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PHYSICS **0625/42**

Paper 4 Theory (Extended) **May/June 2024**

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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[Turn over

1 A load is suspended from a thread. The vertical force on the thread due to the load is 0.75 N.

(a) Calculate the mass of the load.

mass = ... [2]

(b) Fig. 1.1 shows the load suspended from the thread.

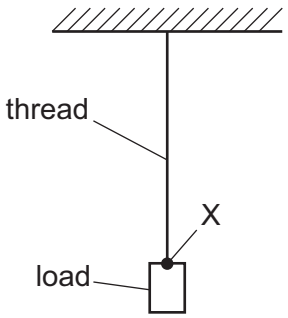


Fig. 1.1

A wire is attached to the load at point X and pulled horizontally to the right.

The tension in the horizontal wire is 1.2 N.

By drawing a scale diagram or by calculation, determine:

- the magnitude of the resultant of the force at X due to the load and due to the tension in the wire
- the direction of the resultant relative to the vertical direction.

Show your working.

magnitude of resultant force = ... N

direction of resultant relative to vertical = ... °

[4]

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(c) Forces may produce changes in the size and the shape of an object.

State **two** other changes that forces may produce.

1 .....

2 .....

[2]

[Total: 8]

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2 **(a)** Define acceleration.

.....

..... [1]

(b) A train has a total mass of 520 000 kg. The train accelerates at 1.1 m / s^2.

(i) Calculate the time taken for the train to increase its speed from 15 m / s to 28 m / s.

time = ... [2]

(ii) Calculate the force required to produce an acceleration of 1.1 m / s^2 for this train.

force = ... [2]

(iii) The train uses electric motors.

Explain why the force on the train due to the motors is greater than the value calculated in **(ii)**.

.....

..... [1]

[Total: 6]

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3 A student drops a heavy ball from a vertical height of 1.8 m above the ground. The ball then falls to the ground. It does **not** bounce after hitting the ground.

(a) Describe the transfers of energy of the ball between stores from when the ball begins to fall to when it reaches the ground.

.....

.....

.....

.....

..... [3]

(b) Calculate the maximum speed of the ball. Ignore air resistance.

Show your working.

maximum speed = ... [3]

[Total: 6]

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4 **(a)** State **two** ways that evaporation differs from boiling.

1 .....

2 .....

[2]

(b) Fig. 4.1 shows part of a container used to store a mixture of liquid and gaseous oxygen.

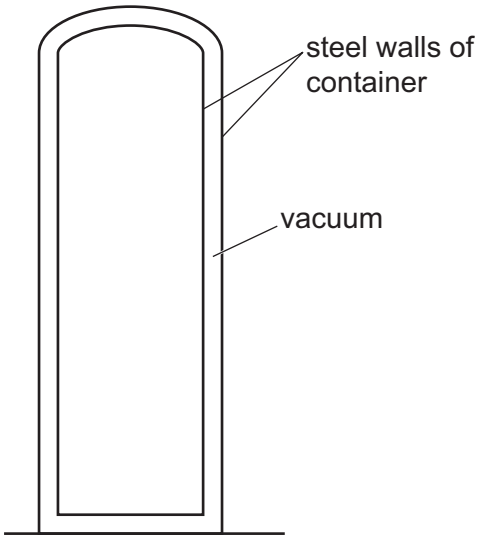


Fig. 4.1

The temperature of the liquid oxygen is –160 °C.

(i) Determine the temperature of the liquid oxygen in K.

temperature = ... K [1]

(ii) The container is made of steel and there is a vacuum between the inner and outer walls. The outer wall of the container is at room temperature.

State **two** methods of thermal energy transfer that a vacuum prevents.

1 .....

2 .....

[2]

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(c) Describe, in terms of particles, how a gas exerts a pressure on the walls of its container.

.....

.....

.....

..... [3]

[Total: 8]

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5 Fig. 5.1 shows a ray of yellow light incident on a glass prism ABC.

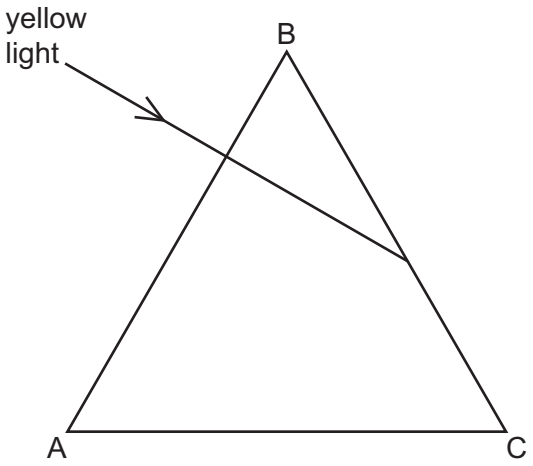


Fig. 5.1

(a) Explain why the ray does **not** change direction when it enters the prism at face AB.

.....

..... [1]

(b) The critical angle for the glass is 42°.

(i) Calculate the refractive index of the glass.

Show your working.

refractive index = ... [2]

(ii) On Fig. 5.1, continue the path of the light through the prism and after it leaves the prism. [3]

(c) Internet data can be transferred using infrared waves in optical fibres.

State **two** advantages of using optical fibres to transmit data.

1 .....

2 .....
[2]

[Total: 8]

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6 **(a)** A sound wave travels through air. Fig. 6.1 shows a pressure–time graph for the air at one place.

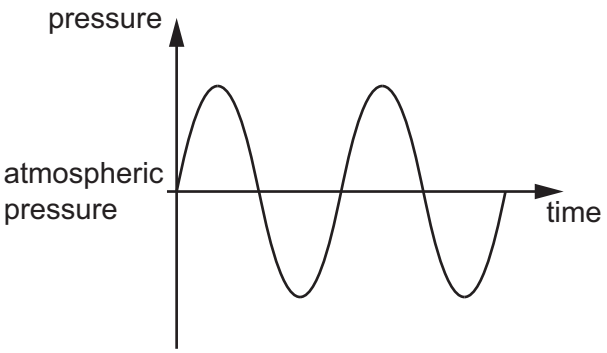


Fig. 6.1

(i) On Fig. 6.1:

- label **one** point C to indicate a compression
- label **one** point R to indicate a rarefaction.

[2]

(ii) Explain why this graph **cannot** be used to find the wavelength of the sound wave.

.....

…..... [1]

(iii) The sound becomes louder and of lower pitch.

State what happens to:

the amplitude of the sound

.....

the frequency of the sound.

.....

[1]

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(b) A sound of frequency 13 kHz is transmitted through water.
The speed of sound in water is 1500 m / s.

Calculate the wavelength of this sound in water.

wavelength = ... [3]

(c) State the approximate speed of sound in air.

speed = ... [1]

[Total: 8]

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7 **(a)** Fig. 7.1 shows three bars of steel, A, B and C.

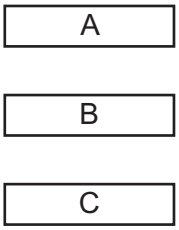


Fig. 7.1

A student is given the three pieces of steel. Two of the pieces are magnetised and one piece is unmagnetised.

Describe and explain how the student determines which piece is unmagnetised using only the three pieces of steel.

.....

.....

.....

.....

.....

.....

.....

..... [4]

(b) Fig. 7.2 shows a circuit diagram of a step-down transformer.

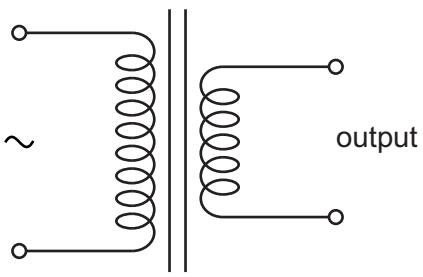


Fig. 7.2

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(i) The mains voltage supplied to the transformer is 240 V. The output power of the transformer is 45 W. The transformer is 100% efficient.

Calculate the input current to the transformer.

input current = ... [3]

(ii) Draw a labelled diagram of a step-down transformer. On the labels, state a suitable material for each of the components.

[3]

[Total: 10]

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8 **(a)** Fig. 8.1 shows a circuit. The circuit is designed to switch on a night light when the surroundings are dark.

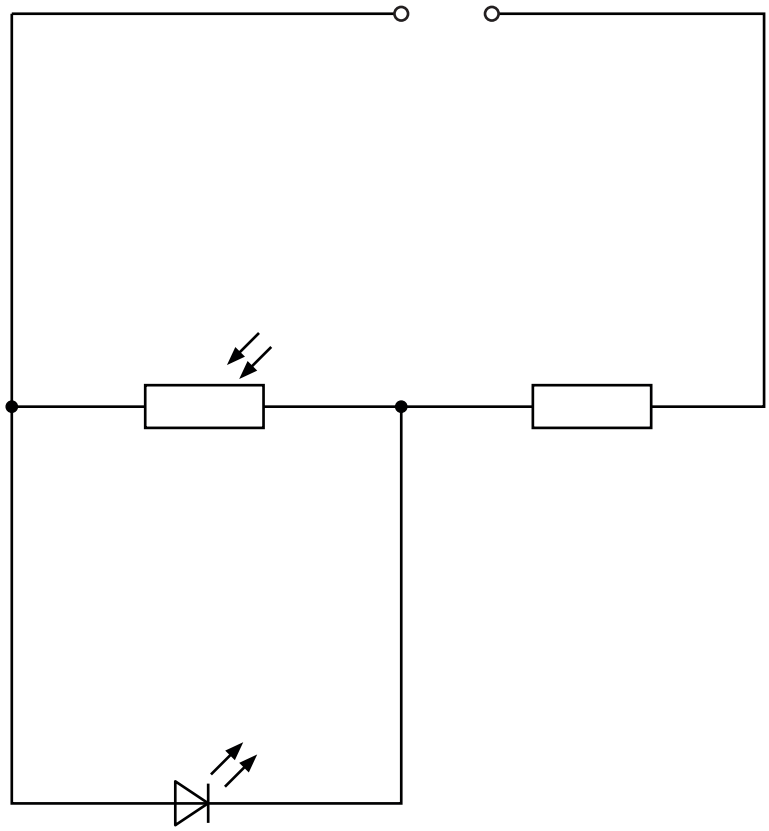


Fig. 8.1

(i) On Fig. 8.1, draw the circuit symbol for a voltmeter used to measure the potential difference (p.d.) across the light-dependent resistor (LDR). [1]

(ii) The surroundings change from light to dark.

1. State the effect of this change on the resistance of the LDR.

..... [1]

2. State and explain the effect of this change on the p.d. across the light-emitting diode (LED).

.....

.....

..... [2]

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(b) Fig. 8.2 shows another circuit. Lamps A and B are identical filament lamps.

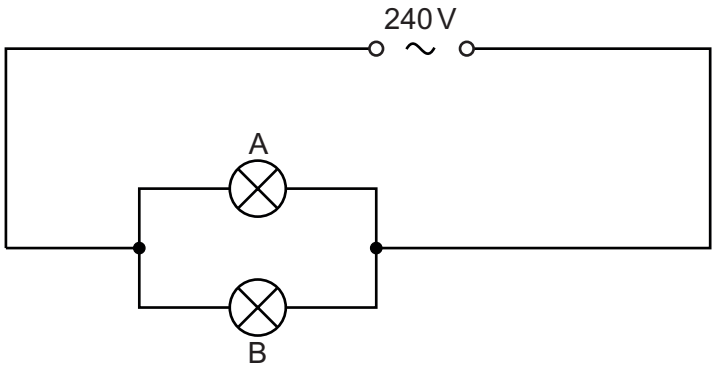


Fig. 8.2

The current supplied by the power supply is 0.50 A.

Calculate the resistance of lamp A.

resistance = ... [3]

[Total: 7]

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9 **(a)** Radioactive isotopes that emit ionising radiation are used in hospitals.

(i) State and explain **two** safety precautions necessary for the use of these isotopes in medical procedures.

safety procedure 1 .....

explanation .....

.....

safety procedure 2 .....

explanation .....

.....

[2]

(ii) Give **two** reasons why alpha-emitters are **not** used as radioactive tracers inside the body.

1 .....

.....

2 .....

.....

[2]

(b) Sodium-24 is an isotope of sodium (Na) that has a proton number of 11 and a nucleon number of 24.

Sodium-24 decays by emission of a beta-particle to form an isotope of magnesium (Mg).

Use nuclide notation to write down the nuclide equation for this decay.

[3]

[Total: 7]

10 (a) The Solar System includes the Sun and planets.

State **two** other types of natural object that orbit the Sun.

1 .....

2 .....

[2]

(b) State the shape of the orbits of the planets.

..... [1]

(c) Fig. 10.1 shows the orbit of an object around the Sun. At point A, the object is closest to the Sun. At point B, the object is furthest away from the Sun.

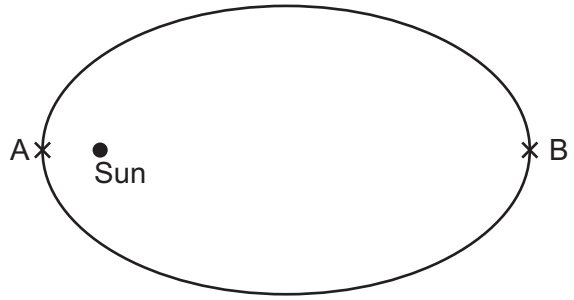


Fig. 10.1

State and explain the energy transfer as the object travels from point A to point B.

statement .....

.....

explanation .....

.....

[2]

(d) Jupiter is 7.8×10^{11} m from the Sun. The speed of light in a vacuum is 3.0×10^{8} m/s.

Calculate the time taken for light from the Sun to reach Jupiter.

time = ... [2]

[Total: 7]

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11 **(a)** Name the galaxy that contains the Sun.

..... [1]

(b) Light observed from distant galaxies is redshifted.

State the theory of the Universe that this observation supports.

..... [1]

(c) Cosmic microwave background radiation (CMBR) is observed at all points in space.

(i) State when this radiation was produced.

..... [1]

(ii) Explain why this radiation is now in the microwave region of the electromagnetic spectrum.

.....

..... [2]

[Total: 5]

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