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2033353289

PHYSICS **0625/43**

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 **16** pages.

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1 A ball of mass 130 g is launched from the ground at an initial velocity of 14 m / s vertically upwards. It decelerates until it is at rest momentarily at a height *h* above the ground.

(a) Define deceleration.

.....

..... [2]

(b) The acceleration of free fall is 9.8 m / s^2.

Show that the time taken for the ball to reach height *h* is 1.4 s. Ignore the effect of air resistance.

[1]

(c) Calculate *h*. Ignore the effect of air resistance.

h = ... [3]

(d) The ball is dropped from the top of a tall building.

Describe and explain the motion of the ball as it falls. Consider the effect of air resistance in your answer.

.....

.....

.....

..... [3]

[Total: 9]

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2 Fig. 2.1 shows solar-powered traffic warning lights.

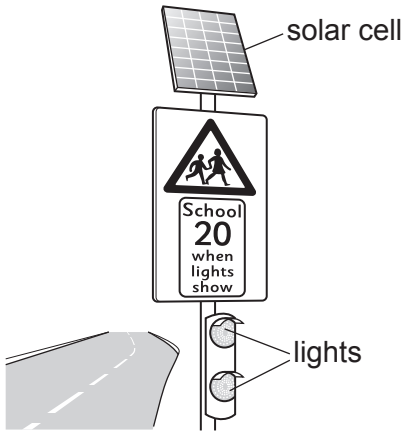


Fig. 2.1

The energy from the solar cell is stored in a battery.

(a) Name the energy store in the battery.

..... [1]

(b) The two lights in Fig. 2.1 are connected in parallel.

State **one** advantage of a parallel connection in a lighting circuit.

.....

..... [1]

(c) The efficiency of the solar cell is 22%. The power supplied to the lights by the cell is 15 W.

(i) State what is meant by 22% efficiency.

.....

..... [1]

(ii) Calculate the solar power input to the solar cell.

power = ... [2]

(d) Suggest **two** advantages of using a solar cell to power the traffic warning lights in Fig. 2.1 compared to using mains electricity.

1 .....

2 .....

[2]

[Total: 7]

3 Fig. 3.1 shows two children balanced on a seesaw. A seesaw is a length of wood which rotates about a central pivot.

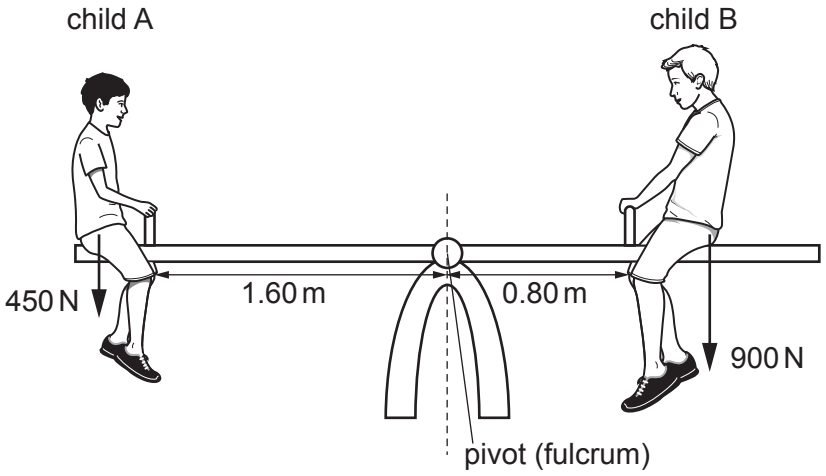


Fig. 3.1

(a) Child B moves 0.050 m further away from the pivot.

(i) Explain why the seesaw rotates clockwise.

.....

..... [1]

(ii) Child A puts on a backpack and the seesaw now balances.

Calculate the mass of the backpack.

mass = ... kg [3]

(b) The concrete floor under the seesaw is replaced with a rubber floor. A child falls from the seesaw and experiences an impulse when they hit the floor.

(i) Define impulse.

.....

..... [1]

(ii) Explain how the rubber floor reduces injury to the child.
Use ideas about impulse, force, momentum and time in your answer.

.....

.....

.....

..... [3]

[Total: 8]

4 Fig. 4.1 shows a stainless-steel saucepan being heated on an electric cooker. The saucepan contains water.

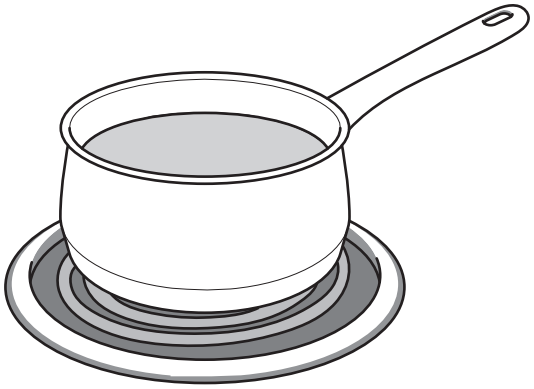


Fig. 4.1

(a) State what happens to the water particles as the water temperature increases.

..... [1]

(b) The saucepan contains 250 cm^3 of water. The specific heat capacity of water is 4200 J / (kg °C). The density of water is 1000 kg / m^3.

(i) Show that the mass of the water in the saucepan is 0.25 kg.

[2]

(ii) Calculate the energy required to increase the water temperature from 20 °C to 65 °C.

energy = ... [3]

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(iii) The heater supplies enough power to heat the water in 39 s.
A student measures the time taken to heat the water as 115 s.

Suggest why the actual time taken to heat the water is longer. Assume that the student takes accurate measurements.

.....

..... [1]

(c) The stainless-steel saucepan is replaced with an aluminium saucepan of the same mass. It contains the same volume of water.

The specific heat capacity of stainless steel is 500 J / (kg °C).
The specific heat capacity of aluminium is 890 J / (kg °C).

Explain how using an aluminium saucepan will affect the time taken to heat the water.

.....

.....

..... [2]

[Total: 9]

5 Fig. 5.1 shows two containers, each filled with hot water.

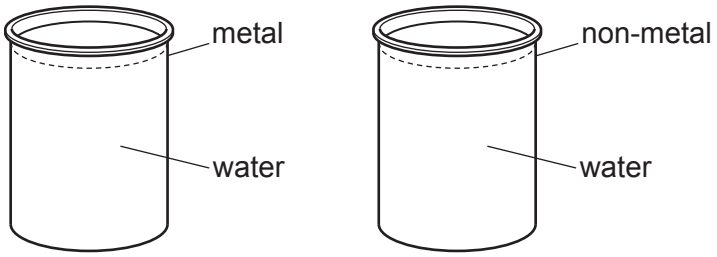


Fig. 5.1

The outer surface of the metal container is hot.

(a) Explain how electrons transfer thermal energy through the metal of the container.

.....

.....

.....

..... [3]

(b) The outer surface of the non-metal container is much cooler than the outer surface of the metal container.

Explain why a non-metal conducts thermal energy less well than a metal.

.....

..... [1]

(c) Explain, in terms of particles, why gases are poor thermal conductors compared to non-metal solids.

.....

.....

..... [2]

[Total: 6]

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6 Fig. 6.1 shows a thin converging lens used to produce a magnified image of an object AB.

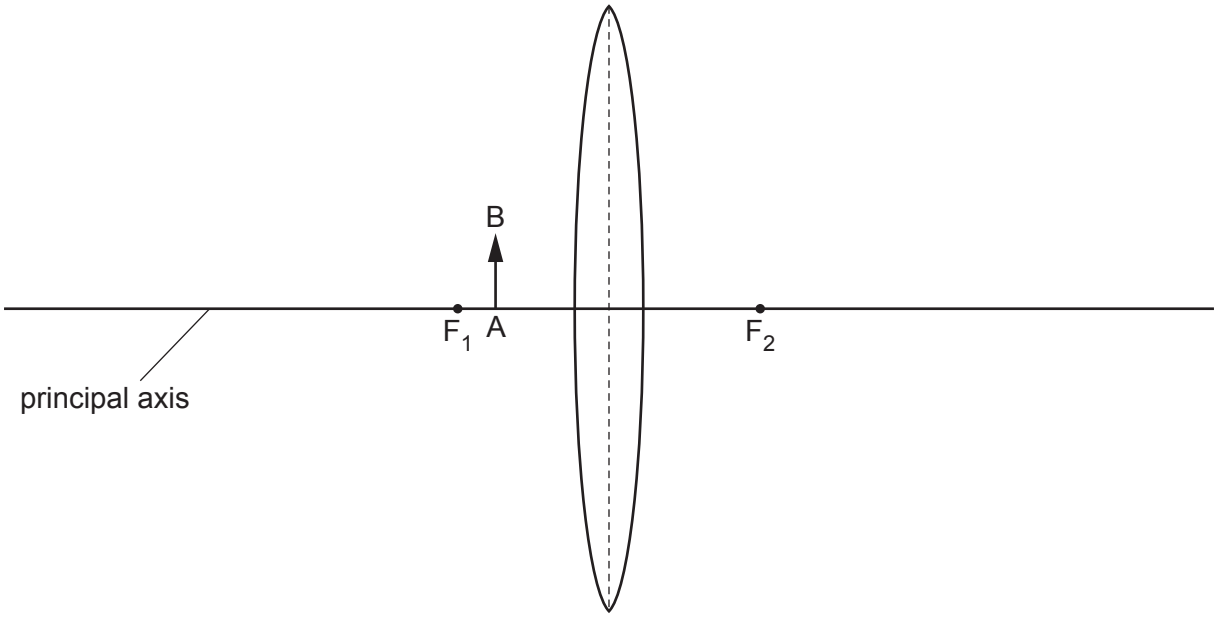


Fig. 6.1

(a) Explain the meaning of the terms principal focus and focal length.

principal focus .....

.....

focal length .....

.....

[2]

(b) On Fig. 6.1, draw the magnified image of AB. Show your working. [4]

[Total: 6]

7 Fig. 7.1 shows two charged metal plates. X marks the position of the centre of the space between the plates.

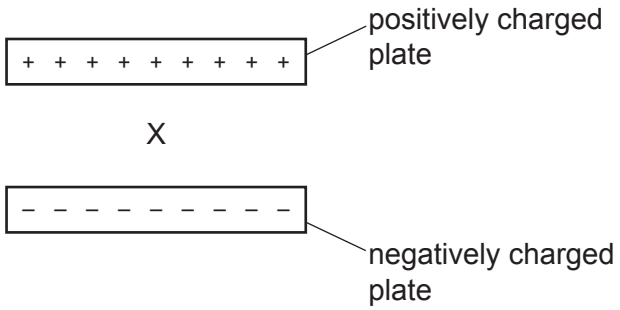


Fig. 7.1

(a) (i) On Fig. 7.1, draw at least **four** field lines to show the pattern and the direction of the electric field between the two charged plates. [2]

(ii) Describe the effect on a negatively charged particle placed at X.

.....

..... [1]

(b) During a thunderstorm, an electric field is set up between a cloud and the ground. Charges on the cloud and on the ground are shown in Fig. 7.2.

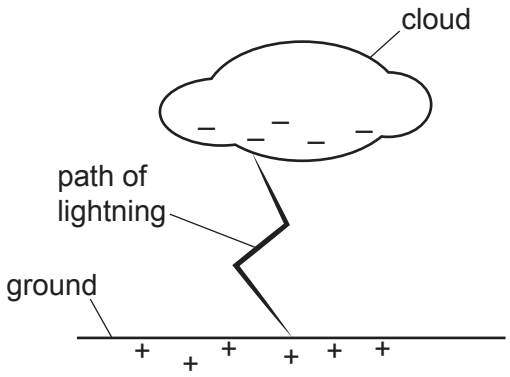


Fig. 7.2

The lightning shown in Fig. 7.2 discharges a current of 28 000 A for 0.0012 s.

(i) Calculate the charge that flows from the cloud to the ground.

charge = ... [2]

(ii) The lightning transfers 1.2×10^8 J of energy.

Calculate the potential difference between the base of the cloud and the ground.

potential difference = ... [2]

[Total: 7]

8 Fig. 8.1 shows images produced during two different medical scanning procedures.



ultrasound scan of a fetus



X-ray scan of a hand

Fig. 8.1

(a) (i) Define ultrasound.

.....

..... [1]

(ii) State how the speed of sound in liquid compares to the speed of sound in air.

..... [1]

(iii) X-rays are part of the electromagnetic spectrum.

State the speed of X-rays in a vacuum.

..... [1]

(b) Describe **three** similarities or differences between the use of ultrasound and X-rays in medical scanning procedures.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

[Total: 6]

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9 Fig. 9.1 shows a mobile phone (cell phone) being charged on a wireless charging plate.

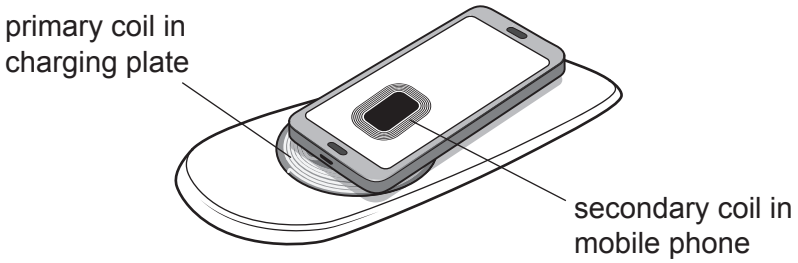


Fig. 9.1

(a) When the charging plate is switched on, there is an alternating current (a.c.) in the primary coil. A secondary coil is in the mobile phone.

Explain how a current is produced in the secondary coil.

.....

.....

..... [3]

(b) The maximum energy stored in the battery of the mobile phone is 0.012 kW h.

(i) Show that this maximum energy is 4.3×10^4 J.

[1]

(ii) The charging plate in Fig. 9.1 has a useful output power of 15 W.
The phone manufacturer claims that the battery can be charged to 50% capacity in less than 30 minutes.

Show that this claim is true.

[3]

[Total: 7]

10 Leaks in underground water pipes are detected using radioactive tracers. Fig. 10.1 shows a radiation detector above a water pipe.

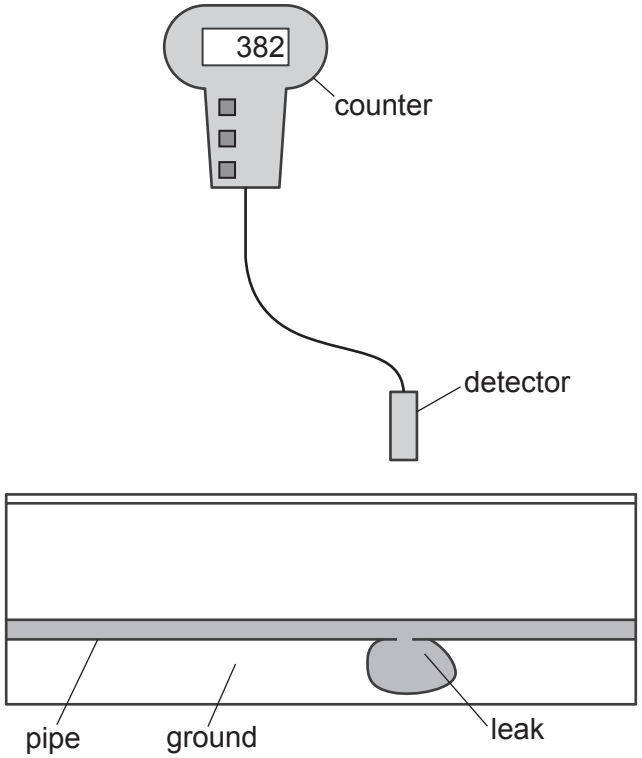


Fig. 10.1

(a) Before the radioactive tracer is added to the water, the detector measures the background radiation above the pipe. The average background radiation is 26 counts / minute.

(i) Define background radiation.

.....

..... [1]

(ii) Suggest **one** source of radiation that may make a significant contribution to the background count rate.

..... [1]

(iii) A radioactive tracer is added to the water. The counter in Fig. 10.1 shows the count rate in counts / minute above the leak in the water pipe.

Determine the count rate due to the tracer.

count rate = ... [2]

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(b) Suggest which radioactive emission, alpha, beta or gamma, is suitable for detecting the leak in the water pipe.

Explain your answer.

emission .....

explanation .....

.....

[3]

(c) **(i)** Explain why the radioactive isotope must **not** have a very **short** half-life.

.....

..... [1]

(ii) Explain why the radioactive isotope must **not** have a very **long** half-life.

.....

..... [1]

[Total: 9]

11 A galaxy is approximately 1.2×10^{26} m from the Earth.

(a) Scientists observe light from the distant galaxy.

The wavelength of the observed light is longer than the wavelength of the light emitted from the galaxy.

State the name of this effect.

..... [1]

(b) **(i)** State the current estimate for the Hubble constant H_0.

H_0 = ... [1]

(ii) Calculate the speed at which the galaxy is moving away from the Earth.

speed = ... [2]

(iii) Scientists have measured the speeds at which distant galaxies are moving away from the Earth and their distances from the Earth.

These measurements suggest that all the Universe was once at a single point.

Explain why.

.....

.....

..... [2]

[Total: 6]

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