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PHYSICS **0625/42**

Paper 4 Theory (Extended) **May/June 2025**

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 9.8 N (acceleration of free fall = 9.8 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 **20** pages. Any blank pages are indicated.

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1 Fig. 1.1 is a speed–time graph for an ice skater.

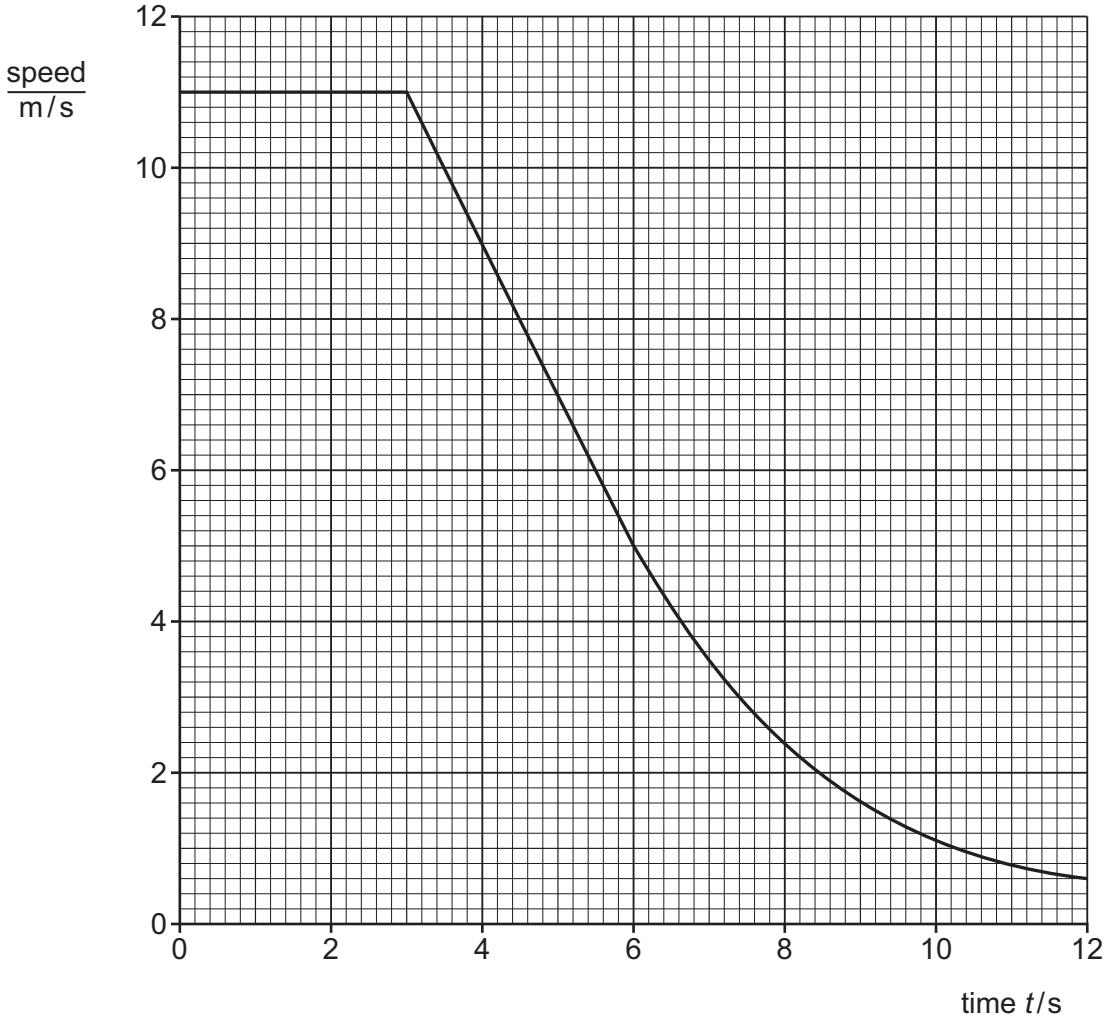


Fig. 1.1

(a) Describe the motion of the skater between $t = 0$ and $t = 3.0$ s.

..... [1]

(b) Calculate the distance travelled by the skater between $t = 0$ and $t = 3.0$ s.

distance = ... [2]

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(c) **(i)** State what is meant by deceleration.

..... [1]

(ii) Draw a tangent to the graph at $t = 9.0$ s.

Use the tangent to calculate the deceleration of the skater at $t = 9.0$ s.

deceleration = ... [3]

[Total: 7]

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2 Fig. 2.1 shows a balanced, uniform metre ruler made of wood.

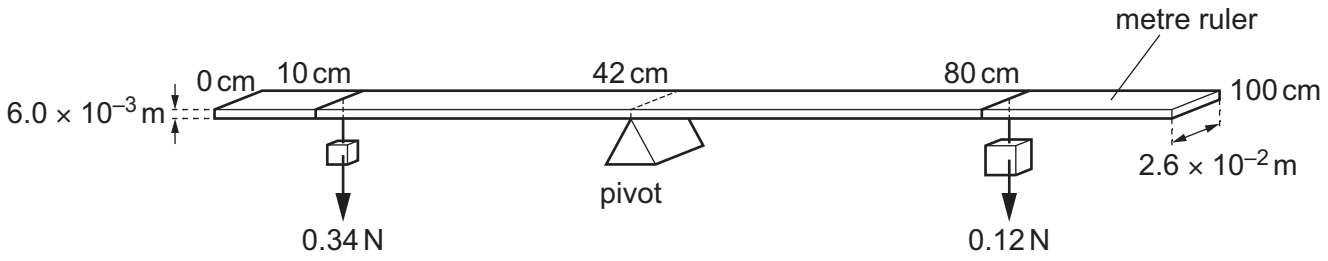


Fig. 2.1

The width of the metre ruler is 2.6×10^{-2} m and the thickness of the ruler is 6.0×10^{-3} m.

(a) Define the 'moment' of a force in words.

.....

..... [1]

(b) On Fig. 2.1, mark the position of the centre of gravity of the metre ruler with a point labelled X. Label the distance of X from the 0 cm end of the ruler. [1]

(c) **(i)** Show that the mass of the metre ruler is 0.081 kg.

[3]

(ii) Calculate the density of the wood of the metre ruler.

density = ... [2]

[Total: 7]

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3 **(a)** Define momentum.

..... [1]

(b) Fig. 3.1 shows two toy trains, A and B, on a track.

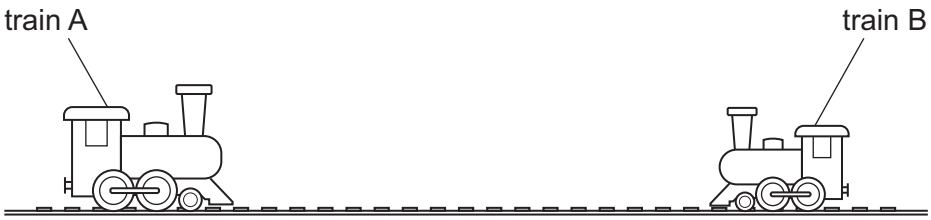


Fig. 3.1

The mass of train A is 0.45 kg and the mass of train B is 0.21 kg. The trains do **not** have motors.

Train A travels towards train B and they collide.

Immediately before the collision:

- the velocity of train A is 0.34 m / s to the right
- the velocity of train B is 0.12 m / s to the left.

The trains stick together when they collide.

Calculate the velocity of the trains immediately after the collision.

velocity = ...

direction .....

[4]

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(c) A different train is travelling with a momentum of 0.26 kg m / s.

The train slows down and stops after 2.1 s.

Calculate the average force acting on the train during this time.

average force = ... [2]

[Total: 7]

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4 **(a)** Fig. 4.1 shows two metal containers, A and B.

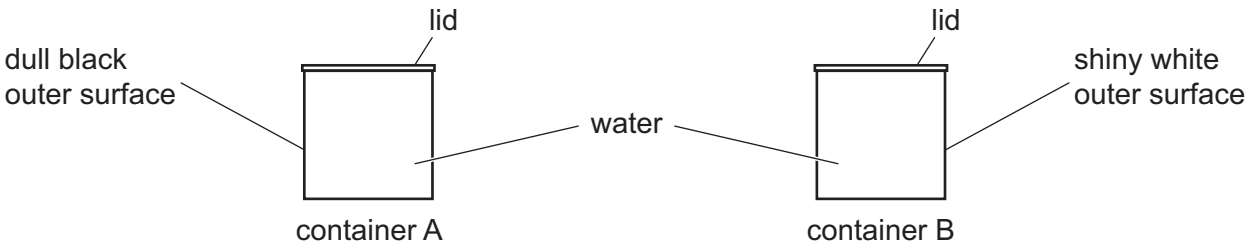


Fig. 4.1

Container A has a dull black outer surface and container B has a shiny white outer surface. A and B both contain very hot water at time = 0. The temperature of the water in each container is recorded every minute.

(i) State which container has the larger temperature change over the first 5 minutes. Explain your answer.

.....

.....

..... [2]

(ii) After 30 minutes, the temperature of the water in container A remains constant.

State, in terms of energy transfers, why the temperature remains constant.

.....

..... [1]

(iii) The experiment is repeated without the lids on the containers.

State the name of the additional method of energy transfer that occurs.

..... [1]

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(b) Fig. 4.2 shows a metal pan with a wooden handle.

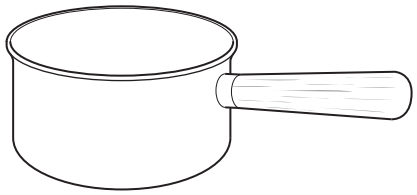


Fig. 4.2

Explain why there is a much greater rate of transfer of energy through the metal than through the wood.

.....

.....

.....

..... [3]

[Total: 7]

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5 **(a)** Describe an experiment to determine the speed of sound in air.

State the apparatus required, the measurements taken and how to calculate the speed of sound in air from the measurements.

You may draw a **labelled** diagram as part of your answer.

.....

.....

.....

.....

.....

.....

.....

[4]

(b) Bluetooth is used to connect a mobile (cell) phone to headphones.

(i) State the name of the region of the electromagnetic spectrum used by Bluetooth.

..... [1]

(ii) State the speed of electromagnetic waves in air.

speed = ... [1]

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(iii) The frequency of a Bluetooth network is 2.48 GHz.

Calculate the wavelength of the waves used in the Bluetooth network.

wavelength = ... [3]

[Total: 9]

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6 **(a)** Fig. 6.1 is a full-size diagram of a lens and an image I of an object.

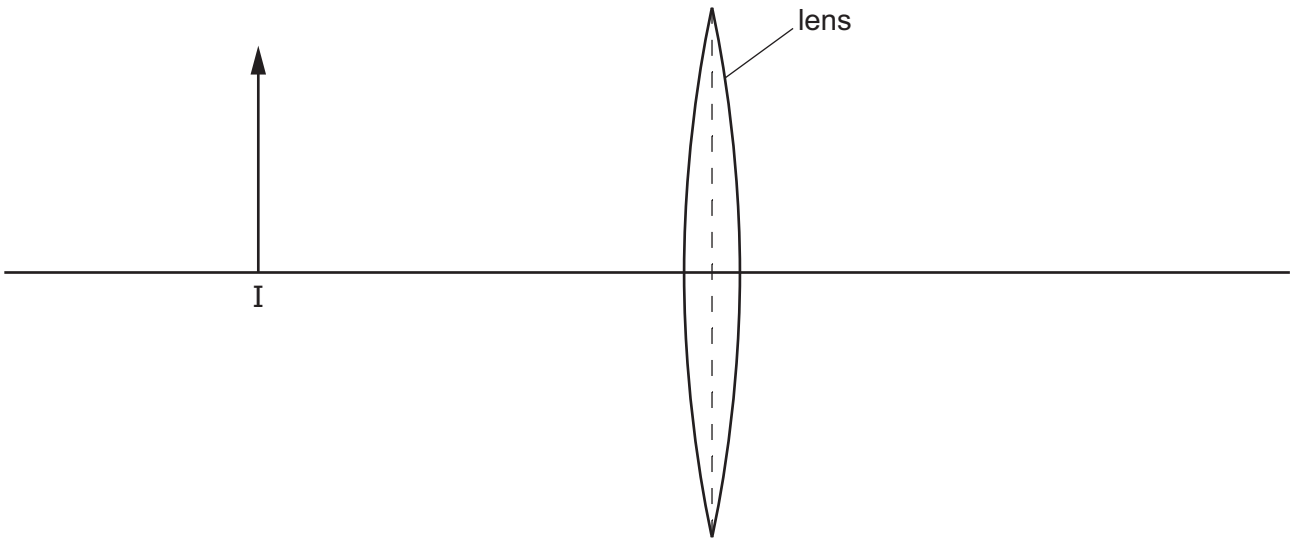


Fig. 6.1

The focal length of the lens is 3.0 cm.

(i) On Fig. 6.1, mark **two** points with labels F, to show the positions of the principal focuses (focal points) of the lens. [1]

(ii) On Fig. 6.1, draw **two** rays from the image I to locate the object. Draw the object and label it O. [3]

(iii) The object is moved so that it is 6 cm to the left of the lens.

State **one** characteristic of the image formed when the object is in this position.

..... [1]

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(b) Fig. 6.2 shows a simplified diagram of an eye with rays from a near object. The eye needs correction for long-sightedness.

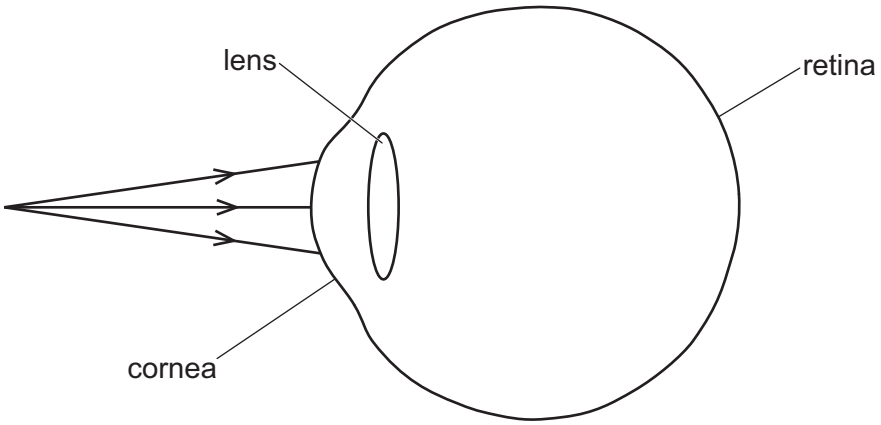


Fig. 6.2

(i) On Fig. 6.2, draw the path of the rays inside the eye to show the effect of long-sightedness. [1]

(ii) A lens is used to correct the long-sightedness.

Draw a lens suitable for this correction.

lens to correct long-sightedness

[1]

[Total: 7]

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7 **(a)** State what is meant by an electric field.

.....

..... [1]

(b) A plastic rod is rubbed with a cloth. The plastic rod becomes negatively charged and the cloth becomes positively charged.

(i) Explain why.

.....

.....

..... [2]

(ii) The negatively charged plastic rod is suspended by an insulating thread. Another negatively charged plastic rod is brought close to the suspended rod.

State what happens to the suspended plastic rod.

..... [2]

(c) **(i)** Define the kilowatt-hour (kW h) in words.

.....

..... [1]

(ii) A small lamp illuminates an electric oven. The lamp has an output power of 25 W and operates for 220 hours in one year. The p.d. across the lamp is 230 V.

1. Calculate the energy transferred by the lamp in one year. Give your answer in kW h.

energy = ... kW h [2]

2. Calculate the current in the lamp.

current = ... [2]

[Total: 10]

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8 **(a)** Fig. 8.1 shows a simplified diagram of an a.c. generator.

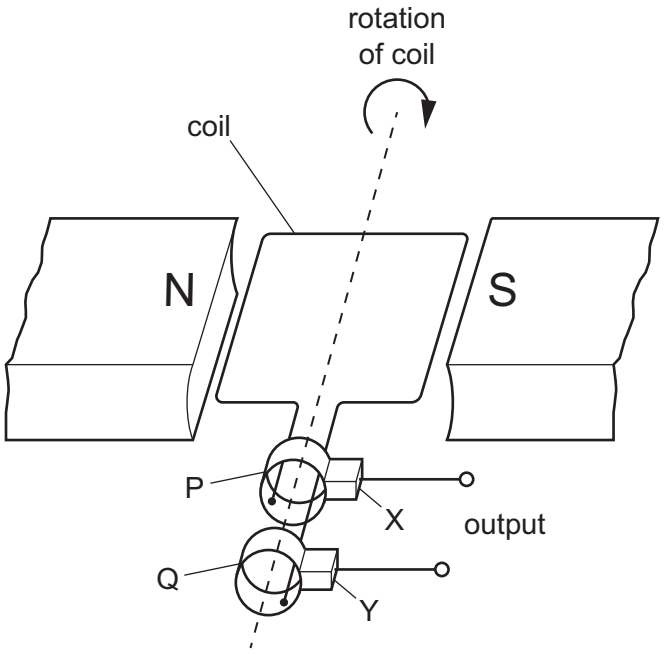


Fig. 8.1

(i) State the names of components:

P and Q .....

X and Y. .....
[2]

(ii) Explain why an electromotive force (e.m.f.) is only induced when the coil is turning.

.....

..... [1]

(iii) State **one** possible change that causes a larger e.m.f. to be induced.

..... [1]

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(b) Fig. 8.2 shows a circuit diagram.

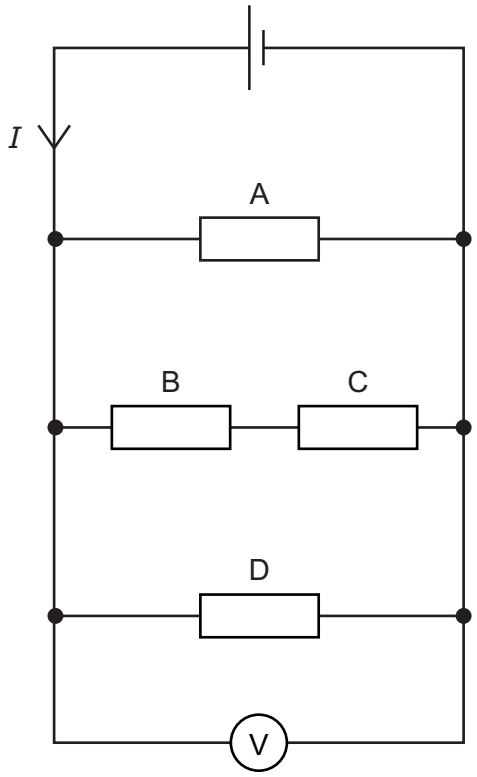


Fig. 8.2

Resistors A, B, C and D are identical. The current in resistor A is 2.4 A.

(i) State the value of the current in resistor B. Explain your answer.

current in resistor B .....

explanation .....

.....

[2]

(ii) Calculate the value of the current I.

current I = ... [1]

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(iii) The reading on the voltmeter is 5.0 V.

Calculate the resistance of resistor A.

resistance = ... [2]

[Total: 9]

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9 **(a)** **(i)** State what is meant by background radiation.

.....

..... [1]

(ii) State **one** source that makes a significant contribution to background radiation.

..... [1]

(b) Radioactive isotopes are used in some medical treatments.

Radium-223 ($^{223}_{88}Ra$) is an isotope of radium. Radium-223 decays by the emission of alpha (α) particles to an isotope of radon (Rn).

(i) Complete the nuclide equation for this decay.

$$^{223}_{88}Ra \longrightarrow {}^{\cdots\cdots}_{\cdots\cdots}Rn + {}^{\cdots\cdots}_{\cdots\cdots}\alpha$$

[2]

(ii) Radium-223 is injected into the body to treat a specific organ.

Explain why the source must be inside the body.

.....

..... [1]

(c) An isotope of technetium is injected into the body to detect cancer in one of the organs. The half-life of this isotope is 6 hours and it decays by emitting gamma (γ) radiation. The radiation is detected outside the body.

(i) Explain why a source of gamma radiation is used.

.....

..... [1]

(ii) Explain why a source with a short half-life must be used.

.....

..... [1]

[Total: 7]

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10 (a) Table 10.1 shows data for planets A, B, C and D.

Table 10.1

planet	surface temperature / K	diameter / km	gravitational field strength N / kg
A	153	143 000	23.0
B	623	4 800	3.7
C	53	50 000	11.0
D	93	120 000	9.0

(i) State and explain which one of these planets is closest to the Sun.

.....

..... [2]

(ii) Calculate the surface temperature of planet D in °C.

surface temperature = ... °C [1]

(iii) An object falls through a height of 2 m on each of the planets in Table 10.1.

State and explain on which planet the object falls 2 m in the shortest time. Ignore any effect due to the atmosphere.

.....

..... [2]

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(b) Fig. 10.1 shows some of the stages in the life cycle of a massive star.

massive star expands

↓

.....

↓

supernova

↓

nebula which contains .....

↓

leaves behind

..... or .....

Fig. 10.1

(i) Complete Fig. 10.1 by adding the correct terms. [4]

(ii) State the quantity that the brightness of a supernova in a galaxy can be used to determine.

..... [1]

[Total: 10]

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