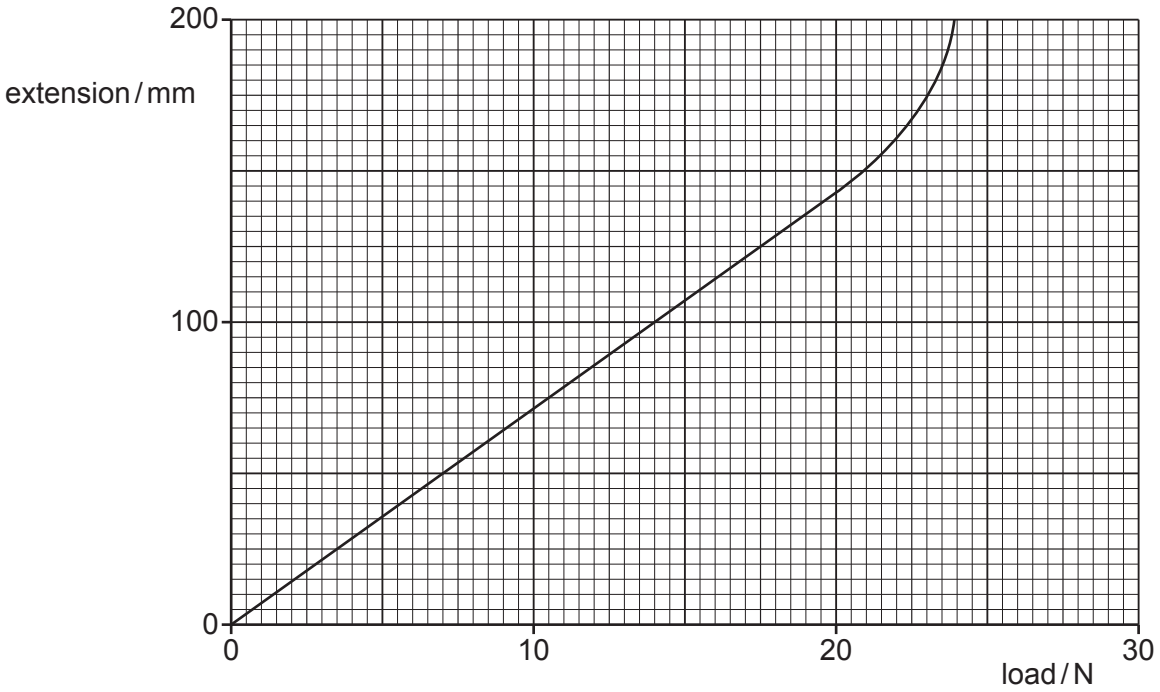

Fig. 2.1

(i) On Fig. 2.1, mark and label the region where the spring obeys Hooke's law. [1]

(ii) Calculate the spring constant k.

View solution

k = ... [2]

(iii) The original length of the spring is 120 mm.

Calculate the length of the spring when a load of 8.5 N is applied to the spring.

View solution

length = ... [2]

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(c) The weight of an object is 4.0 N on a planet where the acceleration of free fall is 8.7 m / s^2.

Calculate the mass of the object.

View solution

mass = ... [2]

[Total: 8]

3 Fig. 3.1 shows a collision at very slow speed between two cars travelling along a straight road.

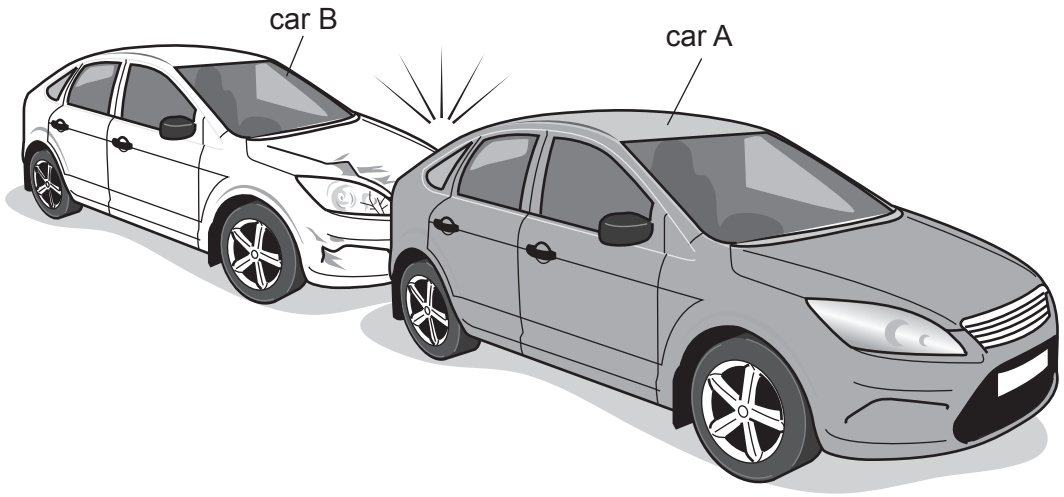

Fig. 3.1

Car B, of mass 800 kg, is moving at 2.0 m/s and collides with car A, of mass 1000 kg, which is stationary. After the collision, both cars travel in the same direction as the initial direction of car B.

(a) After the collision, car A moves at 1.3 m/s.

View solution

Show that the speed of car B after the collision is approximately 0.4 m/s.

[3]

(b) (i) Calculate the impulse exerted by car A on car B.

View solution

impulse = ... [2]

(ii) State the impulse exerted by car B on car A.

impulse = ... [1]

[Total: 6]

View solution

4 **(a)** A power station uses wind energy to generate electricity.

View solution

State and explain whether this method of generating electricity is renewable.

statement .....

explanation .....

.....

.....

[2]

(b) State **two** energy resources that do **not** have the Sun as their source.

View solution

1 .....

2 .....

[2]

(c) For each energy resource, state the form of energy stored in:

View solution

fossil fuels .....

water behind hydroelectric dams. .....

[2]

[Total: 6]

5 **(a)** A thermocouple thermometer is used to determine the temperature difference between a mixture of ice and water and liquid mercury at approximately 600 °C.

Complete Fig. 5.1 with a labelled diagram to show how the thermocouple thermometer can be used in this way.

View solution

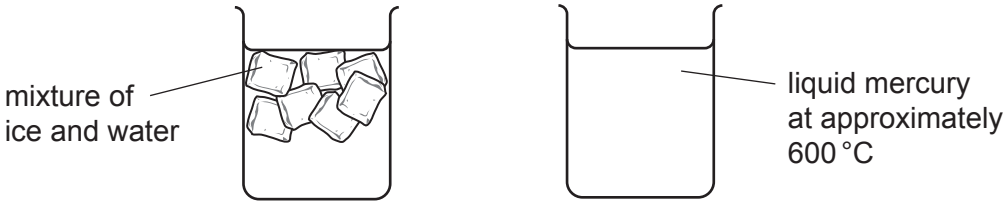

Fig. 5.1

[3]

(b) State **two** other physical properties that can be used to measure temperature.

View solution

1 .....

2 .....

[2]

(c) State **two** benefits of using a thermocouple thermometer instead of a liquid-in-glass thermometer.

1 .....

2 .....

[2]

[Total: 7]

View solution

6 Fig. 6.1 shows particles of a material in which a sound wave is travelling.

Fig. 6.1 (not to scale)

View solution

(a) On Fig. 6.1, mark:

(i) the centre of a compression with the letter C [1]

(ii) the centre of a rarefaction with the letter R [1]

(iii) one wavelength with a double-ended arrow. [1]

View solution

(b) Circle **one** value from the list which is the speed of sound in water.

15 m/s **150 m/s** **1500 m/s** **15 000 m/s** **150 000 m/s** **1 500 000 m/s** [1]

View solution

(c) The wavelength of a sound wave in water is 12 cm.

Calculate the frequency of this sound wave using your value from **(b)**.

frequency = ... [3]

View solution

(d) State and explain whether the sound in **(c)** is ultrasound.

statement .....

explanation .....

.....

..... [2]

[Total: 9]

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7 Fig. 7.1 shows a ray of light approaching face AB of a glass prism of refractive index 1.5.

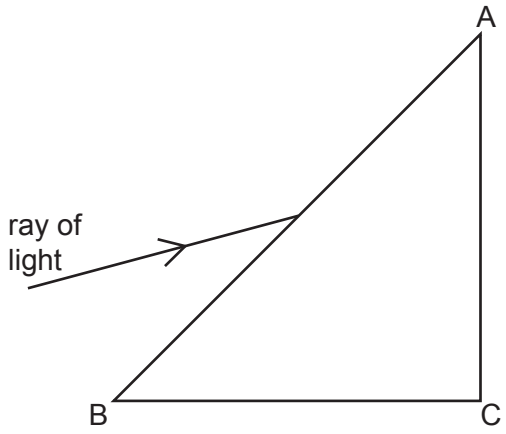

Fig. 7.1

(a) **(i)** On Fig. 7.1, accurately draw the path of the ray within the prism from face AB to face AC.
You will need to make a measurement from Fig. 7.1 and carry out a calculation.

View solution

[4]

(ii) Determine the angle of incidence of this ray when it strikes face AC.

View solution

angle = ... [1]

(b) Without further measurement or calculation, sketch on Fig. 7.1 the approximate path of the ray after passing through the face AC. [1]

(c) Fig. 7.2 shows a ray of light travelling within an optical fibre.

View solution

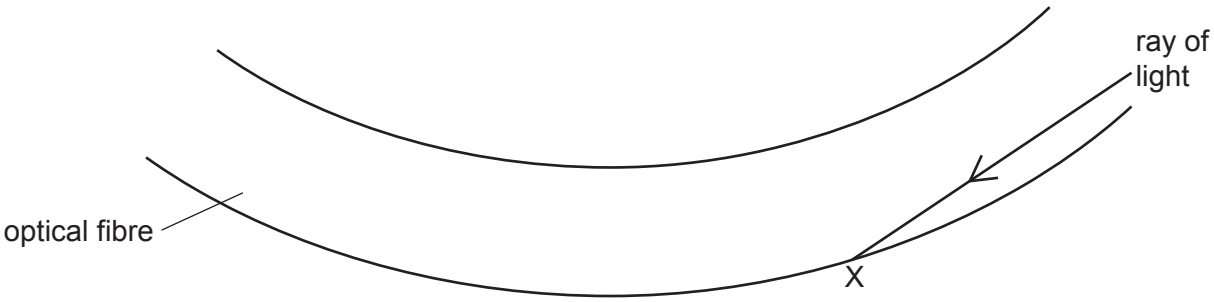

Fig. 7.2

(i) Complete the path of the ray of light to the left-hand end of the fibre. [2]

(ii) Name the process taking place at X. ..... [1]

[Total: 9]

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8 **(a)** Fig. 8.1 shows a conducting object A, initially uncharged, held on an insulating stand. The positively charged rod B is brought close to object A.

View solution

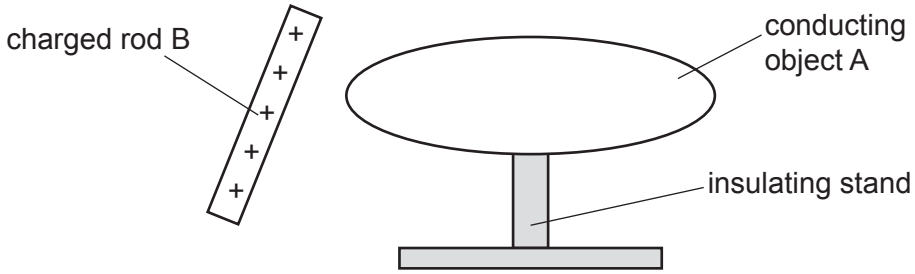

Fig. 8.1

(i) On Fig. 8.1, draw the distribution of charges on object A. [2]

(ii) A wire is connected from object A to earth.

View solution

State and explain any movement of charge.

statement .....

explanation .....

.....

.....

[2]

(b) There is a current in a wire of 0.65 mA for 2.2 minutes.

View solution

Calculate the charge that flows.

charge = ... [3]

[Total: 7]

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9 **(a)** Fig. 9.1 shows a cell of electromotive force (e.m.f.) 1.5 V and a battery of e.m.f. 6.0 V connected in series.

View solution

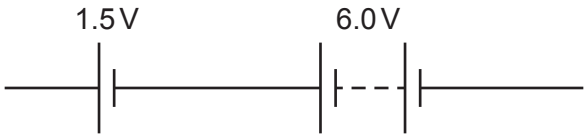

Fig. 9.1

Calculate the combined e.m.f. of the cell and the battery.

e.m.f. = ... [1]

(b) The combined resistance of the three resistors shown in Fig. 9.2 is 4.4 Ω.

View solution

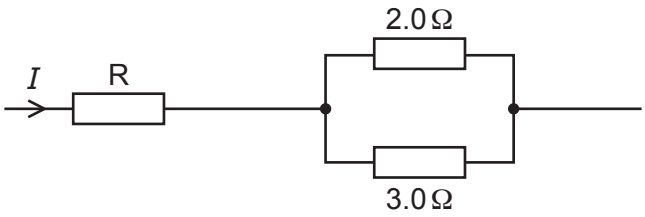

Fig. 9.2

(i) Calculate the resistance of resistor R.

resistance = ... [3]

(ii) The current I in Fig. 9.2 is 0.94 A.

View solution

Calculate the potential difference (p.d.) across the combination of resistors.

p.d. = ... [2]

[Total: 6]

10 **(a)** Name the logic gate shown in Fig. 10.1. .....

View solution

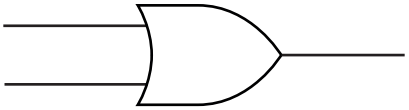

Fig. 10.1

[1]

(b) Fig. 10.2 shows a combination of logic gates.

View solution

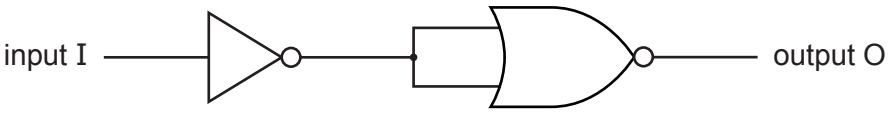

Fig. 10.2

Complete the right-hand column of Table 10.1, the truth table for the combination of logic gates. You may use the blank column for your working.

Table 10.1

input I		output O
0		
1		

[2]

(c) An electrical device has a metal case.

View solution

Explain the benefit of earthing the metal case.

.....

.....

..... [2]

(d) **(i)** Explain how a fuse protects a circuit.

View solution

.....

.....

..... [2]

(ii) The current in an electric kettle connected to the mains through a fuse is 10A.

View solution

Fuses with the following ratings are available.

3A **9A** **10A** **13A** **30A**

Circle the correct fuse rating for this appliance and explain your answer.

.....

.....

..... [2]

[Total: 9]

11 (a) Describe the composition and structure of a neutral atom of beryllium-8, which has a proton number of 4 and a nucleon number of 8.

.....

.....

.....

..... [4]

(b) A radioactive isotope decays by β-emission to form an isotope of barium with nucleon number 135.

View solution

Table 11.1

element	symbol	proton number
iodine	I	53
xenon	Xe	54
caesium	Cs	55
barium	Ba	56
lanthanum	La	57
cerium	Ce	58
praseodymium	Pr	59

Use data from Table 11.1 to write down the nuclide equation for this decay.

[4]

[Total: 8]

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