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*6553459997*

**PHYSICS** **0625/42**

Paper 4 Theory (Extended) **February/March 2020**

**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. Blank pages are indicated.


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**1** A rocket is launched vertically upwards from the ground. The rocket travels with uniform acceleration from rest. After 8.0 s, the speed of the rocket is 120 m / s.

**(a)** Calculate the acceleration of the rocket.

acceleration = ..... [2]

**(b)** **(i)** On Fig. 1.1, draw the graph for the motion of the rocket in the first 8.0 s.

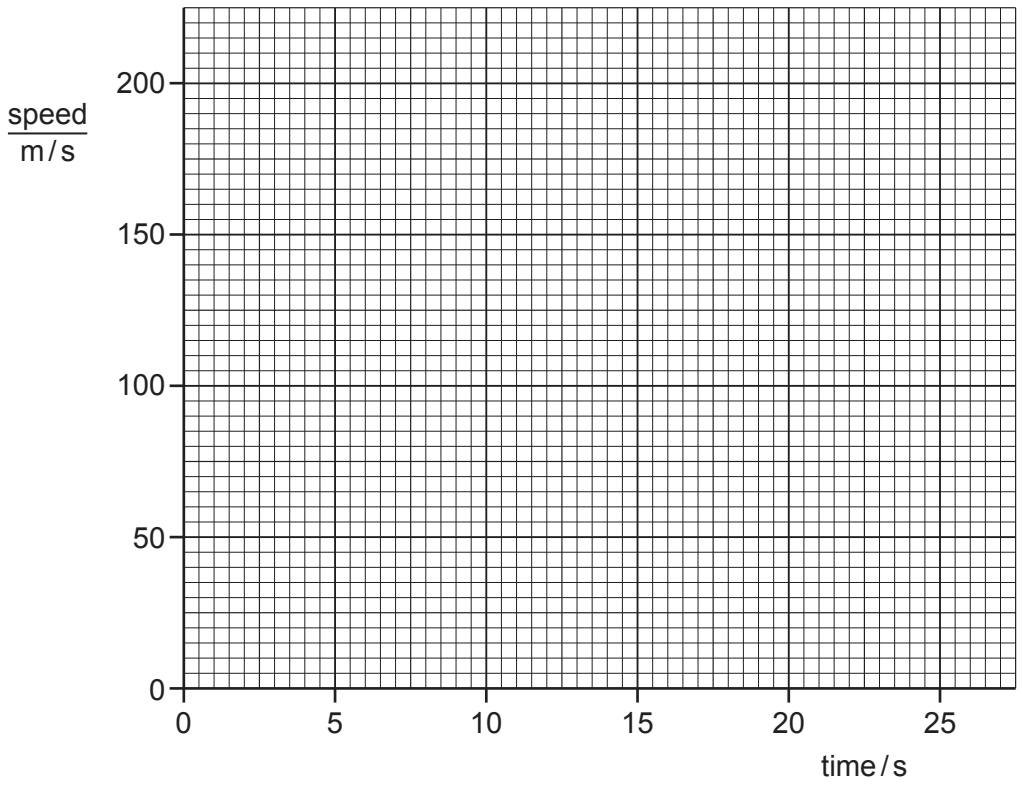



**Fig. 1.1**

[1]

**(ii)** Use the graph to determine the height of the rocket at 8.0 s.

height = ..... [2]

**(iii)** From time = 8.0 s to time = 20.0 s, the rocket rises with increasing speed but with decreasing acceleration.

From time = 20.0 s to time = 25.0 s, the rocket has a constant speed of less than 200 m / s.

On Fig. 1.1, draw the graph for this motion. [3]

[Total: 8]

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**2** Fig. 2.1 shows an athlete crossing the finishing line in a race. As she crosses the finishing line, her speed is 10.0 m / s. She slows down to a speed of 4.0 m / s.

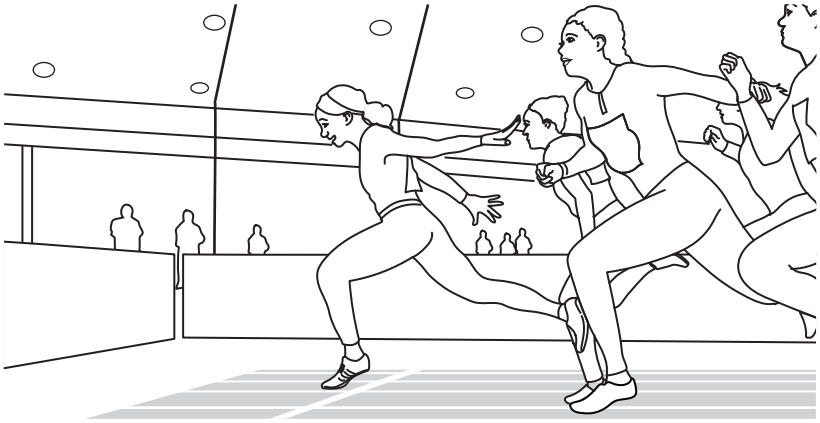


**Fig. 2.1**

**(a)** The mass of the athlete is 71 kg. Calculate the impulse applied to her as she slows down.

impulse = ..... [3]

**(b) (i)** Define *impulse* in terms of *force* and *time*.

.....

..... [1]

**(ii)** The athlete takes 1.2 s to slow down from a speed of 10.0 m / s to a speed of 4.0 m / s.

Calculate the average resultant force applied to the athlete as she slows down.

force = ..... [2]

**(c)** Calculate the force required to give a mass of 71 kg an acceleration of 6.4 m / $s^2$.

force = ..... [2]

[Total: 8]

**3** Fig. 3.1 shows a model of a wind turbine used to demonstrate the use of wind energy to generate electricity. The wind is blowing towards the model, as shown.

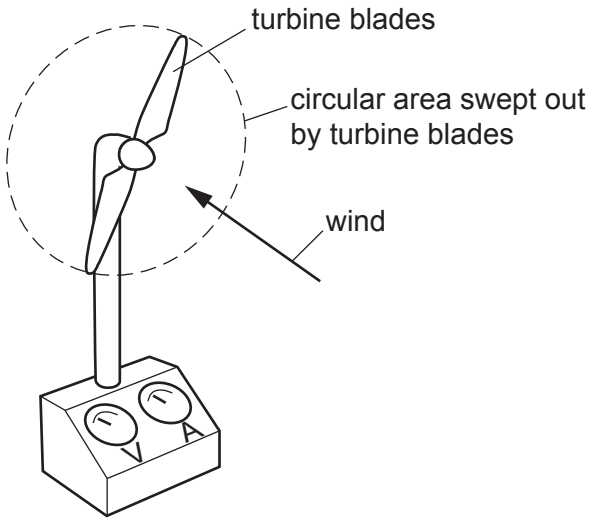



**Fig. 3.1**

**(a)** The mass of air passing through the circular area swept out by the turbine blades each second is 7.5 kg. The kinetic energy of the air that passes through this circular area each second is 240 J.

**(i)** Calculate the speed of the air.

speed = ..... [3]

**(ii)** The kinetic energy of the air drives a generator. State the input power of the air passing through the turbine blades.

input power = ..... [1]

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**(b)** The output current of the generator is 2.0A. The output potential difference (p.d.) of the generator is 11V.

**(i)** Calculate the output power of the generator.

output power = ..... [2]

**(ii)** Calculate the efficiency of the wind turbine.

efficiency = ..... % [2]

**(c)** The density of air is 1.3kg/$m^3$.
Calculate the volume of air passing through the circular area swept out by the turbine blades each second.

volume = ..... [2]

[Total: 10]

**4** **(a)** Define the *specific latent heat of fusion* of a substance.

.....

.....

..... [2]

**(b)** Small pieces of ice at 0 °C are added to 0.35 kg of water. The initial temperature of the water is 24.5 °C. The temperature of the water decreases to 0 °C. The water loses 35 000 J of thermal energy as it cools. All of the ice added to the water melts.

The specific latent heat of fusion of ice is $3.3 \times 10^5$ J / kg.

Calculate:

**(i)** the specific heat capacity of water

specific heat capacity = ..... [2]

**(ii)** the mass of ice added to the water.

mass = ..... [3]

[Total: 7]

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**5** **(a)** Complete the sentences with words that describe the main process of thermal energy transfer in each case.

A man goes for a walk on a cold day. He touches a metal gate, which removes thermal energy from his hands by ..... . He holds the sides of a cup containing a hot drink. His hands gain thermal energy by ..... . Some farm workers have lit a fire. The man warms his hands by the side of the fire. His hands gain thermal energy by ..... . [3]

**(b)** Describe in terms of particles the transfer of thermal energy through the metal of the gate after transfer from the man's hands.

.....

..... [2]

**(c)** Fig. 5.1 shows a car on a sunny day in a hot country.

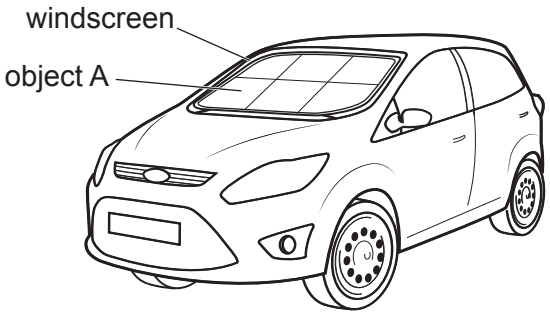



**Fig. 5.1**

The object labelled A is placed inside the windscreen. It is used by the owner of the car to reduce the temperature rise of the air in the car.

Ring the most suitable material for the outer surface of object A. Explain your choice.

**dull black** **dull white** **shiny black** **shiny white**

explanation .....

..... [2]

[Total: 7]

**6** **(a)** Fig. 6.1 shows crests of a water wave moving from left to right in a harbour.

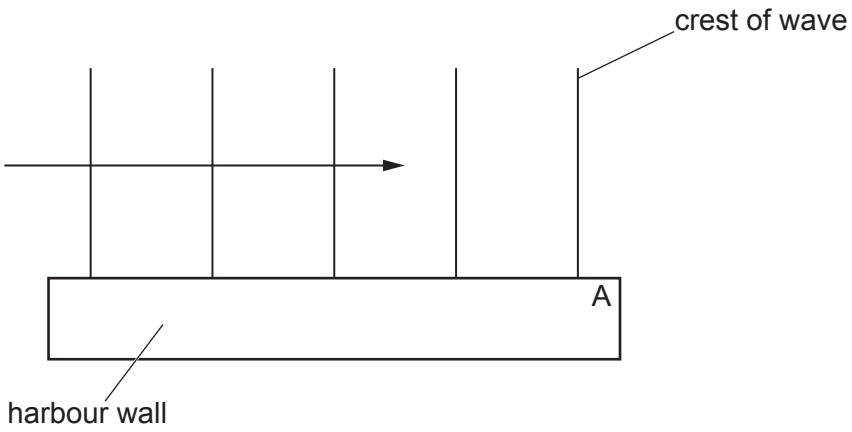



**Fig. 6.1**

**(i)** On Fig. 6.1, draw three more crests to the right of point A. [2]

**(ii)** State the name of the wave process that occurs as the wave passes point A.

..... [1]

**(b)** Fig. 6.2 shows the crests of another wave moving from left to right in a different part of the harbour. This wave moves from deep water to shallow water.

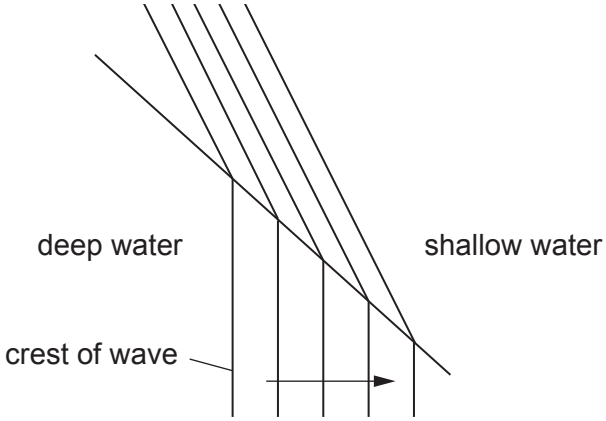



**Fig. 6.2**

**(i)** On Fig. 6.2, draw an arrow to show the direction of movement of the wave after it has passed into the shallow water. [1]

**(ii)** State the name of the process that occurs as the wave passes into the shallow water.

..... [1]

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**(iii)** Complete Table 6.1 to state whether each of the properties of the wave **increases**, **decreases** or **stays the same** as the wave passes into the shallow water.

**Table 6.1**

| property | effect |
|---|---|
| wavelength | |
| frequency | |
| speed | |

[3]

[Total: 8]

**7** **(a)** Fig. 7.1 shows a converging lens and the image I formed when an object is placed to the left of the lens. The principal focuses are labelled A and B and the centre of the lens is labelled C.

**(i)** On Fig. 7.1, draw two rays to locate the position of the object.
Draw the object and label it O.

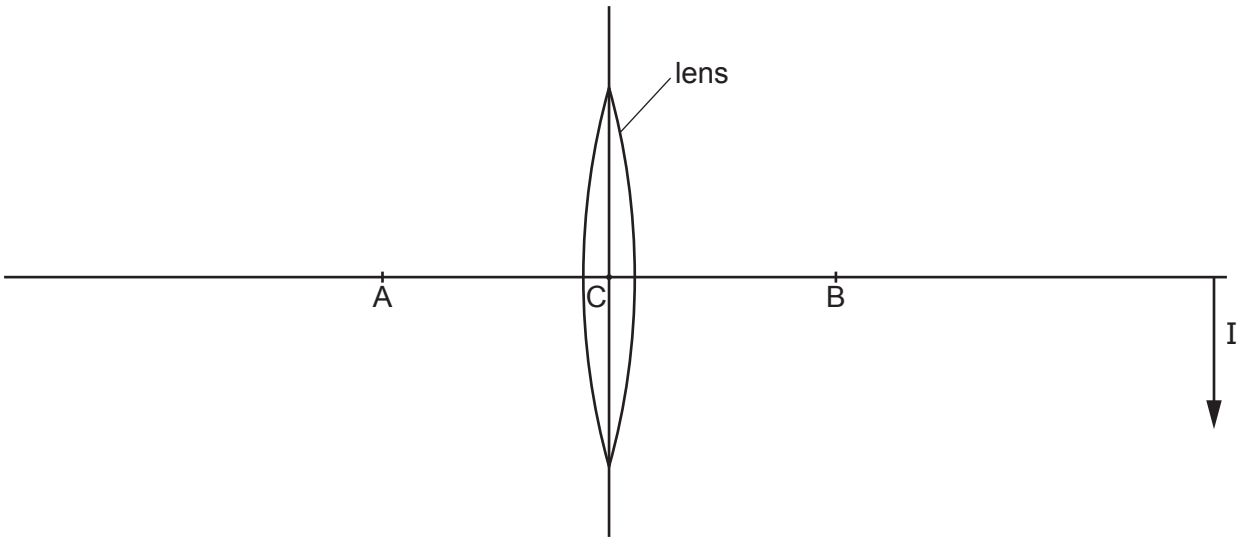



**Fig. 7.1**

[3]

**(ii)** Ring all of the following distances that are equal to the focal length of the lens.

AB AC CB 2AB

[2]

**(b)** Fig. 7.2 shows green light passing through a triangular glass block.

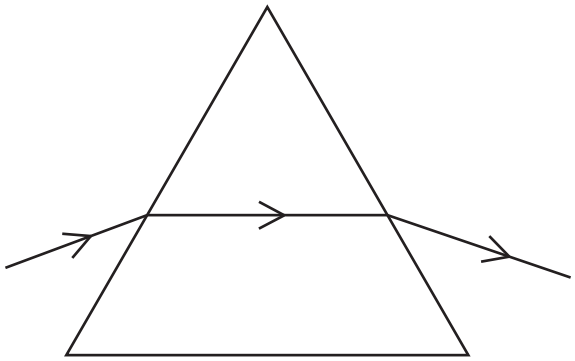


**Fig. 7.2**

Red light enters the triangular glass block shown in Fig. 7.2 along the same path as the green light.

**(i)** On Fig. 7.2, draw the path of the red light within the triangular glass block. [1]

Fig. 7.3 shows green light passing through a rectangular glass block.

Red light enters the rectangular glass block shown in Fig. 7.3 along the same path as the green light.

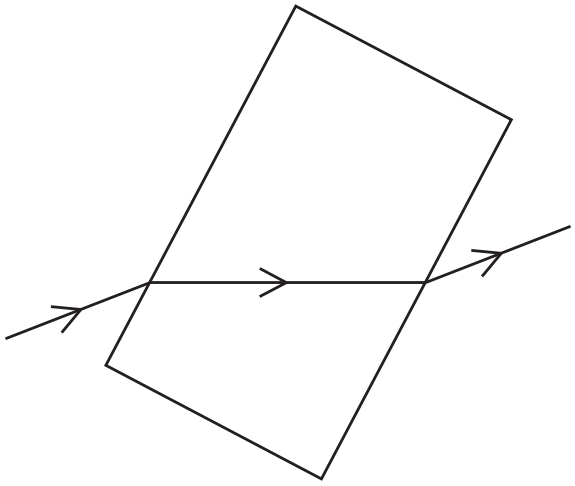


**Fig. 7.3**

On Fig. 7.3:

**(ii)** draw the path of the red light within the rectangular glass block [1]

**(iii)** draw the path of the red light after leaving the rectangular glass block. [1]

[Total: 8]

**8** Fig. 8.1 shows a circuit.

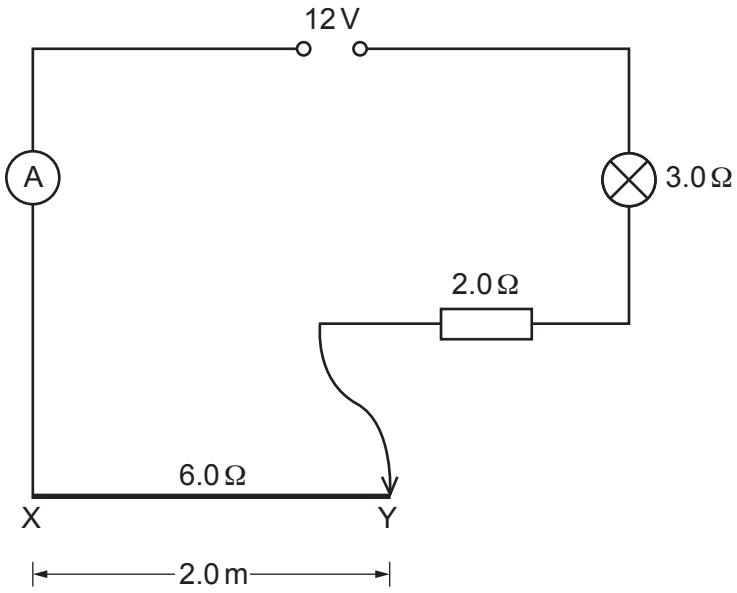



**Fig. 8.1**

The lamp has a resistance of 3.0 Ω. Line XY represents a uniform resistance wire of resistance 6.0 Ω.

**(a)** Calculate the reading on the ammeter.

ammeter reading = ..... [2]

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**(b)** Fig. 8.2 shows the circuit with a different connection to the resistance wire and an added resistor. The length XY of the whole resistance wire is 2.0 m. The contact is made at Q where the distance XQ is 0.60 m.

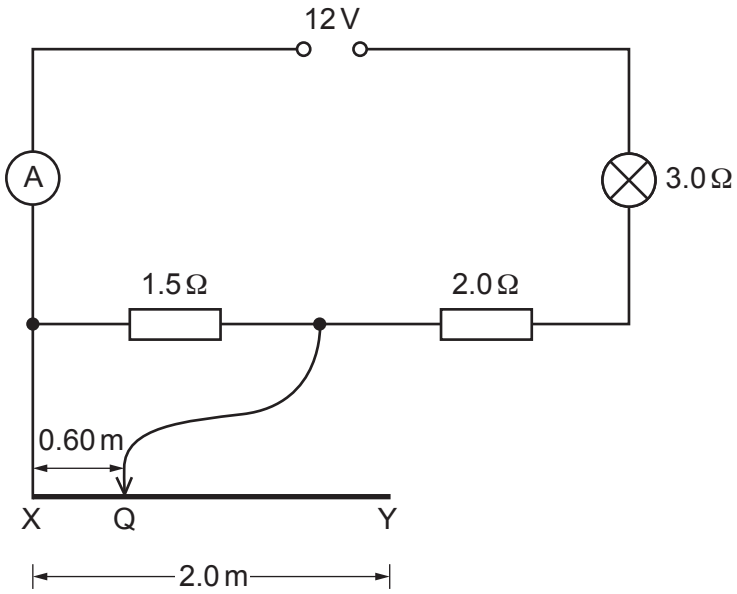



**Fig. 8.2**

Calculate the resistance of the circuit.

resistance = ..... [4]

[Total: 6]

**9** **(a)** State the name of the logic gate with the symbol shown in Fig. 9.1.

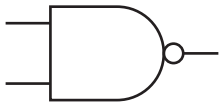


**Fig. 9.1**

..... [1]

**(b)** State the name of the logic gate with the truth table shown in Table 9.1.

**Table 9.1**

| input | output |
|---|---|
| 0 | 1 |
| 1 | 0 |

..... [1]

**(c)** Fig. 9.2 shows a digital circuit.

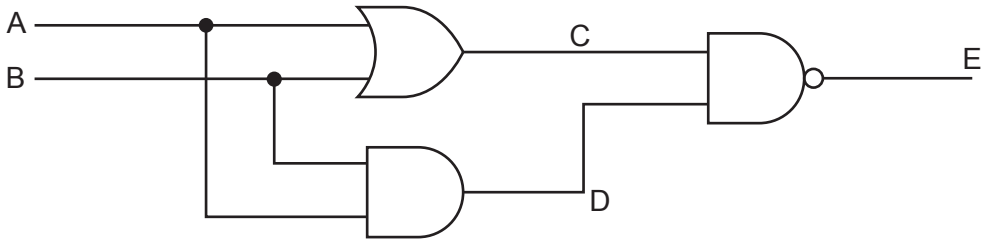



**Fig. 9.2**

Complete the truth table in Table 9.2 for this circuit for all possible combinations of input.

**Table 9.2**

| A | B | C | D | E |
|---|---|---|---|---|
| | | 1 | 1 | |
| | | 1 | 0 | |
| | | 1 | 0 | |
| | | 0 | 0 | |

[4]

[Total: 6]

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**10** **(a)** Fig. 10.1 is a simplified top view of a flat coil. There is an alternating current (a.c.) in the coil.

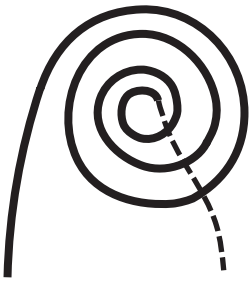


**Fig. 10.1**

Describe the magnetic effect of this alternating current.

.....

.....

..... [2]

**(b)** Fig. 10.2 shows a pan placed above the coil. The base of the pan is made of steel.

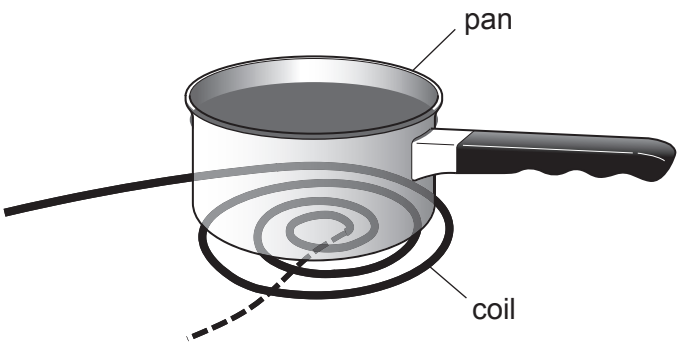



**Fig. 10.2**

State what quantity is induced in the base of the pan.

..... [1]

**(c)** The pan contains water.

State and explain the effect of the quantity induced in part **(b)** on the temperature of the water in the pan.

.....

.....

..... [3]

[Total: 6]

**11 (a)** The isotope hydrogen-1 has a proton number of 1 and a nucleon number of 1.

Two isotopes of helium are helium-3 and helium-4.

Helium-3 has a proton number of 2 and a nucleon number of 3.

Helium-4 has a nucleon number of 4.

Complete Table 11.1 for neutral atoms of these isotopes of helium.

**Table 11.1**

| | helium-3 | helium-4 |
|---|---|---|
| number of neutrons | | |
| number of electrons | | |
| mass compared to a neutral atom of hydrogen-1 | | |

[3]

**(b)** An experiment takes place in a laboratory shielded from all background radiation. A sample of radioactive material is wrapped in aluminium foil of thickness 0.1 mm. A detector of ionising radiation placed 1 cm from the foil records a reading.

A piece of aluminium of thickness 5 mm is placed between the detector and the foil. The detector reading drops to zero.

State and explain any type of radiation passing through the aluminium foil.

.....

.....

.....

..... [3]

[Total: 6]

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