Topic 1

iGda 14w31

10 A motorcycle is driven along a straight road. Fig. 10.1 shows a speed/time graph for the motion of the motorcycle from the time the rider sees a car approaching.

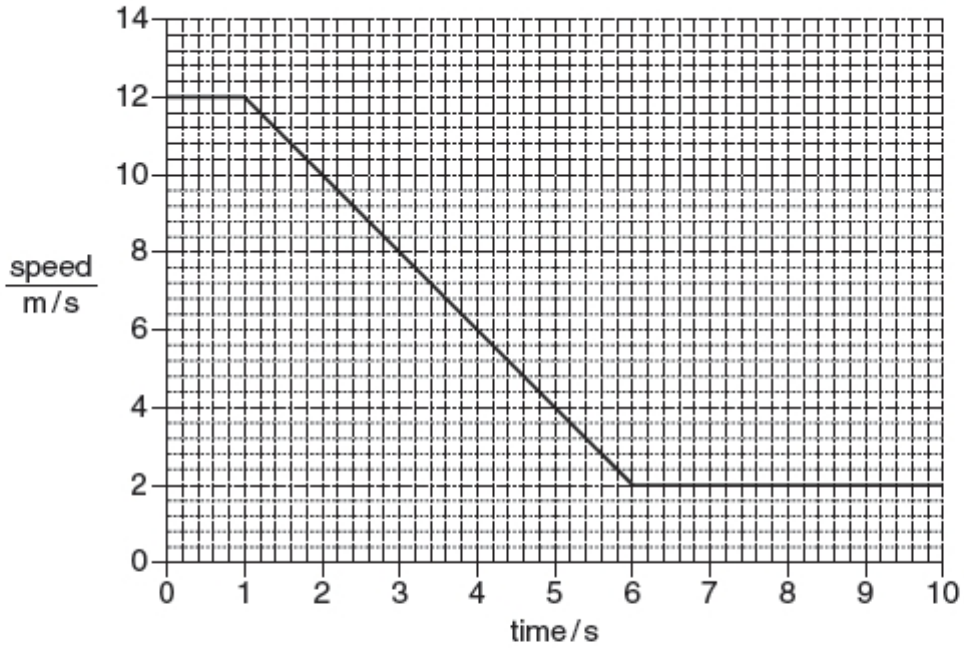

Fig. 10.1

(a) (i) Calculate the distance the motorcycle travels while it is slowing down.

Show your working.

distance = ...m [3]

(ii) Calculate the deceleration of the motorcycle.

Show your working.

deceleration = ... m/s^2 [2]

iGda 14s31

3 Fig. 3.1 shows information about two trucks, **X** and **Y**, coming to rest under the action of the same braking force.

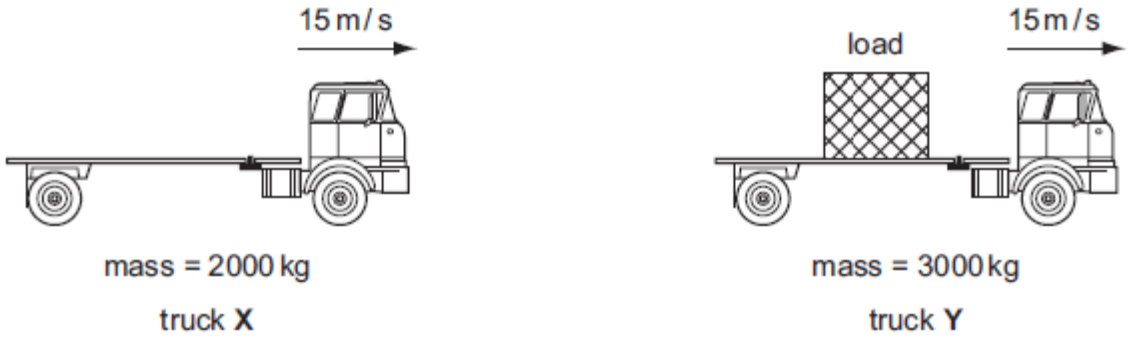

Fig. 3.1

The mass of truck **X** is 2000 kg and the mass of truck **Y** and its load is 3000 kg.

Fig. 3.2 shows the speed / time graph for the two trucks.

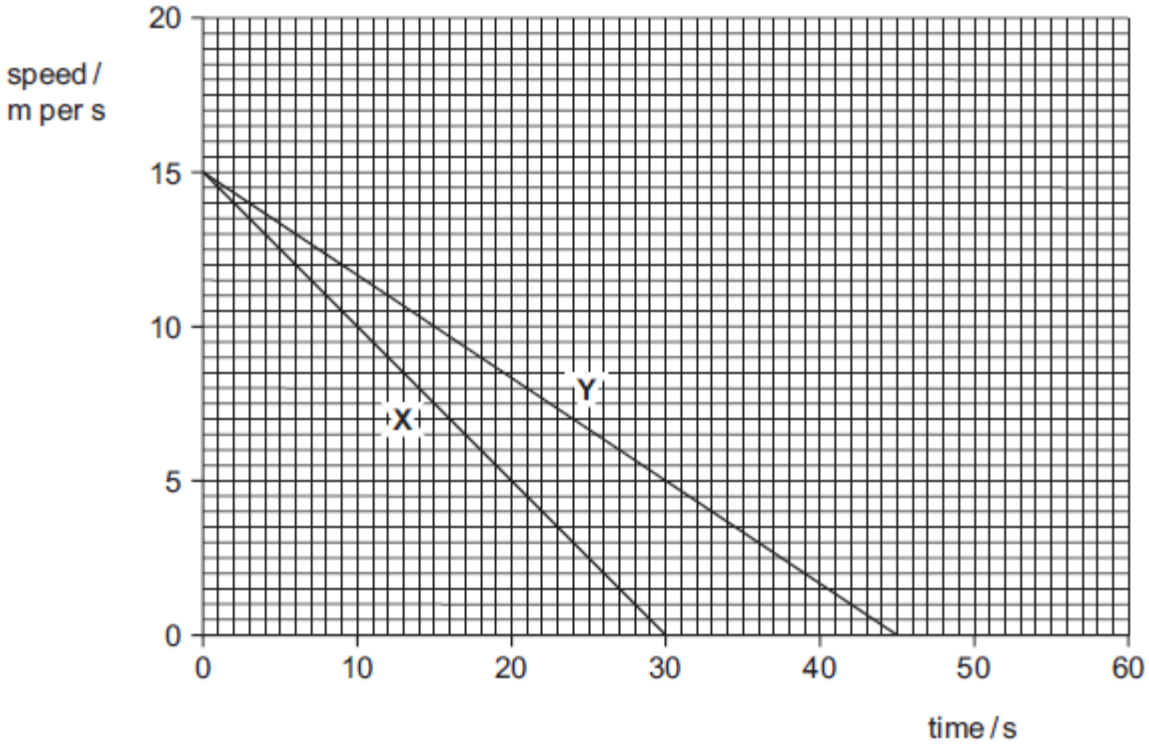

Fig. 3.2

(a) (i) Explain how Fig. 3.2 shows that truck **X** has the greater deceleration.

.....

..... [1]

(ii) Calculate the deceleration of truck **Y**.

Show your working.

deceleration = ... m/s^2 [2]

iGda 13w31

5 Fig. 5.1 shows a solar-powered vehicle.

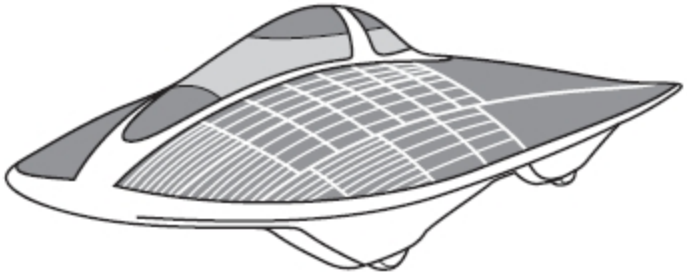

Fig. 5.1

(a) Fig. 5.2 shows a speed/time graph for the vehicle for the first hour of a journey.

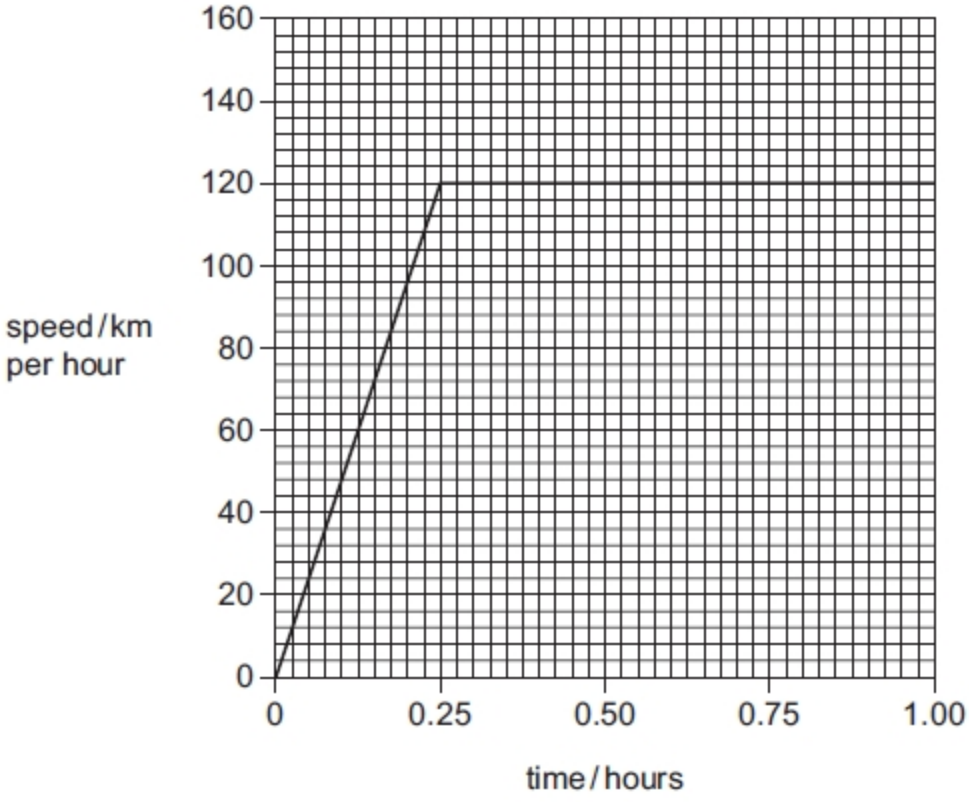

Fig. 5.2

(i) Calculate the distance travelled during the first hour.

Show your working and state the unit of your answer.

..... unit ..... [2]

(ii) Calculate the acceleration of the vehicle during the first quarter of an hour.

State your answer in m/s^2.

Show your working.

..... m/s^2 [3]

iGda 13s31 Q6

(c) Three boys, **A**, **B** and **C**, walk together from their school to a store. They stay at the store for a few minutes and then return to school.

When they leave the store,

- one boy walks back to school at a steady pace,
- one boy walks back to school at a slower steady pace,
- one boy slows down gradually as he walks back to school.

The graph in Fig. 6.3 shows how their speeds vary with time.

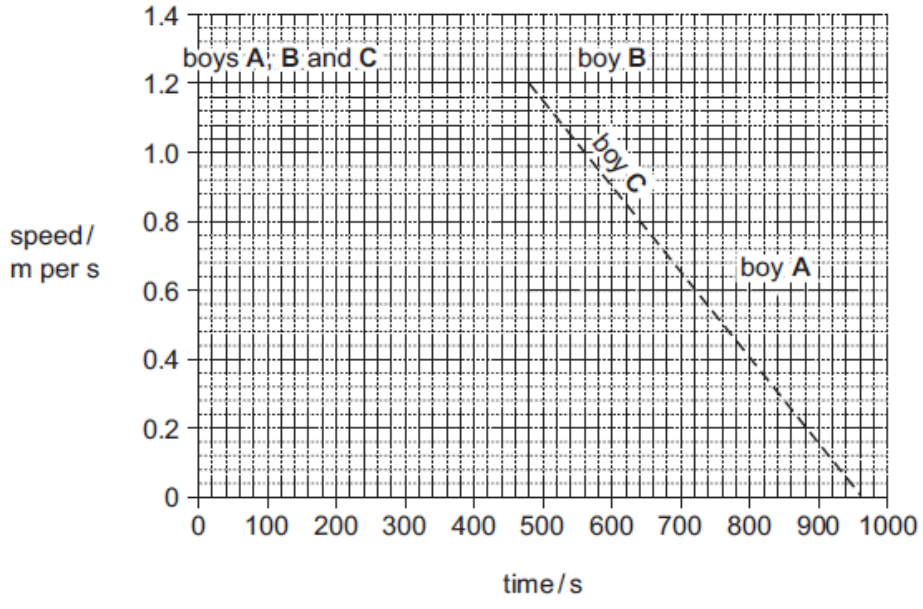

Fig. 6.3

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(i) Calculate the distance of the store from the school.

Show your working.

..... [2]

(ii) For how many seconds do the boys stay in the store?

..... s [1]

(iii) Which boy slowed down on his way back to school?

Explain your answer.

.....

..... [1]

iGda 11w31

7 **(a)** Fig. 7.1 shows a speed-time graph for the performance of an athlete in a race.

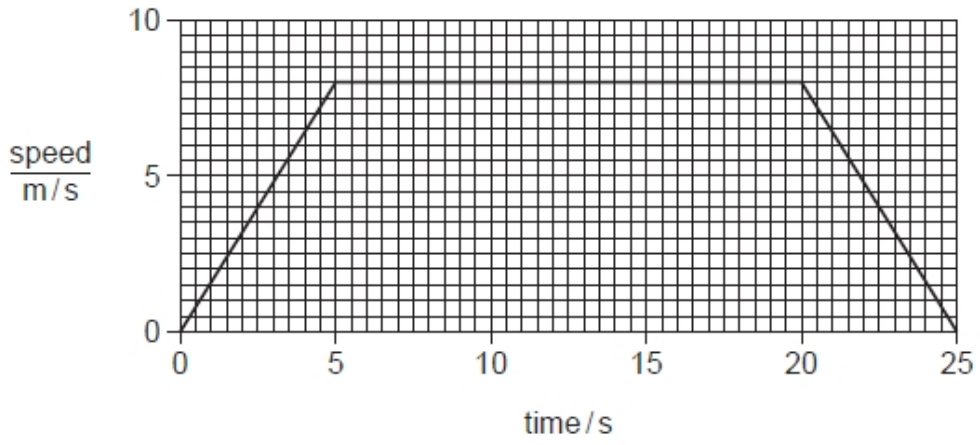


Fig. 7.1

Calculate the distance the athlete travelled between 0 and 25 seconds.

Show your working.

..... [3]

iGda 11s31 Q7 (a)

Microwave pulses travel at 300 000 000 m/s.

(ii) A radar transmitter sends a microwave pulse which is reflected from the aircraft. The microwave pulse returns to the receiver 0.000 027 s after transmission.

Calculate the distance of the aircraft from the radar transmitter.

State the formula that you use and show your working.

formula used

working

..... [2]

(c) As the aircraft lands it is travelling at 85 m/s. It moves along the runway and decelerates at a uniform rate for 40 s until it stops.

(i) Calculate the deceleration of the aircraft along the runway.

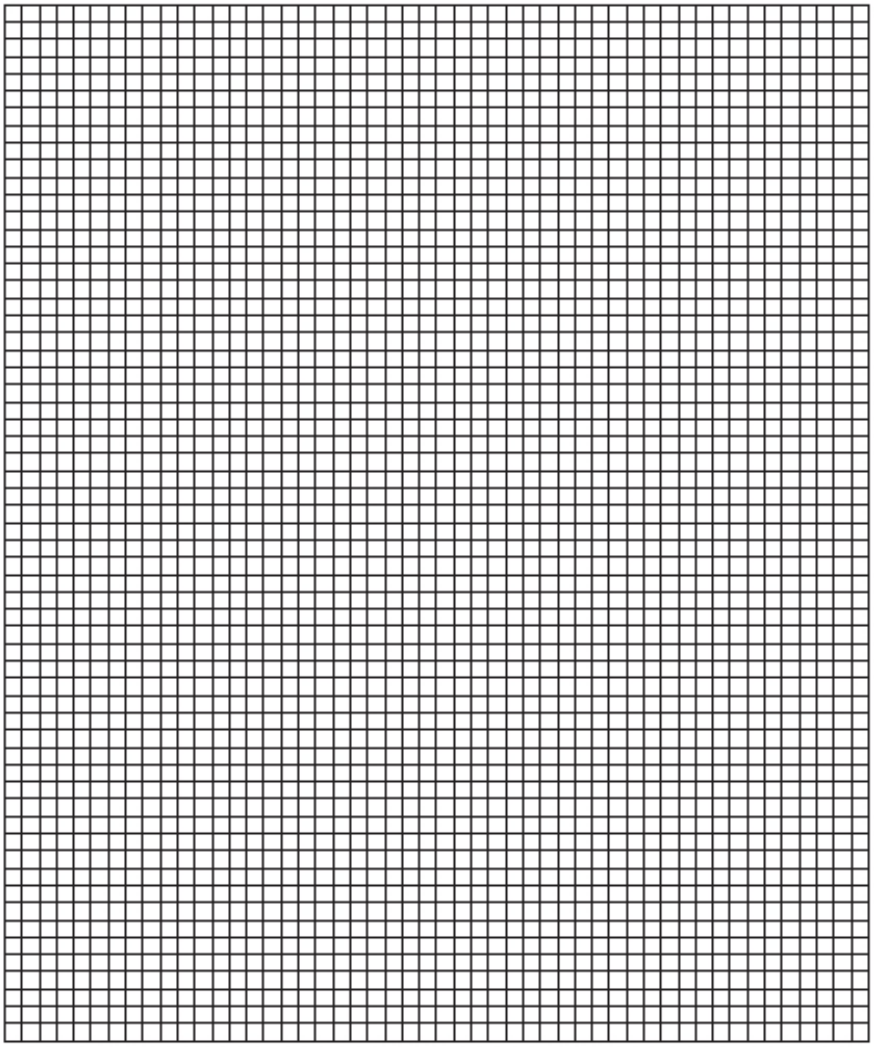
State the formula that you use and show your working.

formula used

working

..... [2]

(ii) On the grid, draw a speed-time graph for the aircraft as it slows down from 85 m / s until it stops.



[3]

iGda 10w31 Q9

(b) Fig. 9.2 is a speed-time graph for the motion of the rock. This graph ignores the effect of air resistance on the rock.

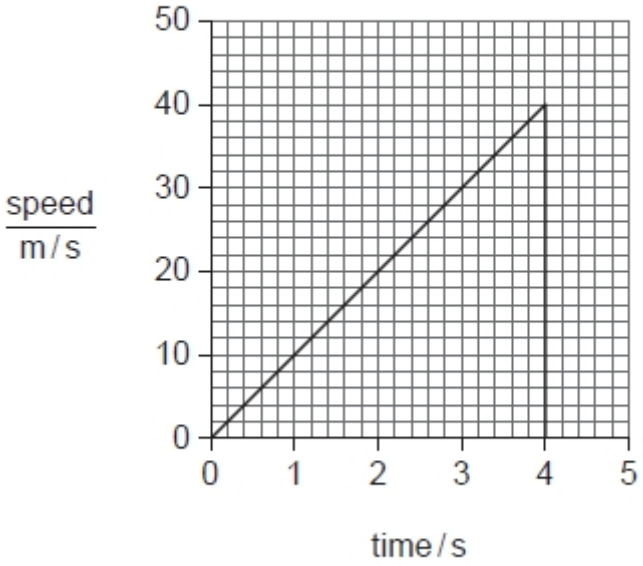


Fig. 9.2

(ii) Calculate the height of the cliff.

Show your working.

..... [2]

iGda 10w31

9 Fig. 9.1 shows a rock that is falling from the top of a cliff into the river below.

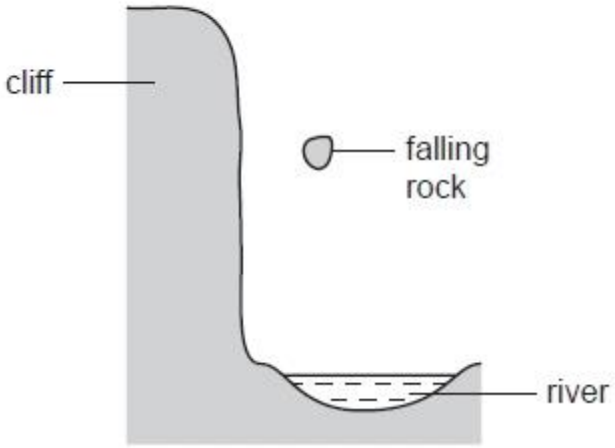


Fig. 9.1

(a) The rock accelerates downwards at $9.8\,m/s^2$. The mass of the rock is 2000 g.

Calculate the weight of the rock.

State the formula that you use and show your working.

formula used

working

..... [2]

iGda 09s31 Q8 (c)

(iii) Fig. 8.1 shows the speed of the dolphin travelling through water.

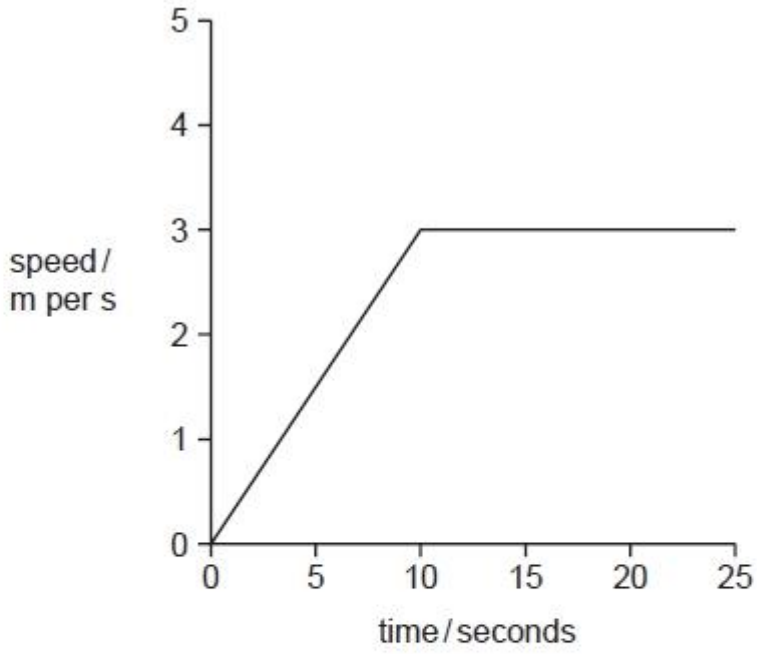


Fig. 8.1

Calculate the distance covered by the dolphin in the first 20 seconds.

Show your working.

..... [2]

Topic 1 MS

iGda 14w31

10 (a) (i) area under graph (triangle and rectangle) ;
$(^1/_2 \times 5 \times 10) + 10$;
= 35 (m) ; [3]

(ii) (deceleration / acceleration =) change in speed / change in time (or working) ;
= 2 (m/s^2) ; [2]

iGda 14s31

3 (a) (i) **X** – takes less time to stop / speed decreases more quickly / gradient is greater / line is steeper ; [1]

(ii) (deceleration =) $\frac{\text{change in speed}}{\text{time}}$;

$\frac{15}{45} = 0.33$ (m/s^2) ; [2]

iGda 13w31

5 (a) (i) area under graph/working/ $120 \times 0.75 + \frac{1}{2} \times 120 \times 0.25$;
= 105 km ; [2]

(ii) (acceleration =) gradient or 120/0.25 ;
= 480 (km/h^2) ;
= 0.037 m/s^2 ; [3]

iGda 13s31 Q6

(c) (i) 1.2 × 240 (with or without units)/use of (distance =) speed × time, or area under graph ;
288 m ; [2]

(ii) 240 (s) ; [1]

(iii) boy **C** (no mark)
(line on) graph goes down (so speed was changing) / owtte / use of data ; [1]

iGda 11w31

7 (a) working may be shown on graph/idea of area under graph ;
$(\frac{1}{2} \times 5 \times 8) + (15 \times 8) + (\frac{1}{2} \times 5 \times 8)$;
= 160 m ; [3]

iGda 11s31 Q7 (a)

(ii) (distance =) speed × time ;
= 300 000 000 × 0.000 027 = 8100 m so distance = 4050 m ; [2]

(c) (i) (deceleration =) change in velocity/ time ;
(= 85/40 =) 2.125 m/s^2 ; [2]

(ii) suitable axes and scales ;
straight line ;
from 85 m/s at **t** = 0 to 0 m/s at **t** = 40 ; [3]

iGda 10w31 Q9 (b)

(ii) distance = under graph / other suitable working ;
height = 80 m ; [2]

iGda 10w31

9 (a) (force =) mass × acceleration ; A weight = mass × gravity
= 9.8 × 2 = 19.6 N ; [2]

iGda 09s31 Q8 (c)

(iii) distance travelled = area under graph/working (shown on graph) ;
= 15 + 30 = 45 m ; [2]

Topic 10

iGda 15s31 Q9

(c) When the water starts to boil, the cook knows that the water is bubbling because he can hear the sound of the bubbling.

Sound waves move through the air as a series of compressions and rarefactions.

State the difference between a compression and a rarefaction.

.....

.....

..... [1]

(f) If the scientists run into difficulties when they are on the ice, they ask for help by launching a rocket (flare). Observers see the rocket explode with a flash of light and hear a loud bang. This is shown in Fig. 1.3.

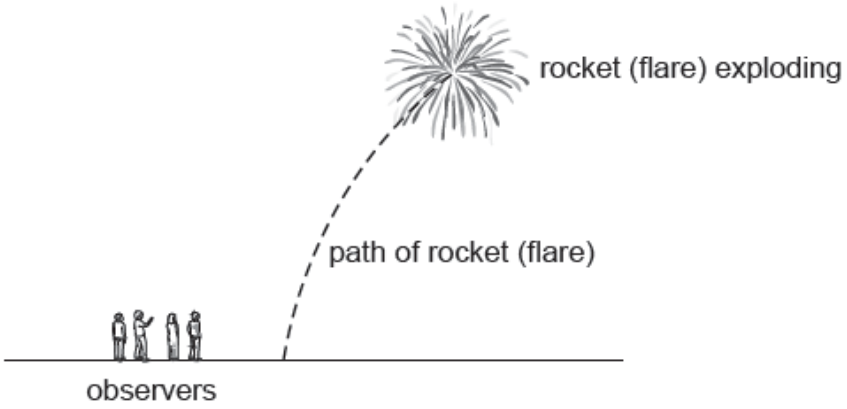


Fig. 1.3

Explain why the flash of light is seen before hearing the bang.

.....

..... [1]

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13 **(a)** Fig. 13.1 shows a fishing boat using ultrasound waves to detect a shoal of fish, 120 m below the surface.

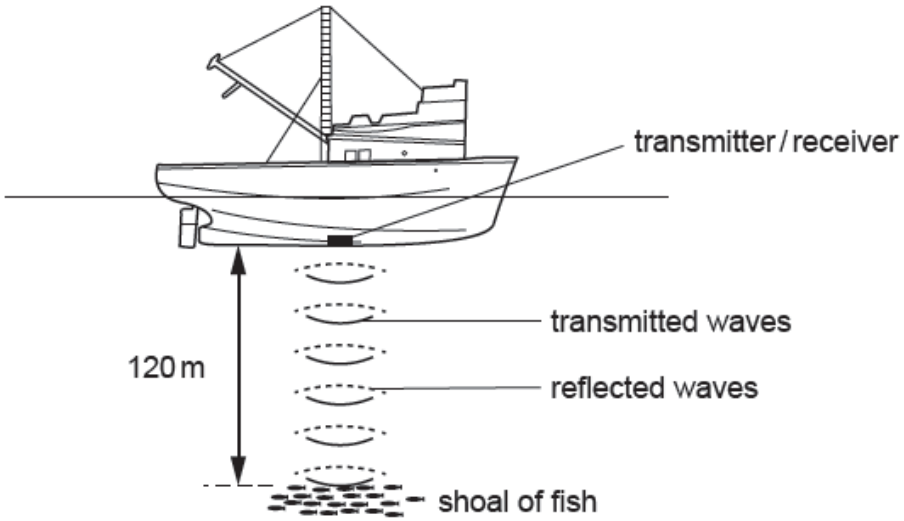


Fig. 13.1

(i) The speed of ultrasound waves in water is 1500 m / s.

Short pulses of ultrasound are sent out from the boat and the echo from the fish is detected by the boat.

Calculate the time taken between the ultrasound waves being emitted and the detection of the echo.

State the formula that you use and show your working.

formula

working

time = ... s [2]

(ii) The frequency of the ultrasound waves used to detect fish is 45 000 Hz.

Calculate the wavelength of the ultrasound waves.

State the formula that you use and show your working.

formula

working

wavelength = ... m [2]

(iii) State the approximate human range of audible frequencies.

from ..... Hz to .....Hz [1]

(iv) State why humans cannot hear ultrasound waves.

.....

..... [1]

iGda 14w31 Q10

(b) The motorcycle rider notices that the sound from a car's engine becomes louder as the car approaches and drops in pitch as the car passes.

Describe these changes in terms of the frequency and amplitude of sound waves released.

becomes louder .....

.....

has a lower pitch .....

.....

[2]

iGda 14s31

10 **(a)** Thunder and lightning happen at the same time. An observer sees the flash of lightning before he hears the thunder.

(i) Explain why the observer sees the lightning before he hears the thunder.

.....

..... [1]

(ii) Describe how the sound of the thunder is transmitted to the observer through the air.

.....

..... [1]

(iii) An observer in a space station orbiting in a vacuum sees the lightning but does not hear the thunder.

Explain why.

.....

..... [1]

(b) Ultrasound waves are sound waves with a very high frequency. These waves cannot be heard by human beings.

(i) State the approximate range of frequencies audible to humans.

..... Hz to ..... Hz [1]

(ii) Devices which emit ultrasound waves can be used to keep small animals such as cats away from gardens.

The ultrasound waves emitted by a device take 0.05 s to travel from the device to a cat. The speed of the ultrasound waves is 330 m / s.

Calculate the distance between the ultrasound device and the cat.

State the formula that you use and show your working.

formula

working

distance = ... m [2]

(iii) An ultrasound device emits waves with a wavelength of 0.011 m.

Calculate the frequency of these waves.

State any formula that you use and show your working.

formula

working

frequency = ... Hz [2]

(b) Water waves are a renewable energy resource.

Outline **two** advantages of using renewable energy resources.

1 .....

.....

2 .....

..... [2]

iGda 13s31 Q2

(c) Fig. 2.2 shows an iceberg floating in the sea.

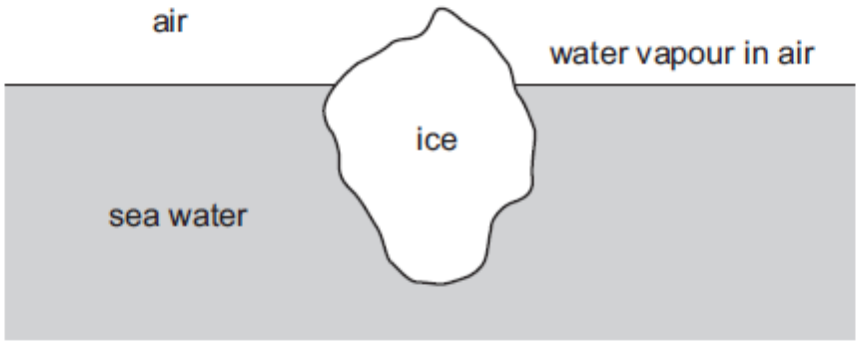


Fig. 2.2

(i) Which material named on Fig. 2.2 best fits the statement below?

"The particles are able to move, are randomly arranged and are closely packed."

..... [1]

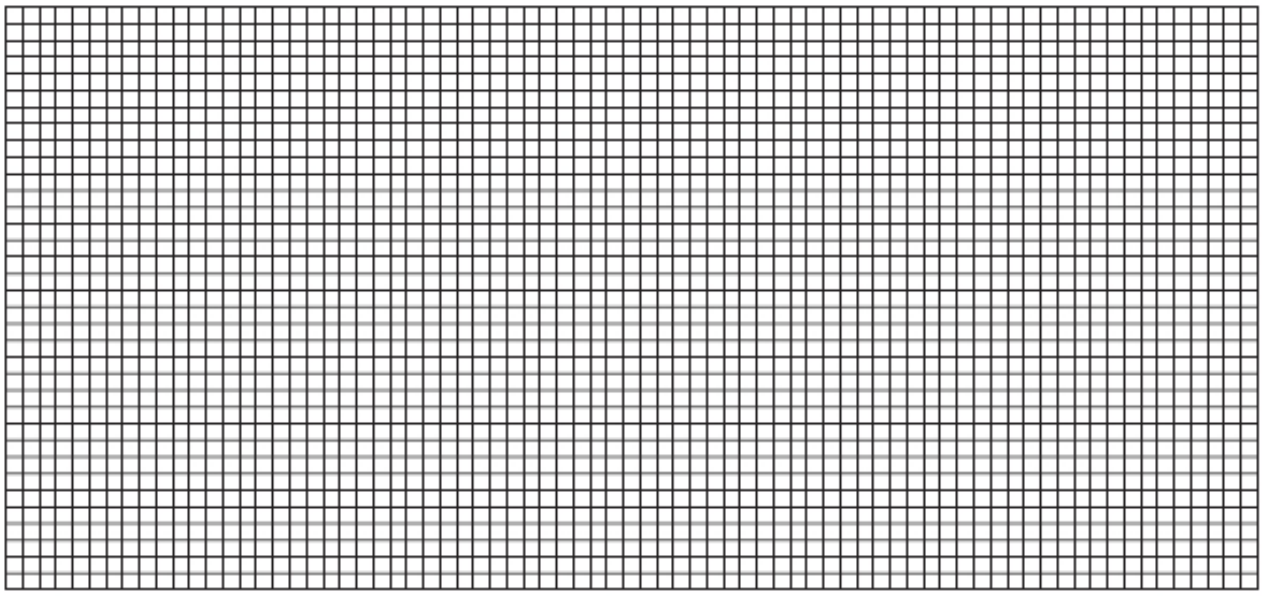
(ii) Name the process by which water molecules in the sea become water molecules in the air.

..... [1]

iGda 12w31

10 **(a)** On the grid below, draw a wave with an amplitude of 2 cm and a wavelength of 4 cm.

On your diagram, clearly label the amplitude and the wavelength.



[3]

(b) **(i)** Two sound waves, **A** and **B**, have the same frequency. **A** has a greater amplitude than **B**.

What difference would you hear?

..... [1]

(ii) Two sound waves, **X** and **Y**, have the same amplitude but **X** has a greater frequency than **Y**.

What difference would you hear?

..... [1]

(iii) The speed of sound was calculated for sound passing through a solid, a liquid, a gas and a vacuum.

The values recorded were

0 m / s	330 m / s
1500 m / s	5000 m / s.

Write the values in the correct boxes in Table 10.1.

Table 10.1

	speed of sound / m / s
vacuum	
solid	
liquid	
gas	

[2]

(iv) Sound travels through the air by a series of compressions and rarefactions.

Explain what is meant by *compressions* and *rarefactions*. You may use a diagram to help your explanation.

.....

.....

..... [2]

4 **(a)** A bat produces a sound wave with a frequency of 212 kHz and a wavelength of 0.0016 m.

(i) State the meaning of the terms *frequency* and *wavelength*, when describing a wave. You may use a diagram if it helps your explanation.

frequency

.....

.....

.....

wavelength

.....

.....

..... [2]

(ii) Calculate the speed of the sound wave produced by the bat.

State the formula that you use and show your working.

formula used

working

..... [2]

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(iii) Sound travels through the air by a series of compressions and rarefactions.

Describe what this means in terms of air particles.

.....

.....

..... [2]

iGda 11w31

2 **(a)** Fig. 2.1 shows two children playing in a swimming pool.

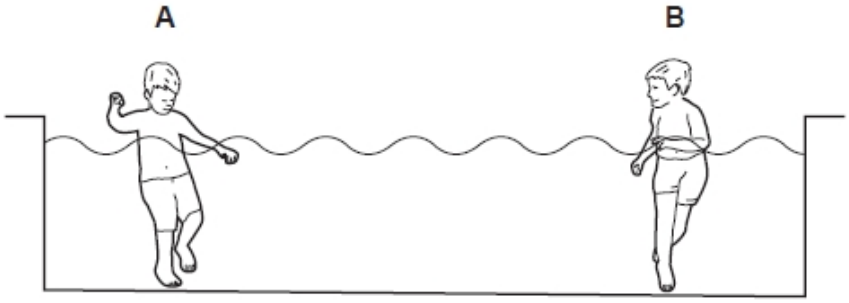


Fig. 2.1

Child **A** makes some small waves on the surface of the water.

(i) In 10 seconds, 5 complete waves pass by child **B** who is standing in the same pool.

Calculate the frequency of the water waves.

Show your working.

..... [1]

(ii) The waves in the pool are transverse waves.

Explain how a transverse wave differs from a longitudinal wave. Draw a diagram if it helps your answer.

.....

.....

..... [2]

iGda 10s31 Q2

(b) The climber makes a loud noise. The echo from a mountain 300 m away reaches him 2 seconds later.

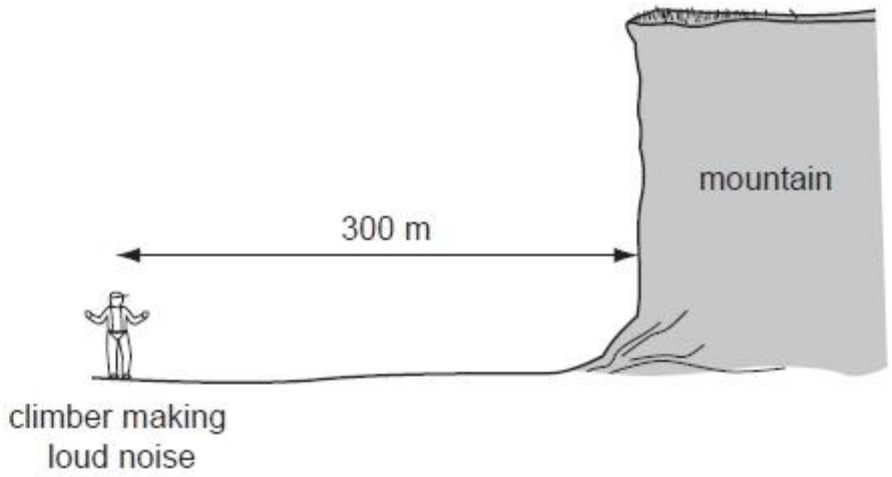


Fig. 2.1

Calculate the speed of sound in air using these results.

State the formula that you use and show your working.

formula

working

..... [2]

iGda 09w31 Q8

(d) Elephants can communicate using infra-sound. These sound waves have frequencies as low as 5 Hz. The audible range for an elephant is 5 Hz – 10000 Hz.

(i) What is meant by the term *frequency*?

.....

..... [1]

(ii) State the audible range for humans.

..... [1]

(iii) Sound waves are longitudinal waves. Explain how these differ from transverse waves.

.....

.....

.....

..... [2]

iGda 09s31 Q8

(c) **(i)** A dolphin near the surface is able to communicate underwater by emitting ultrasonic waves with a frequency of 39000 Hz.

The speed of these waves in water is 1500 m/s.

Calculate the wavelength of the waves.

State the formula that you use and show your working.

formula

working

..... [2]

(ii) The hearing range for a dolphin is from 1 kHz to 100 kHz. State the hearing range of an average adult human.

..... [1]

iGda 08s31 Q9

(b) The graph in Fig. 9.1 shows the motion of a dolphin travelling through water.

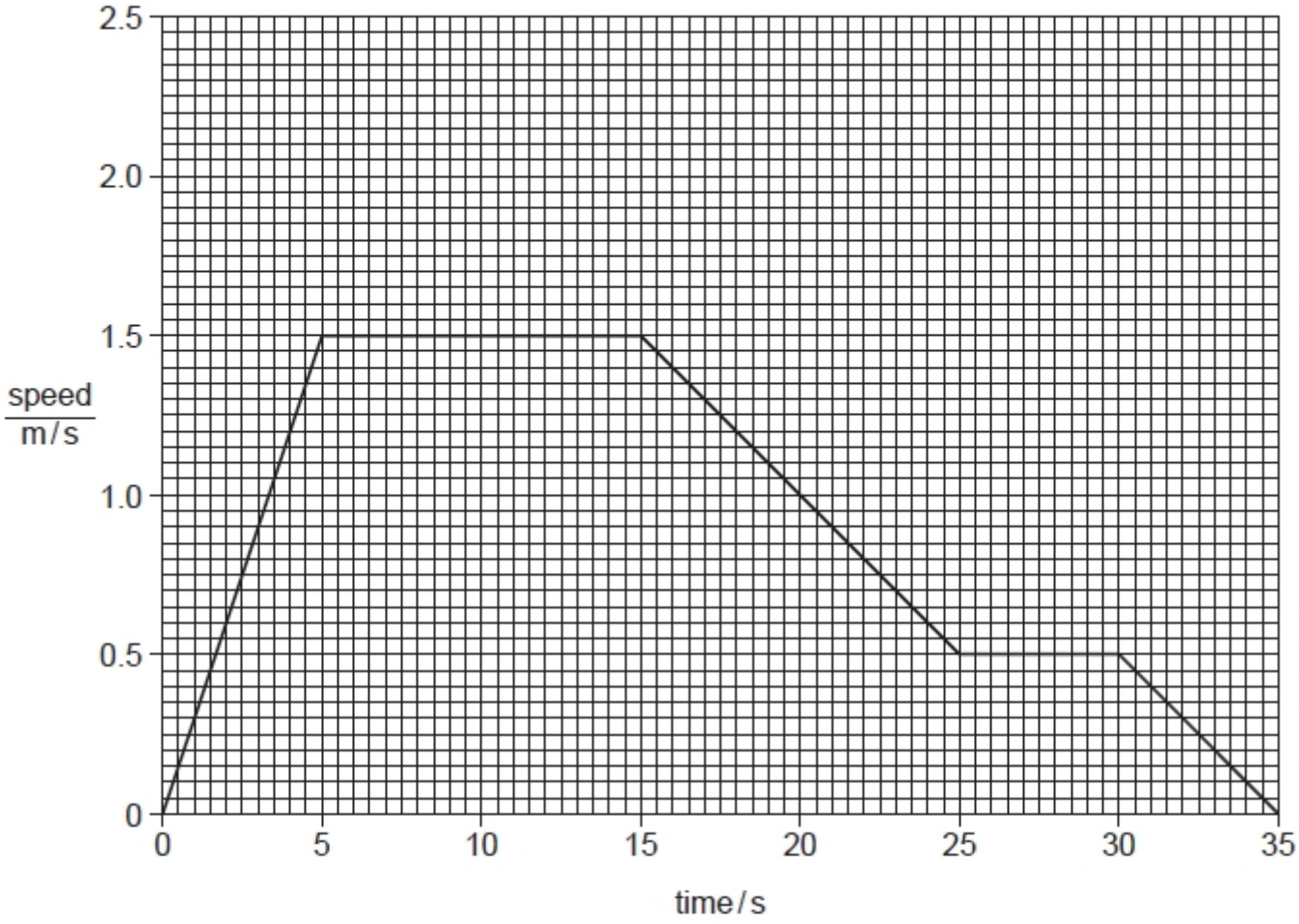


Fig. 9.1

Calculate the distance covered by the dolphin in the first 25 seconds.

Show your working.

..... [2]

iGda 08s31

9 (a) Dolphins can communicate underwater by emitting pulses of sound waves which have a frequency of 40 000 Hz.

(i) The speed of sound waves in water is 1500 m / s.

Calculate the wavelength of these waves.

State the formula that you use and show your working.

formula

working

..... [2]

(ii) The speed of sound in air is 330 m / s.

Suggest in terms of particles why the speed of sound waves in water is so much greater than the speed of sound waves in air.

.....

..... [2]

Topic 10 MS

iGda 15s31 q9

(c) compressions are regions where the particles in air are close together / rarefactions are regions where the particles in air are spread out ;
compressions are regions with air at higher pressure than normal / rarefactions are regions with air at lower pressure than normal ; [max 1]

iGda 15s31 q1

(f) light travels faster than sound, etc. ; [1]

iGda 15s31

13 (a) (i) (time =) distance / speed ;
= 240 / 1500 = 0.16 (s) ; [2]

(ii) (wavelength =) velocity / frequency ;
= 1500 / 45 000 = 0.033 (m) ; [2]

(iii) 20 Hz to 20 000 Hz ; [1]

(iv) ultrasound waves have a frequency above 20 000 Hz ; [1]

iGda 14w31 Q10

(b) becomes louder – amplitude increases ;
has a lower pitch – frequency decreases ; [2]

iGda 14s31

10 (a) (i) light waves travel faster than sound waves / v.v ; [1]

(ii) as a series of compressions and rarefactions ;
as longitudinal waves ;
by transfer of vibrations of particles ; [max 1]

(iii) sound cannot travel through a vacuum / sound requires a, medium / particles ; [1]

(b) (i) 20 Hz to 20000 Hz [1]

(ii) (distance =) speed × time ;
330 × 0.05 = 16.5 (m) ; [2]

(iii) $v = f \times \lambda$ / $(f =) \frac{V}{\lambda}$;

$\text{frequency} = \frac{330}{0.011} = 30000\ (\text{Hz})$; [2]

iGda 13s31 Q2

(b) less fossil fuels used up / fossil fuels are conserved ;
no emissions causing acid rain ;
no CO_2 emissions / greenhouse gases ;
(reduced) greenhouse effect / global warming / consequences e.g. climate change / changed weather patterns etc.; [max 2]

iGda 13s31 Q2

(c) (i) sea water ; [1]

(ii) evaporation ; [1]

iGda 12w31

10 (a) amplitude labelled ;
wavelength labelled ;
correct dimensions ; [3]

(b) (i) **A** is louder than **B** ; [1]

(ii) **X** has higher pitch ; [1]

(iii)

	speed of sound / m/s
vacuum	0
solid	5000
liquid	1500
gas	330

(all correct for 2 marks, 3 or 2 correct for 1 mark) ;; [2]

(iv) compression region of high pressure / lots of (air) particles ;
rarefaction region of low pressure / fewer (air) particles ; [2]

iGda 12s31

4 (a) (i) *frequency* – number of waves produced/passing a point per second ;
wavelength – distance between, two consecutive peaks/troughs ; [2]

(ii) (v =) f × λ ;
212000 × 0.0016 = 339.2 m/s ; [2]

(iii) *compression* – region of high pressure/lots of air particles ;
rarefaction – region of low pressure/fewer air particles ; [2]

iGda 11w31

2 (a) (i) 0.5 waves per second/0.5 Hz ; [1]

(ii) longitudinal – wave motion is in same direction as disturbance of medium ;
transverse – wave motion at right angles to disturbance of medium ; [2]

iGda 10s31 Q2

(b) (speed =) distance/time ;
= 300 m/s ; [2]

iGda 09w31 Q8

(d) (i) the number of waves per, second / unit time ; [1]

(ii) 20 Hz – 20 000 Hz ; *allow from 10 Hz up to 26 000 Hz* [1]

(iii) longitudinal - pattern of disturbance is in same direction as direction of wave (movement) / ref. compressions and rarefactions ;
transverse - pattern of disturbance is at right angles to direction of wave (movement) ; [2]

iGda 09s31 Q8

(c) (i) v = fλ *or* v/f ;
λ = 1500 / 39 000 = 0.038 m ; [2]

(ii) 10 to 25 Hz – 20 000 to 25 000 Hz ; [both values within these ranges] [1]

iGda 08s31 Q9

(b) area under graph/working ; 3.75 + 15 + 5 + 5 ;
= 23.75 m ; [2]

iGda 08s31

9 (a) (i) velocity = frequency × wavelength ;
wavelength = 1500 / 40 000 = 0.0375 m ; [2]

(ii) sound travels through particle vibration ;
vibrations travel better when particles are closer together ; [2]

Topic 13

iGda 15s31

1 (a) Fig. 1.1 shows a wind-powered generator used to power an Arctic research station.

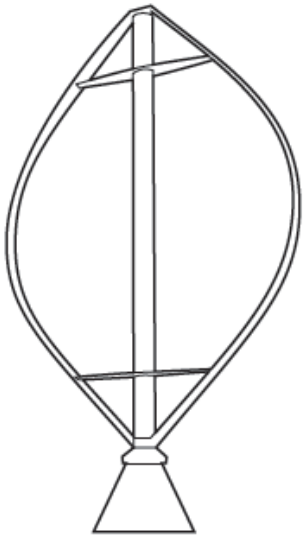


Fig. 1.1

During one 24-hour period, the average power output of the wind-powered generator is 20 kW. Calculate the energy output of the generator in joules over the 24-hour period.

Show your working.

energy = ... J [2]

iGda 14s31

5 (a) In a domestic lighting circuit, lamps are connected in parallel.

Explain why the lamps are **not** connected in series.

.....

.....

..... [2]

(b) (i) Explain why a balloon rubbed with a woollen cloth gains a negative electric charge.

.....

.....

..... [2]

Fig. 5.1 shows two similarly charged balloons, suspended close together.

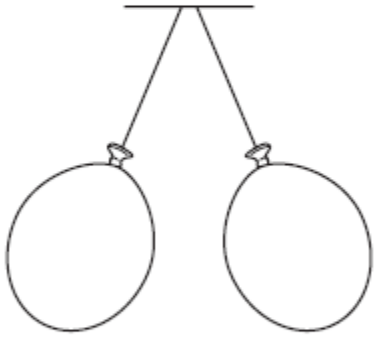


Fig. 5.1

(ii) Explain why the two balloons move apart.

.....

..... [1]

(c) Describe how a circuit breaker protects a worker using an electric drill.

.....

..... [1]

(d) Explain why energy losses in overhead electricity transmission cables are lower when the voltage is high.

.....

.....

..... [2]

10 (a) A student investigates how the change in potential difference across a lamp affects the current flowing through it.

(i) Draw the circuit diagram that the student uses.

[3]

(ii) During his investigations the student measures the voltage across the lamp as 3.0V and the current passing through the lamp as 0.3A.

Calculate the resistance of the lamp.

State the formula that you use and show your working.

formula used

working

..... [2]

(b) Table 10.1 shows some information about six pieces of wire, all at room temperature (20 °C).

Table 10.1

wire	metal composition	length/cm	cross-sectional area/mm^2
A	copper	10	0.5
B	nichrome	10	0.5
C	copper	20	0.5
D	nichrome	20	0.5
E	copper	10	1.0
F	copper	20	1.0

(i) Which wire, **B** or **D**, will have the greater resistance?

Explain your answer.

wire .....

..... [1]

(ii) Which wire, **A** or **E**, will have the greater resistance?

Explain your answer.

wire .....

..... [1]

(iii) If the resistance of wire **A** is 10 Ω, state the resistance of wires **C** and **E**.

wire **C** resistance = ...

wire **E** resistance = ...

Explain your answers.

.....

.....

..... [2]

iGda 11s31 Q1 (a)

(ii) The heater has a power output of 5 kW. How much energy does the heater deliver in one second?

..... [1]

iGda 11s31

4 **(a)** In older television sets there is a tube which contains three heated wires (filaments). The picture on the screen is produced when emissions from these wires are made to hit the screen.

The particles emitted are electrons

(ii) State the charge on these particles.

..... [1]

(iii) When a television set is in use, a static charge builds up on the screen. Suggest why this happens.

.....

..... [1]

(iv) The heated wire has an electrical resistance.

State **two** factors which affect the resistance of a piece of wire.

1 .....

2 ..... [1]

(b) Television sets contain microprocessors.

What is a microprocessor?

.....

..... [1]

iGda 14w31

3 **(a)** A car has two headlamps and two rear lamps. All four lamps are connected in parallel with each other across a 12 V battery.

(i) Each headlamp takes a current of 4 A and each rear lamp takes a current of 0.4 A.

State the total current taken by all four lamps.

current = ... A [1]

(ii) Calculate the resistance of **one** of the headlamps.

State the formula that you use, show your working and state the unit of your answer.

formula

working

resistance = ... unit ..... [3]

(b) One of the headlamps of the car has a power rating of 55 W.

Calculate the power of the headlamp, when the current passing through it is 4 A and the voltage across it is 12 V.

State the formula that you use and show your working.

formula

working

power = ... W [2]

iGda 14s31 Q10

(c) A student builds a simple circuit including a buzzer. Fig. 10.1 shows the circuit diagram for the circuit.

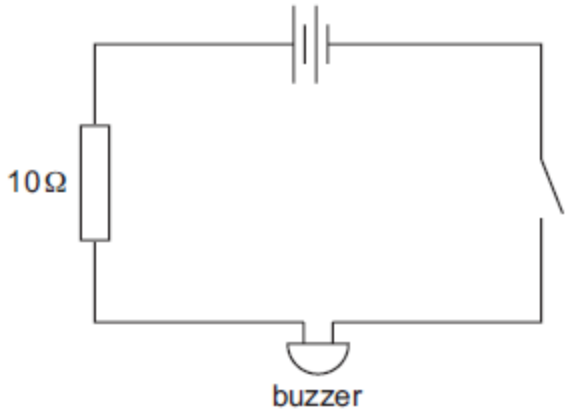


Fig. 10.1

When the student closes the switch, the buzzer does not emit a sound. The teacher tells the student that he needs a greater current to make the buzzer work.

Redraw the circuit diagram to show **two** ways in which the student could increase the current flowing through the buzzer.

[2]

iGda 13w31

8 (a) Fig. 8.1 shows a circuit which could be used for the lights on a car. When each headlight bulb is fully lit, 6 A passes through it. When each sidelight is fully lit, 0.5 A passes through it.

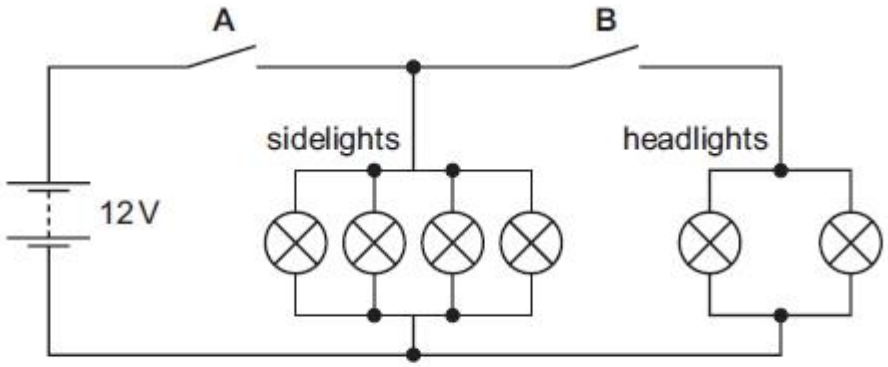


Fig. 8.1

Calculate the total current flowing from the battery when

switch **A** is closed and switch **B** is open,

.....

switches **A** and **B** are both closed.

..... [1]

(b) Fig. 8.2 is a graph showing how the resistance of a thermistor changes with temperature.

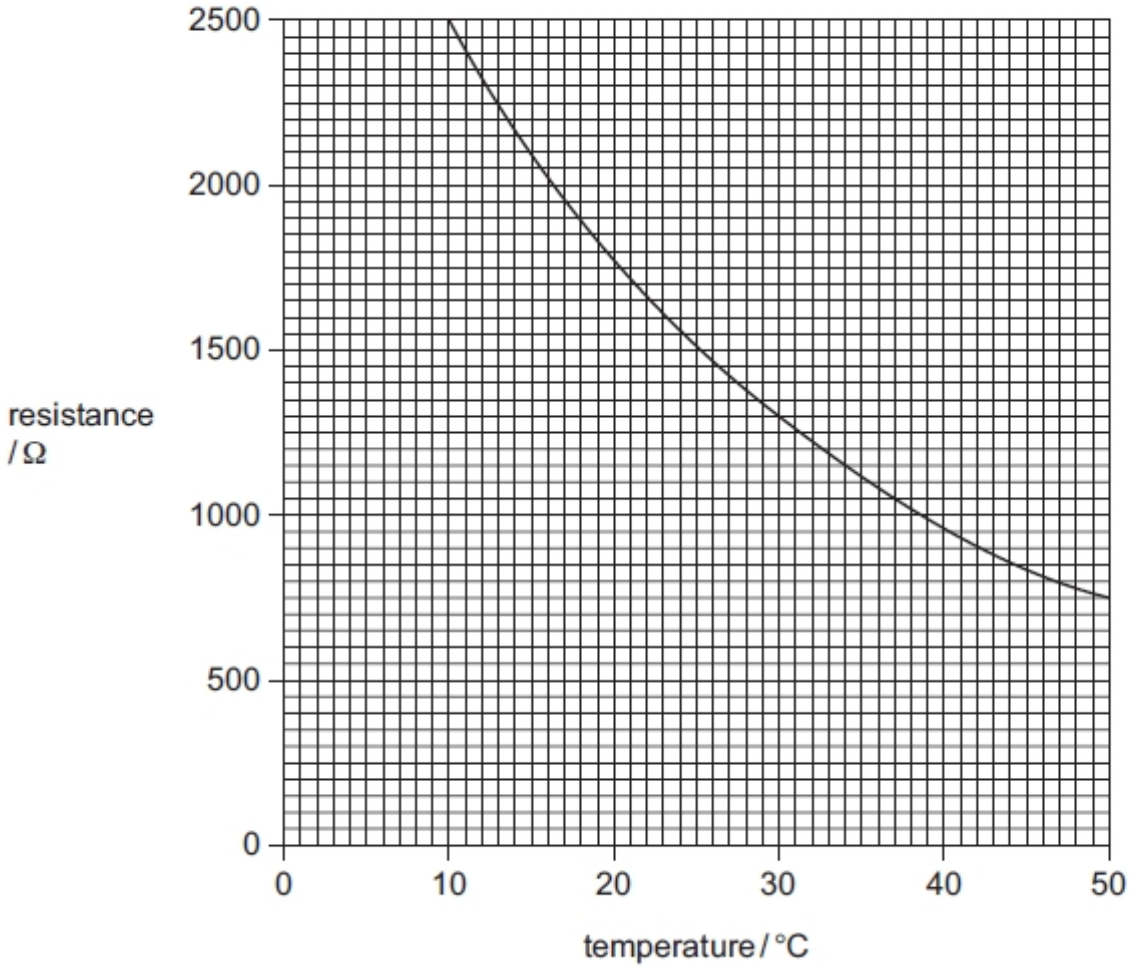


Fig. 8.2

Calculate the current that passes through the thermistor at 30 °C when it is connected to a 12 V power supply.

State the formula that you use, show your working and state the unit of your answer.

formula

working

..... unit ..... [3]

iGda 13s31 Q6
Flour used to make bread is sold in bags in a store.

(b) The store has a fire alarm, which detects an increase in temperature.

The fire alarm circuit has a resistor **R**, a thermistor and a buzzer connected to the battery shown in Fig. 6.2.

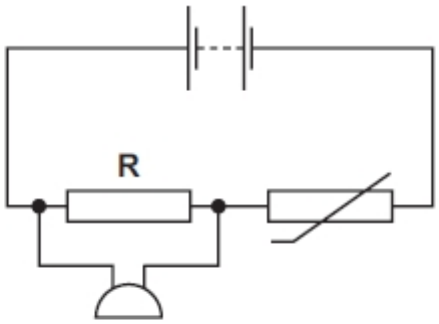


Fig. 6.2

Explain what happens to the current in the fire alarm circuit when the temperature increases.

.....

.....

.....

..... [3]

iGda 12w31

1 (a) Complete Table 1.1 by choosing one of the words from the list to match each statement.

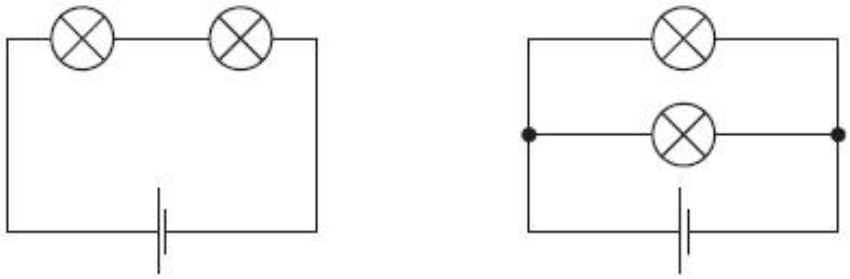
ammeter	**ampere**	**circuit**	**coulomb**	**electron**
ohm	**relay**	**volt**	**voltmeter**	**watt**

Table 1.1

statement	word
a complete loop of conductors	
the unit of electrical charge	
an instrument that measures potential difference	
a device used in switching on circuits	

[2]

(b) Fig. 1.1 shows two circuits **A** and **B**. All the lamps and both cells are the same.



circuit **A** circuit **B**

Fig. 1.1

(i) One lamp is unscrewed from circuit **A**.

State what happens to the other lamp.

Explain your answer.

.....

.....

..... [1]

(ii) Explain why lights in a house are connected in parallel and not in series.

.....

.....

..... [2]

(iii) The resistance of each lamp is 1.2Ω.

Calculate the combined resistance of the two lamps in circuit **B**.

State the formula that you use and show your working.

formula used

working

..... [3]

iGda 11w31 Q4

(c) The graph in Fig. 4.2 shows how the current through a different light bulb changes after it is switched on.

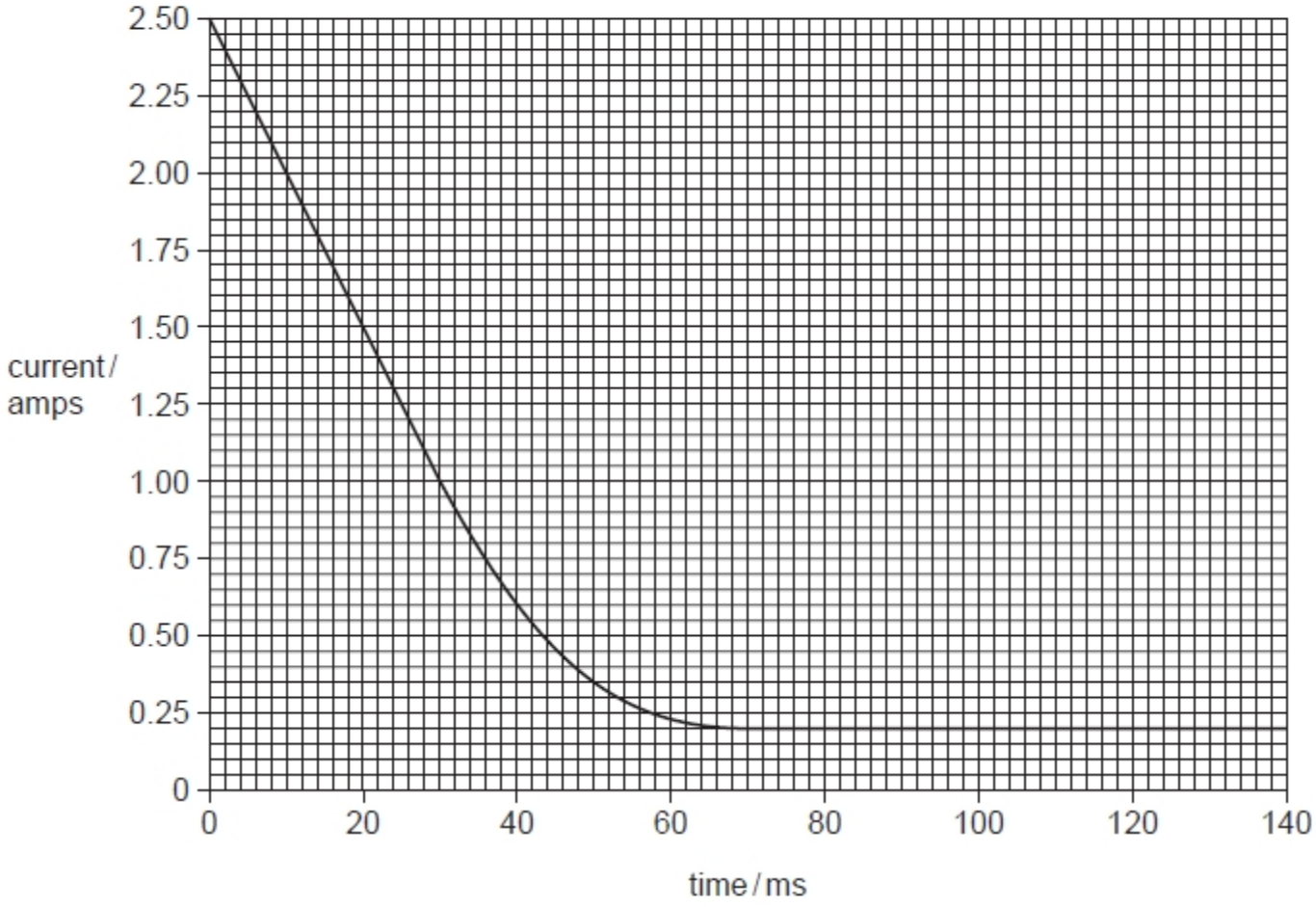


Fig. 4.2

(i) Describe what happens to the current after the bulb is switched on.

.....

.....

..... [2]

(ii) Use the graph to find the current through the light bulb 80 ms after it is switched on.

..... [1]

(iii) The voltage supplied to the bulb is 230 V.

Calculate the power of this light bulb 80 ms after it is switched on.

State the formula that you use and show your working.

formula

working

..... [2]

(d) A lamp with a resistance of 1000 Ω when lit is connected in parallel with another lamp with a resistance of 2000 Ω when lit.

Calculate the combined resistance of these two lamps.

State the formula that you use and show your working.

formula

working

..... [3]

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5 A student investigated the relationship between the potential difference across a lamp and the current passing through it.

(a) Fig. 5.1 shows her results.

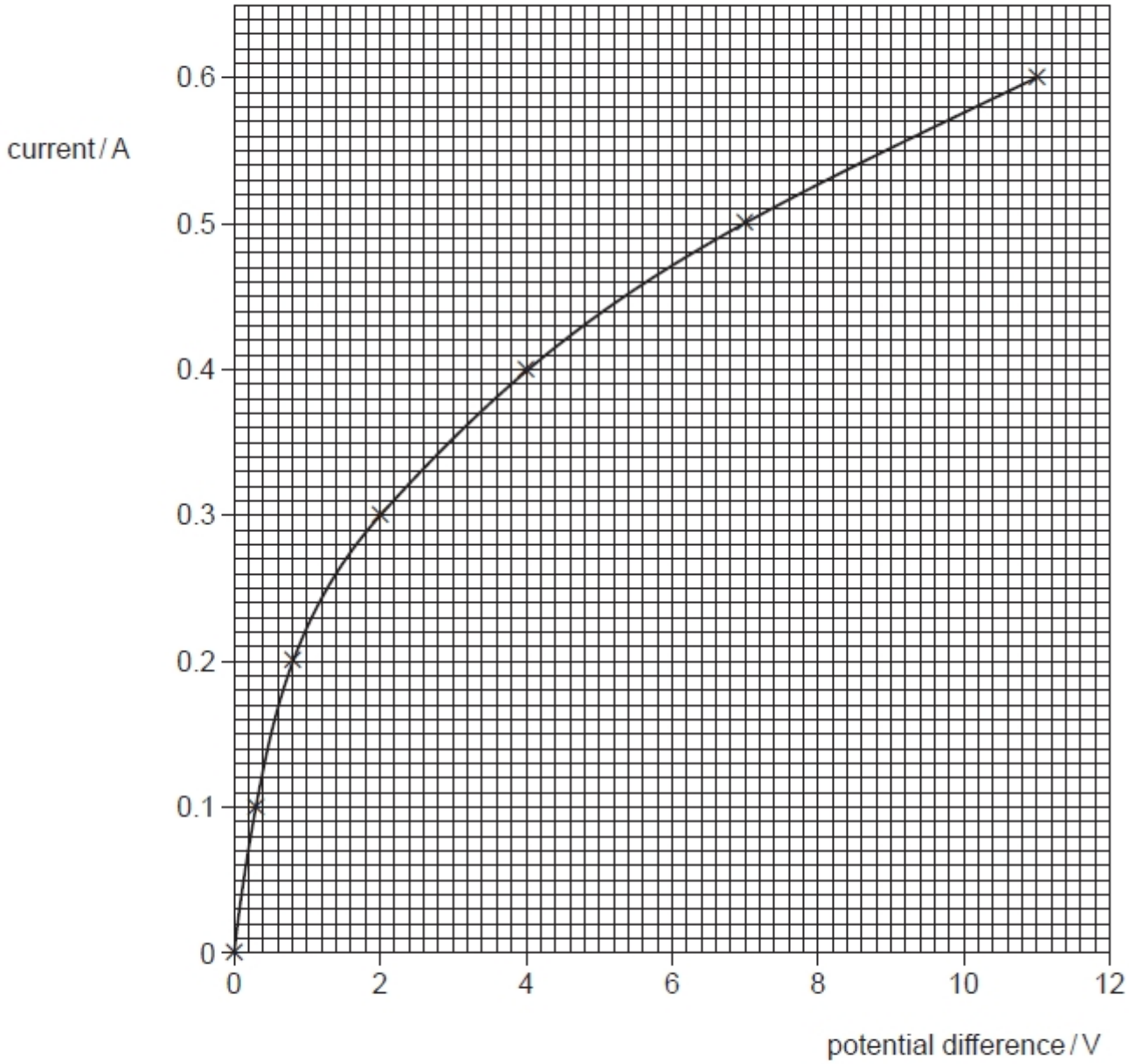

Fig. 5.1

(i) What is the current when the potential difference is 6 V?

..... [1]

(ii) Calculate the resistance of the lamp when the potential difference is 6 V.

State the formula that you use and show your working.

formula used

working

..... [2]

iGda 10s31 Q2

(d) The climber uses a torch at night. His torch contains four cells, a switch and a lamp all connected in series.

(i) Draw a circuit diagram for this circuit using the correct symbols.

[2]

(ii) The potential difference across each of the cells in the circuit is 1.5 V.

State the total potential difference across the four cells connected in series.

..... [1]

(e) The climber carries a nylon tent. As he walks, the tent rubs against his clothing. The fabric gains a negative static charge.

Explain how this happens.

.....

.....

.....

.....

..... [3]

iGda 09w31 NOT WITH Q5 (a)

5 (a) Fig. 5.1 shows some apparatus set up to measure the specific heat capacity of aluminium.

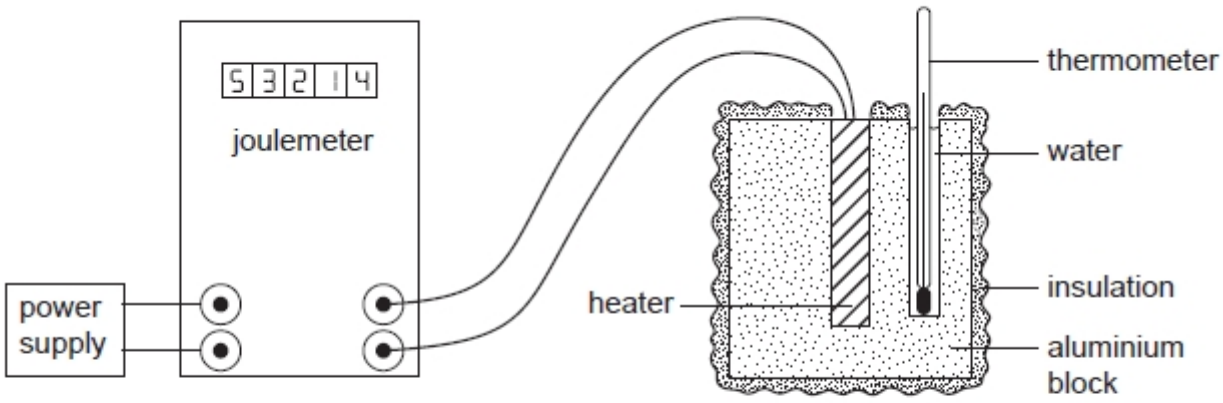

Fig. 5.1

The block is heated electrically and the electrical energy input is measured using a joulemeter. The temperature of the block and the total electrical energy supplied are measured at intervals.

Answer to (ii): The energy needed to raise the temperature of the block from 25oC to 45oC is 40kJ

(iv) The temperature of the block rose from 25 °C to 45 °C in 600 seconds.

Use your answer from **(ii)** to calculate the electrical power during this time.

State the formula that you use and show your working.

formula

working

..... [2]

(v) The voltage of the power supply in Fig. 5.1 is 12V. It is fitted with a 10 amp fuse.

Use the formula

power = voltage x current

to explain why this fuse is adequate for this experiment.

.....

.....

..... [2]

iGda 09s31

1 (a) A student investigated how a change in potential difference across a lamp affected the current flowing through it.

She used wires to connect the components shown in Fig. 1.1 to make a circuit.

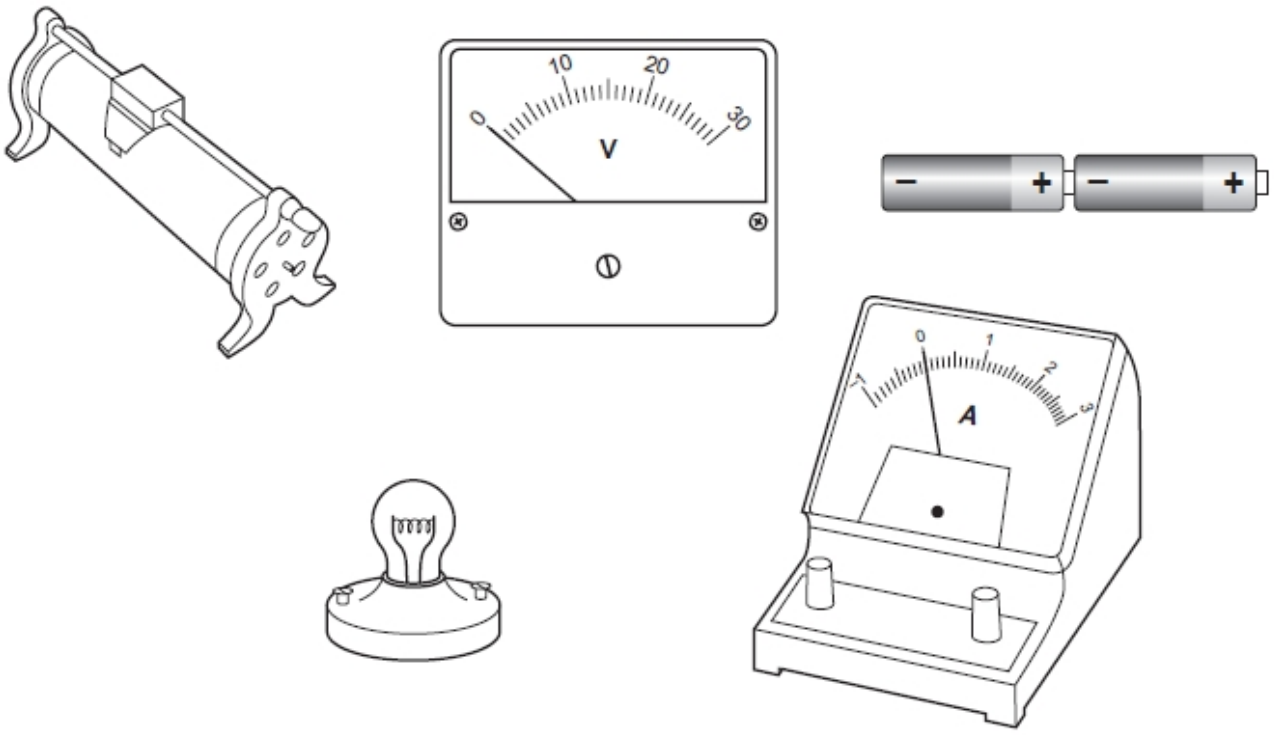

Fig. 1.1

(i) Using the correct symbols, draw a diagram to show the circuit she used.

[2]

(ii) Explain why the variable resistor is included in the circuit.

.....

..... [1]

(iii) Her results are shown in Table 1.1.

Table 1.1

potential difference across lamp / V	current through lamp / A	resistance of lamp filament / Ω
4	1.2	3.3
8	1.5	
12	1.7	7.1

Complete the table by calculating the missing resistance and writing your answer in the empty box.

State the formula that you use and show your working.

formula

working

[2]

(iv) The student concluded that the relationship between potential difference and current did not correspond to Ohm's law.

Explain why the relationship between potential difference and current for the lamp did not correspond to Ohm's law.

.....

.....

..... [2]

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3 The circuit in Fig. 3.1 was set up and the current measured by meters M_1, M_2, M_3, M_4 and M_5.

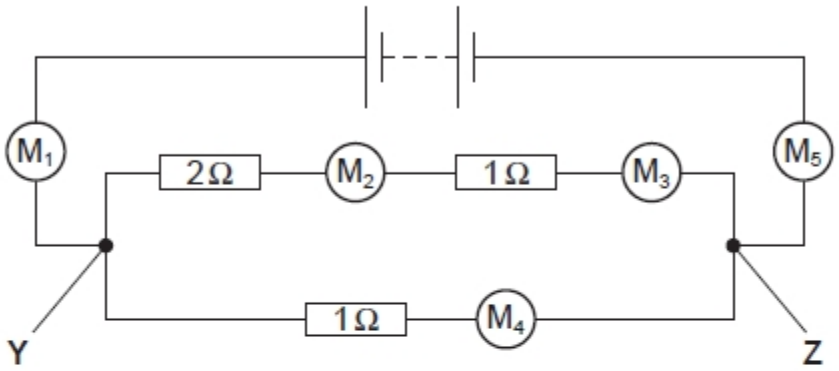

Fig. 3.1

(a) (i) The readings on M_1 and M_2 are shown in Table 3.1. Complete the table for M_3, M_4 and M_5.

Table 3.1

M_1 = 4A
M_2 = 1A
M_3 =
M_4 =
M_5 =

[1]

(ii) Calculate the total resistance of the 2 Ω and 1 Ω resistors in series.

..... [1]

(iii) Calculate the total resistance between **Y** and **Z**.

State the formula that you use and show your working.

formula

working

..... [3]

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(b) The current flows through M_1 for one minute.

Calculate the charge which has passed.

State the formula that you use and show your working.

formula

working

..... [2]

(c) A man walking on a non-conducting floor surface may become positively charged as shown in Fig. 3.2.

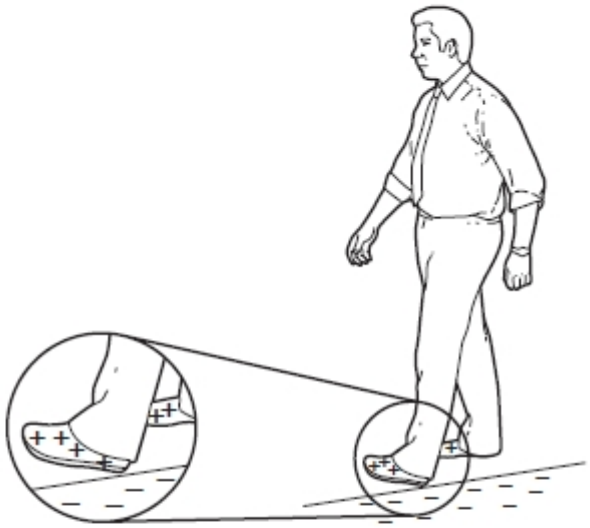


Fig. 3.2

Explain in terms of charged particles how he acquired this charge.

.....

.....

.....

..... [3]

1 (a) Use of (energy =) power × time ;
= 24 × 60 × 60 × 20 000 = 1.73×10^9 (J) ; [2]

iGda 14s31

5 (a) so that all lamps get full mains voltage/have full brightness/v.v. ;
so that all lamps operate independently/if one lamp blows the rest still work/you can have one light on without having them all on ; [2]

(b) (i) electrons transferred ;
from cloth/to balloon ; [2]

(ii) like charges repel ; [1]

(c) circuit breakers cut electricity to a device if too much current flows/there is a voltage surge ; [1]

(d) current is low when voltage is high ;
less, energy/power loss, as heat (with low current) ; [2]

[Total: 8]

iGda 12s31

10 (a) (i) ammeter in series ;
voltmeter in parallel ;
means of varying p.d. ;
[max 2 if not a usable circuit] [3]

(ii) (R =) V/I ;
= 3/0.3 = 10 Ω ; [2]

(b) (i) **D** because it is longer/resistance proportional to length ; [1]

(ii) **A** because it has a small cross-section area/it is thinner/resistance inversely proportional to cross-section area ; [1]

(iii) **C** – 20 Ω and twice as long ;
E – 5 Ω and double cross-section area ; [2]

[Total: 9]

iGda 11s31 Q1 (a)

(ii) 5000 J/5 kJ ; [1]

iGda 11s31 Q4 (a)

(ii) negative ; [1]

(iii) electrons / charged particles, accumulate on screen ; (**not** protons or ions) [1]

(iv) *any two for 1 mark*:
length,
cross sectional area / diameter / thickness / width,
resistivity / conductivity / material,
temperature ; [max 1]

(b) a device that processes, information / electrical signals ; [1]

iGda 14w31

3 **(a)** **(i)** 8.8 (A) ; [1]

(ii) $R = \frac{V}{I}$;

$= \frac{12}{4} = 3$;

Ω / ohms ; [3]

(b) (P =) V x I ;
= 12 x 4 = 48 (W) ; [2]

iGda 14s31 Q10

(c) diagram shows more cells ;
diagram shows no resistor or resistor in parallel with buzzer **or** resistor less than 10 Ω / AVP ; [2]

iGda 13w31

8 **(a)** 2.0 A
14 A ; (both required for the mark) [1]

(b) 1300 (ohms) ;
V = I × R ;
12 / 1300 = 0.009 A ; [3]

iGda 13s31 Q6

(b) resistance of thermistor goes down ;
current goes up ;
reference to V = IR ;
(supply) voltage is constant ; [max 3]

iGda 12w31

1 **(a)**

statement given	*word required*
a complete loop of conductors	circuit
unit of electrical current	coulomb
measures potential difference	voltmeter
used in switching circuits	relay

any **two** correct for 1 mark ;; [2]

(b) **(i)** goes out (no mark) ;
incomplete circuit ; [1]

(ii) so that they can be individually turned on and off ;
so that they all get the full mains voltage ;
so that if one fails the rest still operate ; [max 2]

(iii) $1/R = 1/R_1 + 1/R_2$;
$= 1/1.2 + 1/1.2$;
$R = 0.6\,\Omega$; [3]

[Total: 8]

iGda 11w31 Q4

(c) **(i)** decreases ;
to constant (minimum) value ; [2]

(ii) 0.2(0) A ; [1]

(iii) power = voltage × current ;
230 × 0.20 = 46 W ; [2]

(d) 1/R = 1/R1 + 1/R2 ;
= 1/1000 + 1/2000 ;
R = 2000/3 = 666.7 Ω ; [3]

iGda 10w31

5 **(a)** **(i)** 0.47 A ; [1]

(ii) resistance = voltage / current ;
= 6/0.47 = 12.8 Ω ; e.c.f. [2]

iGda 10s31 Q2

(d) **(i)** all symbols correct ;
all symbols connected in series ; [2]

(ii) 6 V ; [1]

(e) electron transfer ;
fabric gains electrons / tent loses electrons / or vice versa ;
by friction between surfaces ; [3]

iGda 09w31 Q5 (a)

(iv) power = energy / time ;
40 000/600 = 66.7/67 W ; *ecf from (iii)* [2]

iGda 09s31

1 (a) (i) correct symbols including all components ;
[need not be a variable resistor] [accept if only one cell]
correct circuit including all components ;
[voltmeter in parallel with lamp only, all else in series] [2]

(ii) to vary, current/voltage/pd (across lamp) ; [1]

(iii) (R=) V/I ; [not volts/amps] [not V/A] [accept pd/I]
= 5.3 ; [2]

(iv) filament gets hot ;
resistance (of filament/lamp) is not constant ;
voltage and current are not (directly) proportional ; [2]

iGda 08s31

3 (a) (i) M_3 = 1A ;
M_4 = 3A ;
M_5 = 4A ; [1]

(ii) 3 Ω ; [1]

(iii) 1/R = 1/R1 + 1/R2 ;
= 1/3 + 1/1 = 4/3 ;
R = ¾ Ω ; [3]

(b) charge = current × time ;
= 4 × 60 = 240 C ; [2]

(c) friction ;
electron transfer ;
from man to floor ;
man left with a positive charge ; [max 3]

[Total: 10]

Topic 14

iGda 08s31

5 The bodywork of a car is usually made from steel.

(a) If part of the bodywork goes very rusty it is usually removed and replaced with plastic filler, before being painted.

A car mechanic can use a magnet to find out if parts of the bodywork of a car have been filled with plastic filler.

He tests three areas of a car by placing a magnet near the surface as shown in Fig. 5.1.

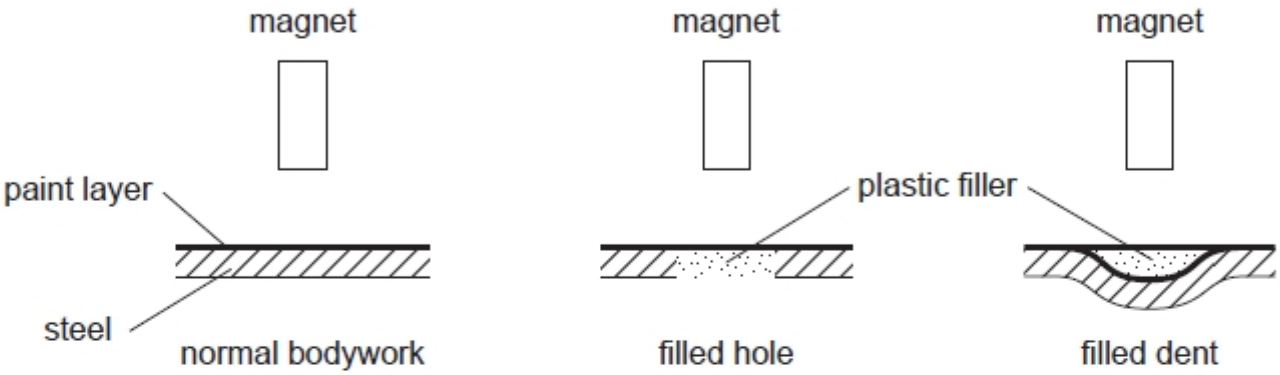


Fig. 5.1

(i) Complete the table.

area	effect on a magnet
normal bodywork	
filled hole	
filled dent	weakly attracted

[1]

(ii) What assumption have you made about the properties of plastic filler?

.....

[1]

(iii) Would this method work if the bodywork was made of aluminium?

Explain your answer.

.....

[1]

(iv) Suggest why the bodywork of some cars is made from aluminium rather than steel.

.....

[1]

(b) The power of ocean waves can be used as a source of energy.

Fig. 13.2 shows a model of a device which could generate electricity from waves. A magnet is able to move inside a coil. The coil is fixed to the concrete block on the sea floor.

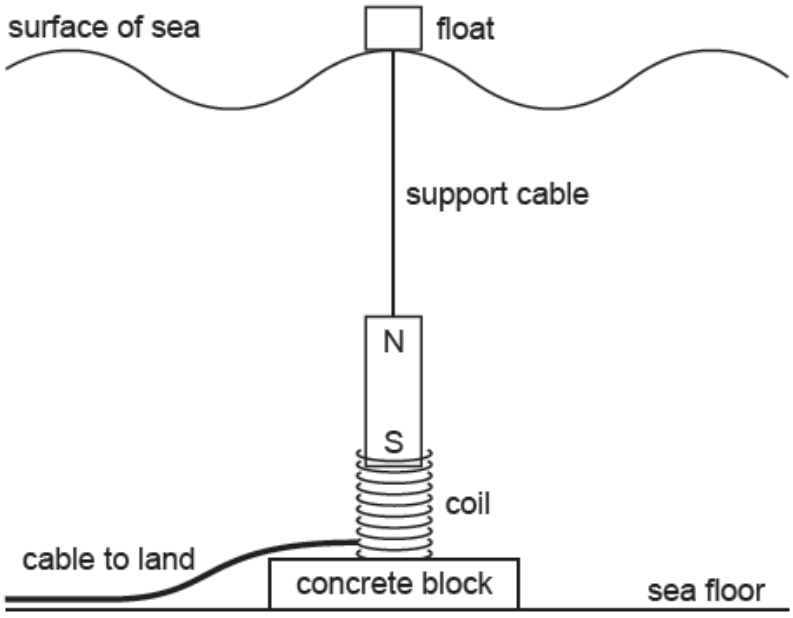


Fig. 13.2

(i) Describe how this device generates an e.m.f.

.....

.....

.....

.....

..... [3]

(ii) Suggest **two** changes which could be made to the device to increase the e.m.f. produced.

1 .....

.....

2 .....

..... [2]

iGda 14w31 Q8

(b) Fig. 8.1 shows how electricity produced in a nuclear power station is transferred from the power station to the consumer.

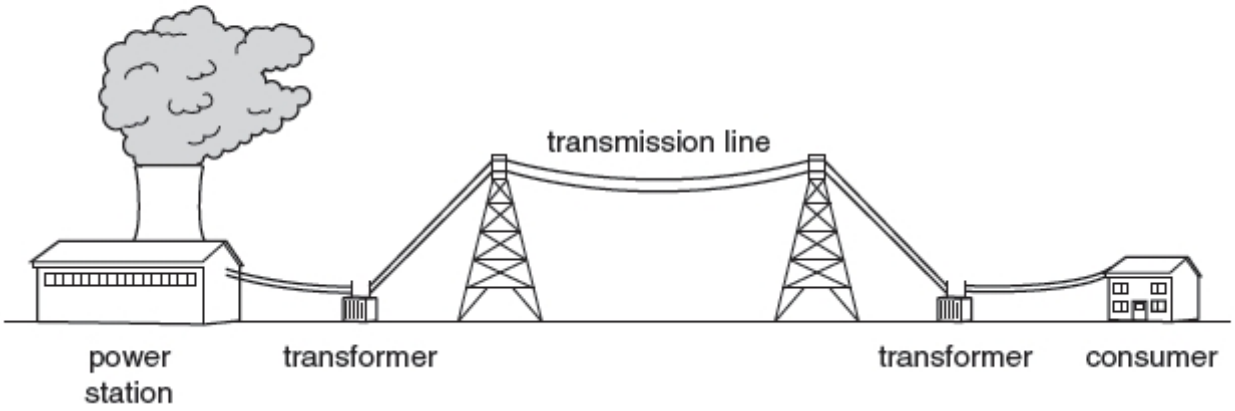


Fig. 8.1

(i) Choose numbers or words from the list to complete the sentences below.

You may use each number or word once, more than once or not at all.

12	**230**	**25 000**
decreases	**increases**	**larger**
smaller	**step-up**	**step-down**

Electricity is transmitted at .....V but is supplied to consumers' homes at .....V. This requires a ..... transformer. The transmission voltage used makes the current ....., which ..... the energy lost in the cable (transmission line). [2]

(ii) The input power into a small transformer is 500 W and the useful output power is 450 W.

Calculate the percentage efficiency of the transformer.

State the formula that you use and show your working.

formula

working

..... % [2]

iGda 14s31 Q8

(d) Fig. 8.1 and Fig. 8.2 show a perspective view and an end view of a simple a.c. generator.

Fig. 8.2 also shows the magnetic field lines between the poles of the magnet.

perspective view of generator

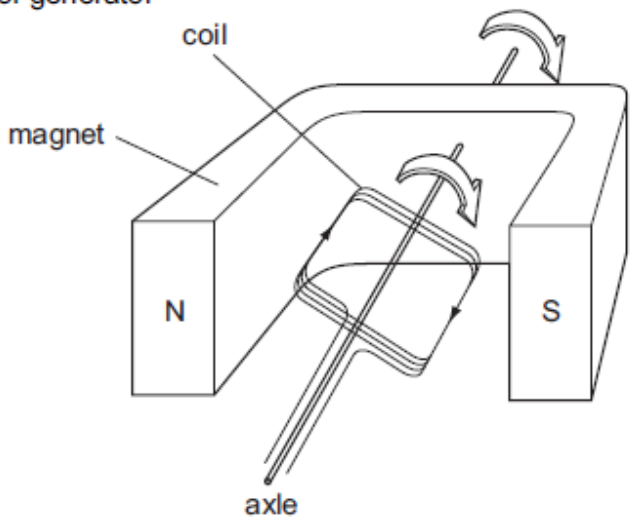


Fig. 8.1

end view of generator

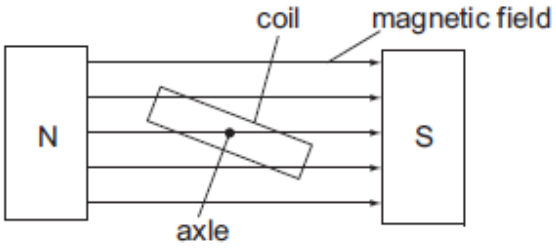
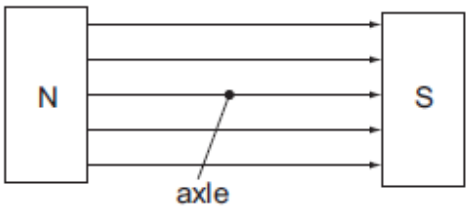


Fig. 8.2

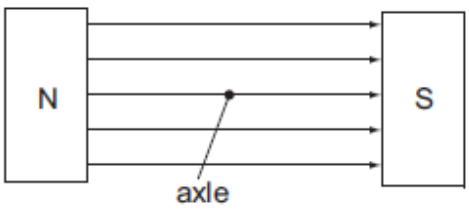
Complete the diagrams to show the positions of the coil when the current produced is

(i) zero,



[1]

(ii) maximum.



[1]

(e) On the grid in Fig. 8.3, sketch a graph of voltage against time for **two** rotations of the coil in this simple a.c generator.

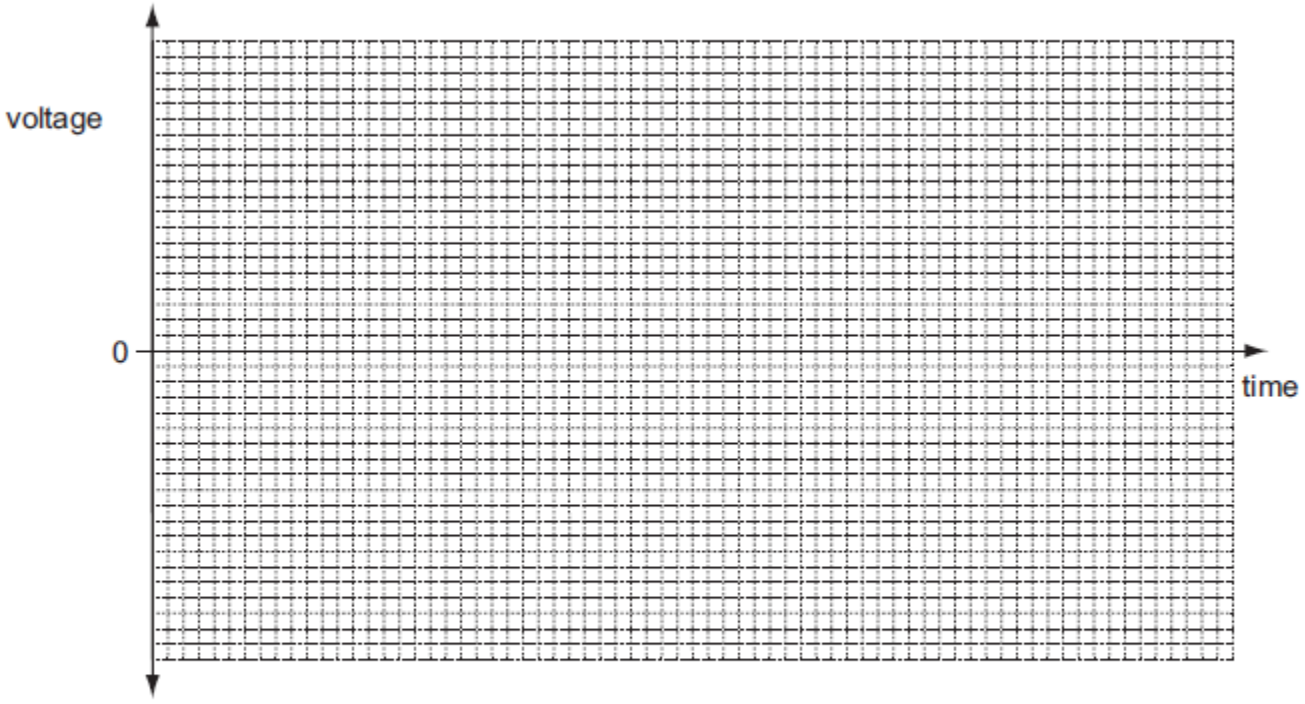


Fig. 8.3

[3]

iGda 13w31 Q8

(b) Fig. 8.2 is a graph showing how the resistance of a thermistor changes with temperature.

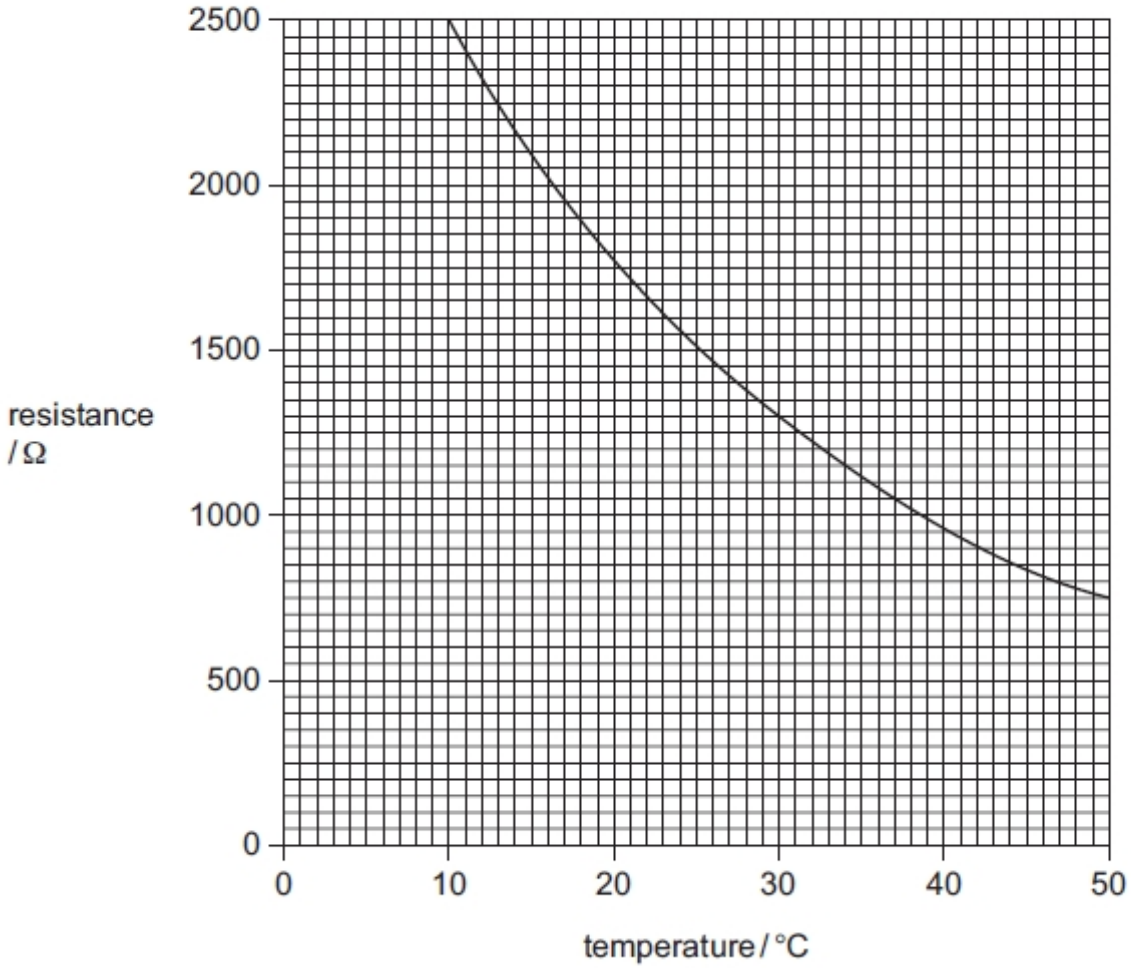


Fig. 8.2

Calculate the current that passes through the thermistor at 30 °C when it is connected to a 12 V power supply.

State the formula that you use, show your working and state the unit of your answer.

formula

working

..... unit ..... [3]

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(c) Fig. 8.3 shows a simple a.c. generator. It consists of a coil of wire rotating between the poles of a permanent magnet.

The output is fed to an external circuit through carbon contacts pressing against two slip rings.

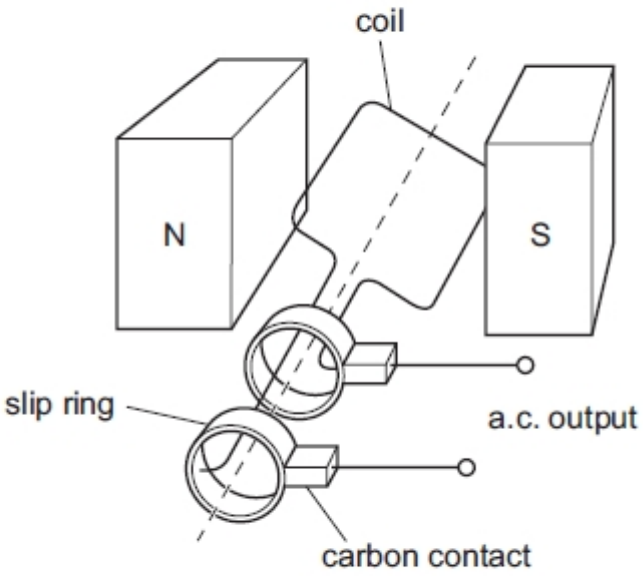
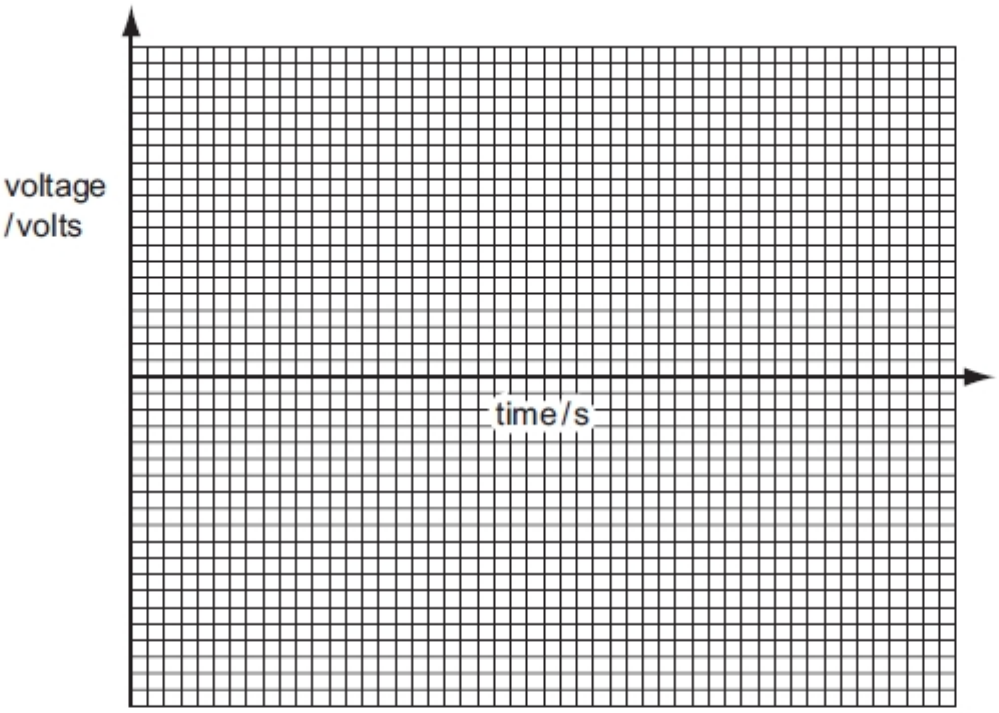


Fig. 8.3

(i) On the grid below, sketch a graph of voltage output against time for the generator.



[2]

(ii) State **two** factors on which the magnitude of the output voltage depends.

1 .....

2 ..... [2]

9 (a) Fig. 9.1 shows a mobile phone (cell phone) and battery charger.

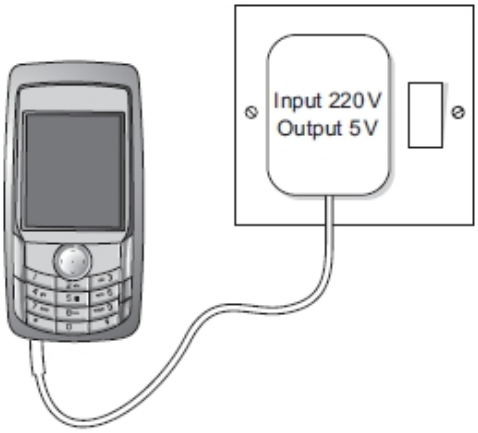


Fig. 9.1

A transformer inside the battery charger reduces the 220 V mains supply to the 5 V used to charge the mobile phone battery. The transformer has 40 turns on its secondary coil.

Calculate the number of turns on the primary coil of the transformer in the battery charger.

State the formula that you use and show your working.

formula

working

..... [2]

(b) Describe and explain how transformers are used in the large scale transmission of electricity.

.....

.....

.....

.....

.....

..... [3]

(b) Fig. 1.2 shows a circuit breaker. It is designed to switch off the current in a circuit if the current becomes too large.

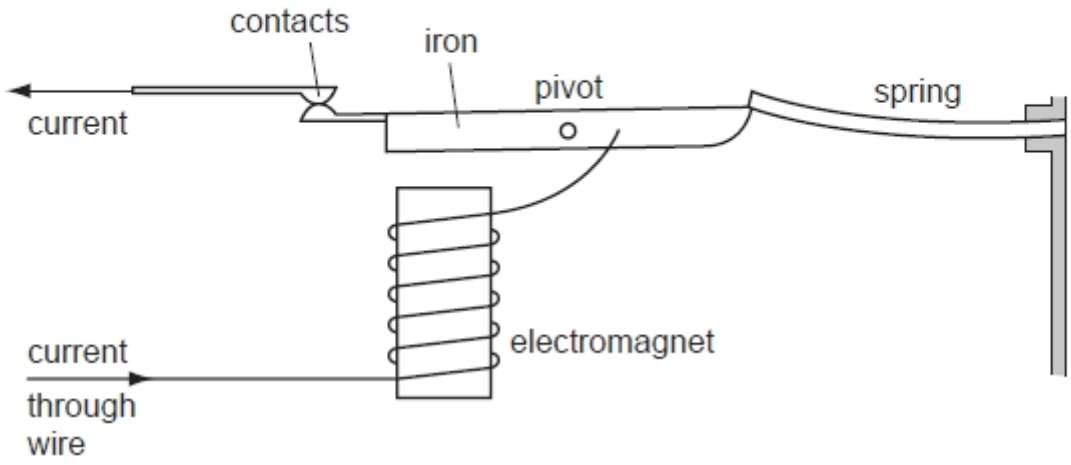


Fig. 1.2

Explain how the circuit breaker switches off the current if the current becomes too large.

.....

.....

.....

..... [3]

iGda 10w31 Q5

(b) A student was given two bar magnets and a bar of soft iron. She carried out the following experiments.

(i) She brought the magnets close together with like poles facing.

State what she observed.

.....

..... [1]

(ii) She brought the soft iron bar towards one of the magnets.

State what she observed.

.....

..... [1]

(c) Fig. 5.2 shows a strip of aluminium foil hung between the poles of a magnet. When the current is switched on, the foil experiences a force as shown.

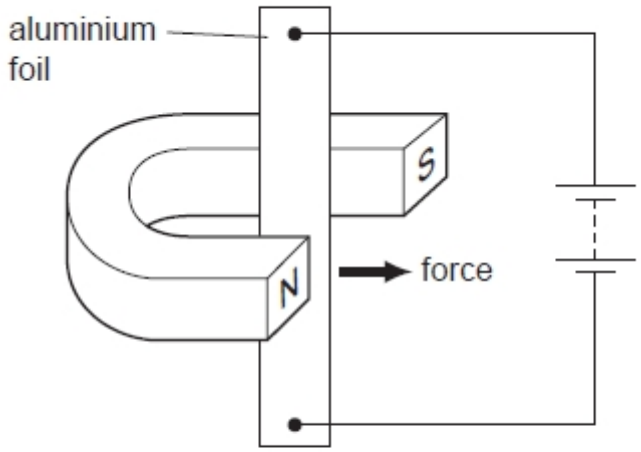


Fig. 5.2

(i) Explain why a force is produced.

.....

.....

..... [2]

(ii) State **two** changes which would increase the size of the force acting on the aluminium foil.

1 .....

2 ..... [2]

(d) A transformer used in a television set has 100 turns on the primary coil.

The potential difference across the primary coil is 240 V and the potential difference across the secondary coil is 35 000 V.

Calculate the number of turns on the secondary coil.

Use the formula $V_p/V_s = N_p/N_s$.

Show your working.

..... [2]

(b) Transformers are used to change the voltage of an a.c. supply. Fig. 5.2 shows a shaver unit, which contains a transformer, of the type found in many European homes.

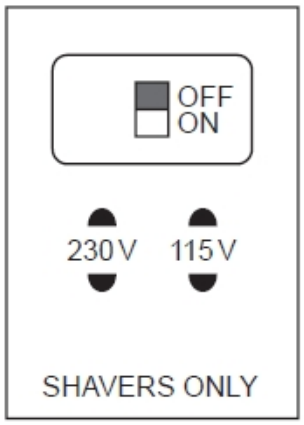


Fig. 5.2

The shaver unit has two sockets, one for shavers working at 115 V, the other for shavers working at 230 V. Fig. 5.3 shows how the sockets are wired to the output / secondary coils of a transformer.

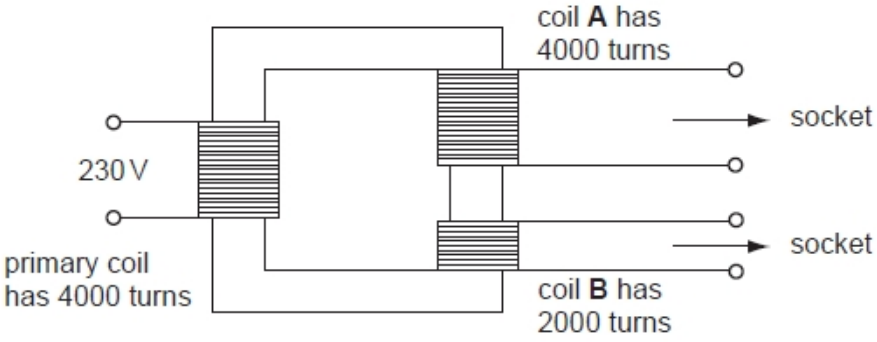


Fig. 5.3

(i) Use Fig. 5.3 to explain which coil, **A** or **B**, gives an output of 115 V.

coil .....

explanation .....

..... [1]

(ii) The transformer in a shaver unit is known as an isolating transformer and is designed to make the electrical appliance plugged into it safer to use in a bathroom.

Explain why it is dangerous to use electrical appliances in bathrooms unless they have such safety protection.

.....

..... [2]

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(c) Fig. 5.4 shows an electromagnet being used in a door lock.

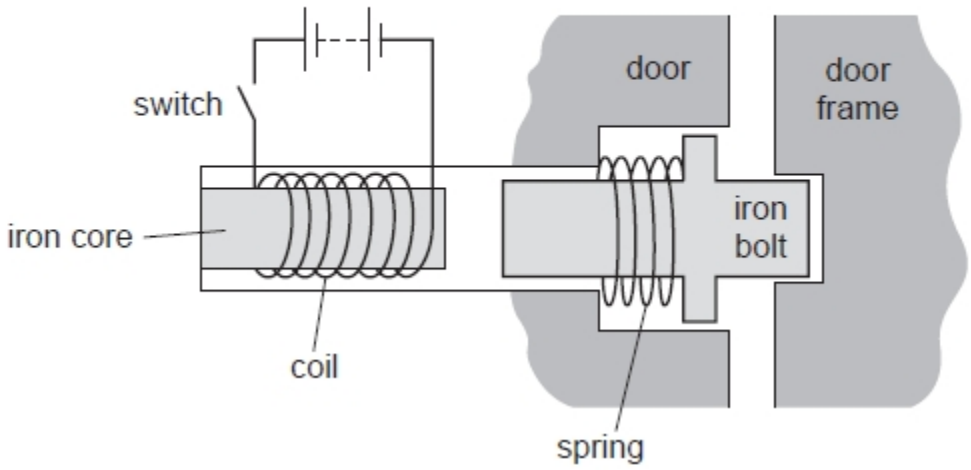

Fig. 5.4

(i) When the switch is pressed, the iron bolt moves to the left.

Explain why this happens.

.....

.....

.....

..... [3]

(ii) Would this door lock work if the bolt was made of aluminium?

Explain your answer.

.....

..... [1]

(iii) The electrical connections to the coil were accidentally reversed.

Would the door lock with the iron bolt still work?

Explain your answer.

.....

..... [1]

(iv) Suggest how the strength of the electromagnet could be increased.

.....

..... [1]

(b) Fig. 1.2 shows a wire moving upwards between the poles of two magnets. The ends of the wire are connected to a sensitive ammeter. The ammeter shows the induced current.

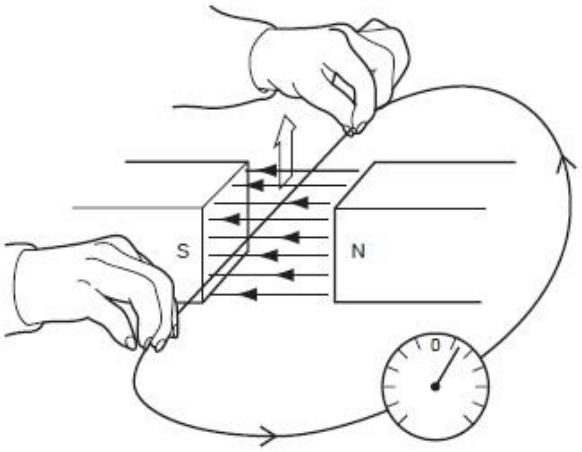

Fig. 1.2

(i) Draw on the ammeter in Fig. 1.3 the reading obtained if the wire was moved twice as quickly in the same direction.

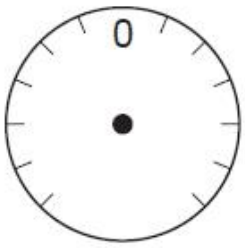

Fig. 1.3

[1]

(ii) Draw on the ammeter in Fig. 1.4 the reading obtained if the wire was moved in the opposite direction.

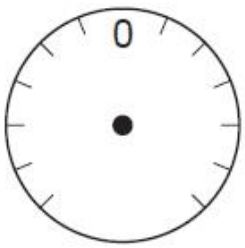

Fig. 1.4

[1]

(iii) Suggest why the ammeter must be a sensitive ammeter.

.....

..... [1]

(iv) Name a device which uses this principle of inducing an electric current when a wire moves in a magnetic field.

..... [1]

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2 (a) A student is given the apparatus shown in Fig. 2.1.

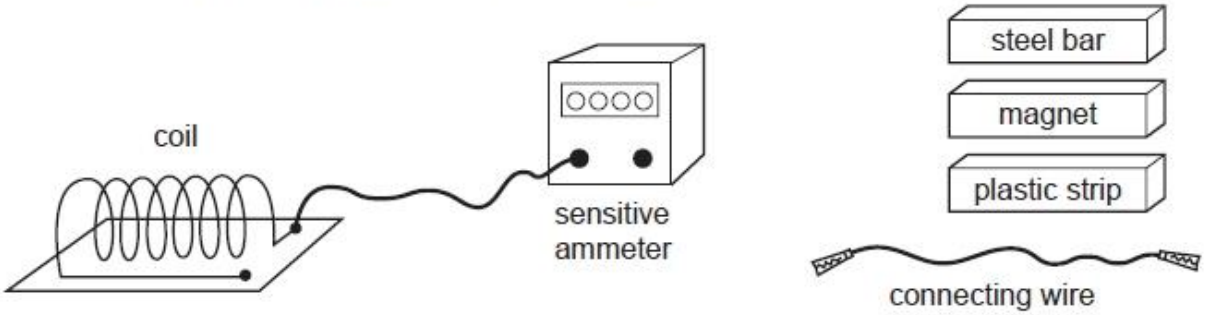

Fig. 2.1

Describe as fully as you can, how the student would select from the apparatus provided, and use it to produce an electric current.

.....

.....

.....

.....

..... [3]

(b) Electric power is produced at power stations using generators.

A simple generator is shown in Fig. 2.2.

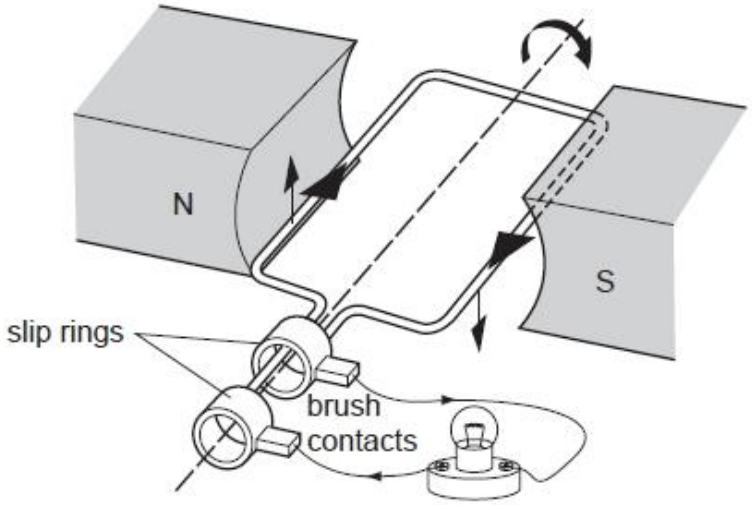

Fig. 2.2

(i) Explain why a current is induced in the coil when it rotates.

.....

..... [1]

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(ii) Explain why the current is at a maximum when the coil is horizontal, and at a minimum when the coil is vertical.

.....

.....

..... [2]

Topic 14 MS

iGda 08s31

5 (a) (i) (normal bodywork) strongly attracted ;
(filled hole) not attracted ; [1]

(ii) (plastic filler) is not magnetic ; [1]

(iii) no – aluminium is not magnetic ; [1]

(iv) aluminium does not corrode/corrodes less than steel ; [1]

iGda 15s31 Q13

(b) (i) float moves up and down ;
makes magnet move in coil ;
magnetic field in coil is changing / cut ;
induces emf ; [max 3]

(ii) stronger magnet ;
more turns ; [2]

iGda 14w31 Q8

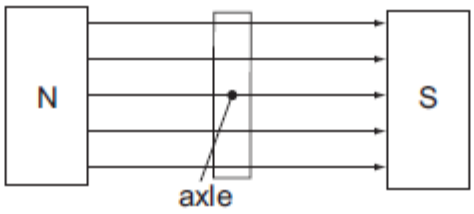
(b) (i) 25 000
230
step down
smaller (allow decreases)
decreases (allow smaller)
(all five correct: 2 marks, four correct: 1 mark) ;; [max 2]

(ii) (efficiency =) $\frac{\text{energy output}}{\text{energy input}}$;

$= 100 \times \frac{450}{500} = 90\%$; [2]

iGda 14s31 Q8

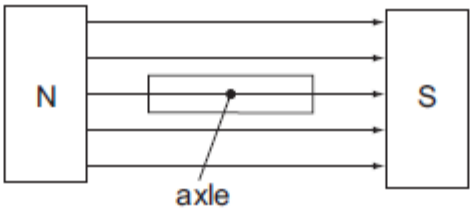
(d) (i) zero



;

[1]

(ii) greatest



;

[1]

(e) sine curve ;
approx. constant amplitude and half-period ;
repeated once / 2 rotations ; [3]

[Total: 11]

iGda 13w31 Q8

(c) (i) sine graph ;
regular amplitude and frequency ; [2]

(ii) strength of magnetic field ;
speed of rotation ;
number of turns on the coil ; [max 2]

iGda 13s31

9 (a) (i) $V_1/V_2 = N_1/N_2$;
$N_1 = 220 \times 40/5 = 1760$ (turns) ; [2]

(b) transformers increase voltage at power station ;
to reduce current in cables ;
to reduce energy losses ;
transformers decrease voltage at point of use ;
correct voltage for safe use in domestic appliances / owtte ; [max 3]

[Total: 5]

iGda 11s31 Q1

(b) (large current produces) stronger electromagnet ;
(strong enough to) attract iron (on pivot) ;
contacts break ; [3]

iGda 10w31 Q5

(b) **(i)** magnets repel ; [1]

(ii) iron bar attracted to magnet ; [1]

(c) **(i)** magnetic field produced by current flowing through aluminium foil ;
this interacts with, other magnetic field / stronger magnet ; [2]

(ii) increase current / voltage ;
increase magnetic field / stronger magnet ; *ignore bigger magnet* [2]

(d) working, e.g. $N_s = N_p \times V_s / V_p = 100 \times 35000 / 240$
= 14 583 (allow correct rounding to 2 significant figures) [2]

iGda 10s31 Q5

(b) **(i)** **B** (no mark)
turns ratio 2:1 ; [1]

(ii) water can conduct electricity ;
danger of electrocution ; [2]

(c) **(i)** current (flows in circuit) ;
produces (electro)magnet ;
(magnet) attracts iron bolt ; [3]

(ii) (no – no mark)
aluminium is not magnetic / not attracted to electromagnet ; [1]

(iii) (yes – no mark)
still an electromagnet (so still attracts bolt) ; [1]

(iv) more coils / bigger voltage / bigger core ; [1]

iGda 09s31

(b) **(i)** ammeter reading to right but larger than original ;

(ii) ammeter reading to left ; [1]

(iii) current is small ; [ignore refs to accuracy] [1]

(iv) alternator/dynamo/generator ; [1]

iGda 08w31

2 **(a)** place magnet in coil ;
magnet or coil need to be moving or implied ;
connect other end of coil to meter ; not just 'complete the circuit' [3]

(b) **(i)** wire moving across a magnetic field / idea that wire is experiencing a change in magnetic field ;
allow: there is a change in flux through the coil [1]

(ii) magnetic field is changing most / cuts most (magnetic) lines of force ;
rate of, cutting / changing, magnetic field is greatest when horizontal ;
is zero when vertical / cuts no (magnetic) lines of force ; [max 2]

[Total: 6]

iGda 14w31

8 **(a)** A spillage of a radioactive substance occurs in a store for radioactive materials. The activity due to normal background radiation is 100 counts per minute. After the spillage, the activity in the store rises to 900 counts per minute.

(i) State the meaning of the term *background radiation*.

.....

.....[1]

(ii) Write down the increase in activity produced by the spilled material.

..... counts per minute [1]

(iii) The half-life of the material spilled is 20 days.

The radioactive store can only be safely entered again when the total activity falls to 200 counts per minute.

Calculate how many days it will take before the store can be safely entered.

Show how you worked out your answer.

.....

.....

..... days [3]

(iv) The spilled radioactive material contains a small quantity of californium-253.

Write down the numbers of protons, neutrons and electrons found in an atom of californium-253.

number of protons .....

number of neutrons .....

number of electrons ..... [1]

iGda 14s31 Q8

(b) In some power stations highly radioactive isotopes are formed when energy is released. Workers at these power stations are monitored to check their exposure to radiation.

(i) State **one** way in which a worker's exposure to radiation can be monitored.

.....

..... [1]

(ii) State **one** effect of ionising radiation on the human body.

.....

..... [1]

11 X-rays and γ(gamma)–rays are both forms of electromagnetic radiation. They are also both forms of ionising radiation and are used in the treatment of cancer.

(a) State the meaning of the term *ionising radiation*.

.....

..... [1]

(b) Name the radiation that comes between X-rays and visible light in the electromagnetic spectrum. Give **one** use for this radiation.

radiation .....

use .....

..... [2]

(c) State the speed at which both X-rays and γ-rays travel through a vacuum.

..... [1]

(d) (i) State the meaning of the term *half-life*.

.....

..... [1]

(ii) Fig. 11.1 shows the decay of a sample of the isotope Cs-137.

Cs-137 has a half-life of 30 years.

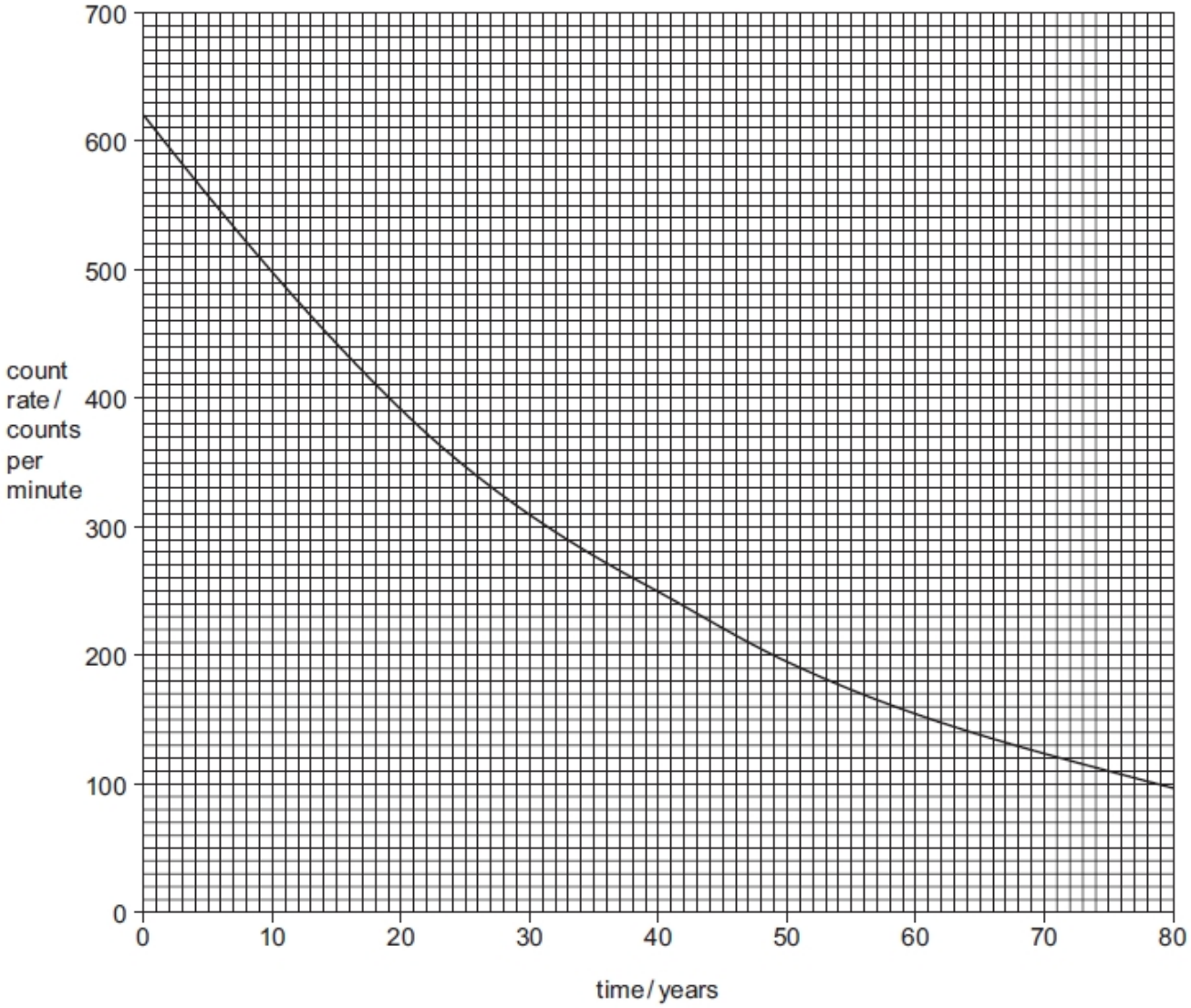


Fig. 11.1

(ii) Use Fig. 11.1 to show that the half-life of Cs-137 is 30 years.

Show your working on the graph.

[2]

iGda 12w31 Q7

(b) Three types of nuclear radiation are alpha, beta and gamma. Each of these can be identified by its behaviour in electric and magnetic fields.

Describe how you could identify alpha, beta and gamma radiations by their deflections in an electric field.

Explain your answer. You may use a diagram to help your explanation.

.....

.....

.....

.....

.....

.....

.....

..... [5]

(c) In a nuclear power station, nuclear fuel such as uranium releases energy by the process of nuclear fission.

(i) State what happens to the uranium atoms.

.....

[1]

(ii) At a nuclear power station, technicians work close to radioactive sources.

State **one** way in which these workers could be harmed by radiation emitted from radioactive sources.

.....

.....

[1]

(iii) State **two** ways in which these workers could be protected from the radiation.

1 .....

2 .....

[2]

iGda 12s31

7 Nuclear power can be used to generate electricity.

(a) Energy is released from atoms during nuclear fission.

Describe what happens to the nuclei of atoms during nuclear fission.

.....

[1]

(b) When an unstable strontium-90 nucleus changes into an yttrium nucleus, a beta particle is emitted.

strontium nucleus | yttrium nucleus | beta particle

(i) What is a beta particle?

.....

[1]

(ii) The nucleus of the strontium-90 atom contains 38 protons and 52 neutrons.

How many protons and neutrons are there in the yttrium nucleus that is produced?

number of neutrons .....

number of protons ..... [2]

(iii) Explain how a neutral atom may be changed by a collision with a beta particle.

.....

.....

.....

[2]

(c) The graphs in Fig. 7.1 show how the count rate for three different radioactive sources, **X**, **Y** and **Z**, changes with time.

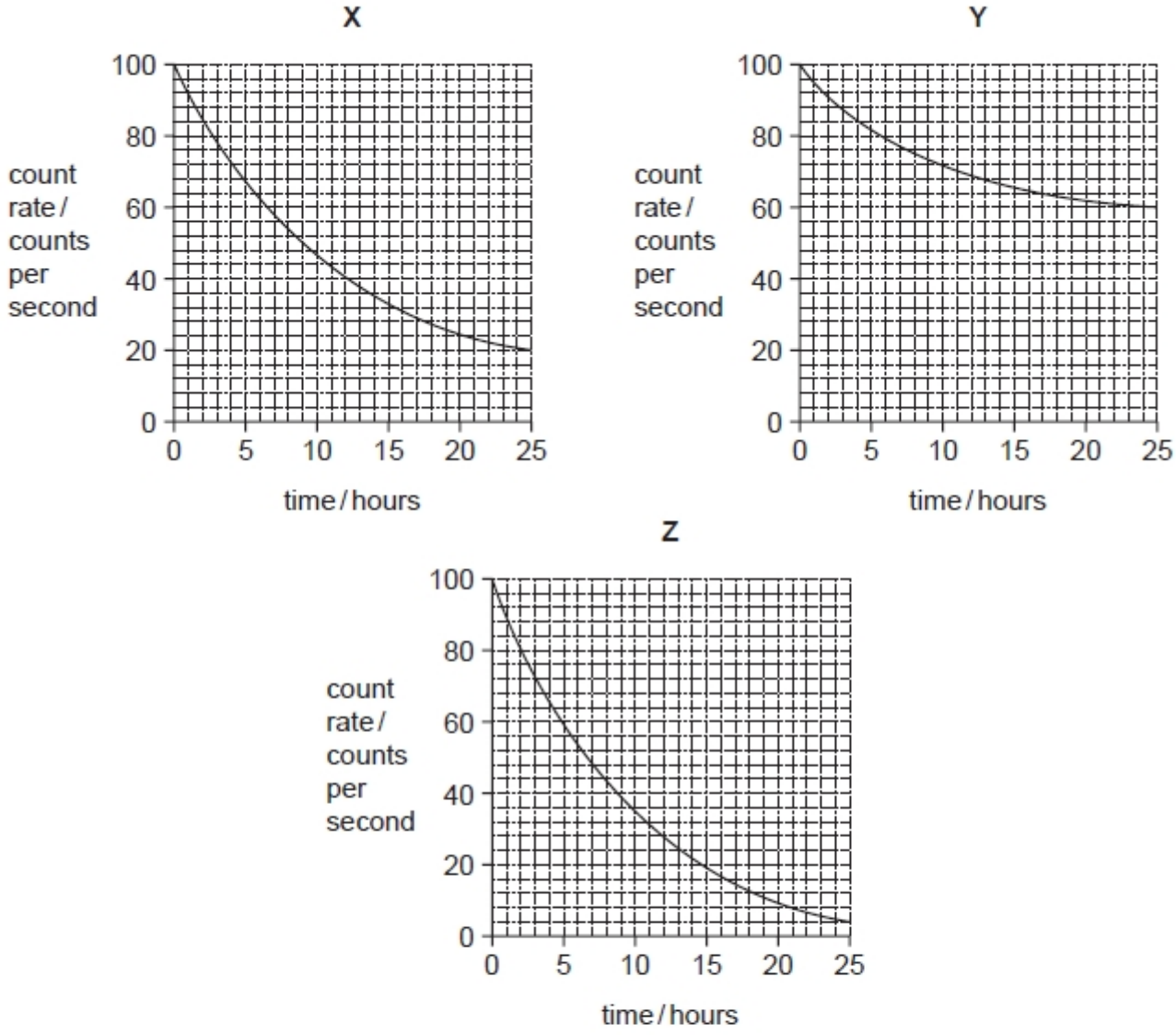


Fig. 7.1

(i) For source **X**, what is the count rate after 10 hours?

..... [1]

(ii) Which source, **X**, **Y** or **Z** has the shortest half-life?

..... [1]

iGda 10w31 Q9

(d) The rock contains radioactive substances emitting high levels of ionising radiation.

(i) State how the radioactivity could be detected.

.....

.....

[1]

(ii) Explain why it would be dangerous for a person to handle this rock without proper protection.

.....

.....

.....

[1]

iGda 10s31

3 **(a)** A person swallows a radioactive substance.

Explain why this could be harmful.

.....

.....

.....

.....

[3]

(b) In a nuclear power station, nuclear fuel such as uranium gives out energy.

(i) State what happens to the uranium atoms.

.....

[1]

(ii) Describe **one** problem associated with this process.

.....

.....

.....

[2]

iGda 09w31 Q5

(b) A thin sheet of aluminium is placed between a radioactive source and a radiation detector. The source emits one type of radiation only.

The radiation detected is reduced but not completely stopped.

(i) Suggest which type of radiation is being emitted and explain your answer.

.....

.....

..... [2]

(ii) A thin sheet of another metal will completely stop this type of radiation. Suggest what this metal could be.

..... [1]

iGda 09s31 Q4

4 (a) Many people have survived accidents where they have been exposed to ionising radiation from radioactive materials. Such exposure can have serious effects on their health.

The table and graph show how the dose (amount) of radiation received is linked to a type of cancer called leukaemia. The radiation dose is measured in units called grays.

Table 4.1

radiation dose / grays	incidences of leukaemia / cases per 10 000 people per year
1.0	1.0
2.5	2.3
5.0	
10.0	10.1
15.0	15.2

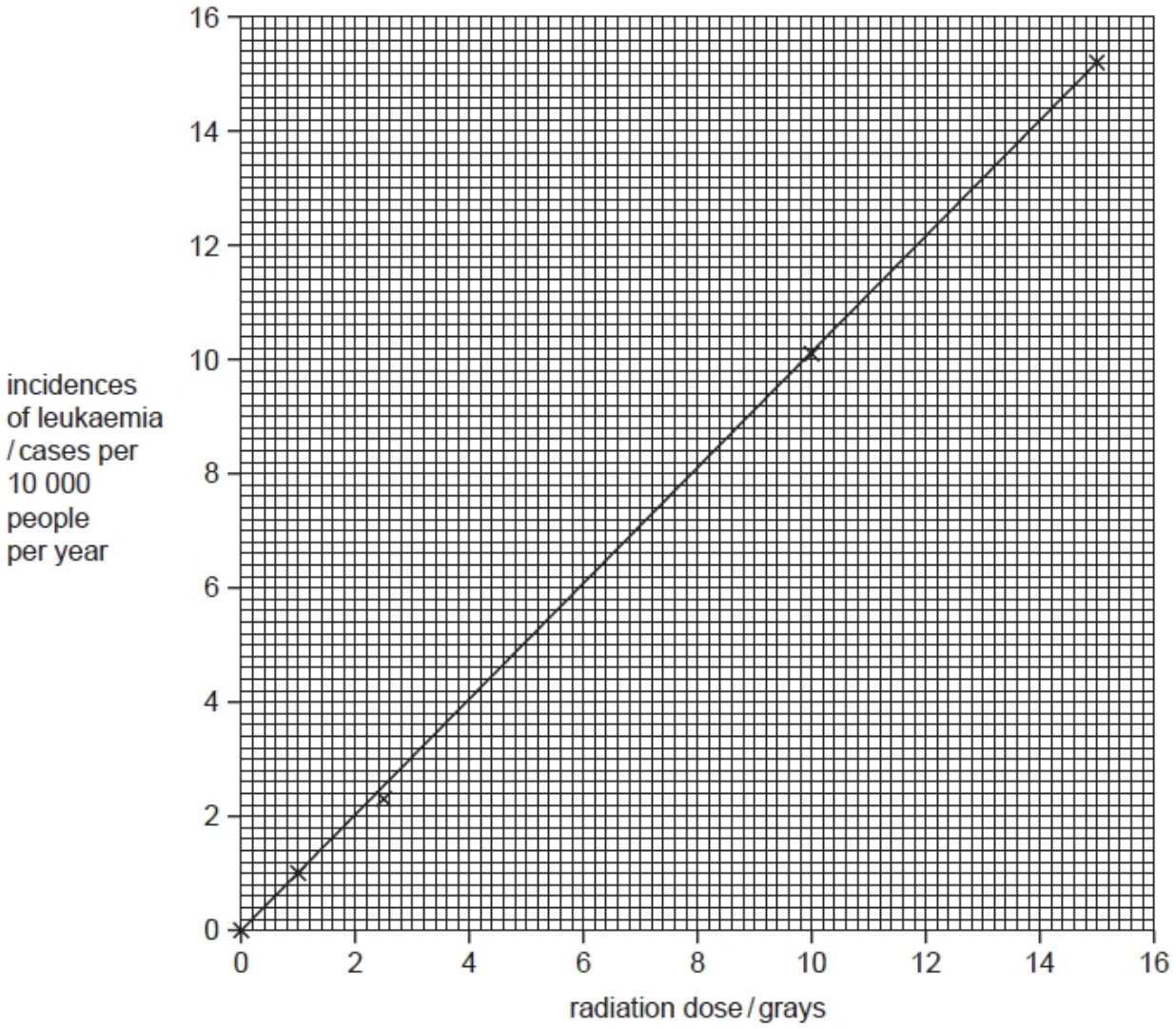


Fig. 4.1

(i) The result for 5.0 grays has been missed out of the table.

Use the graph to help you fill in the missing value in the table. [1]

(ii) What is the relationship between the ionising radiation and the incidence of leukaemia?

.....

..... [1]

(b) Two types of nuclear radiation from naturally occurring sources are alpha and beta. They can be identified by their different penetrating powers.

Describe how you could distinguish between alpha and beta radiation by their penetrating powers.

.....

.....

..... [1]

(c) Radon-222 (^{222}Rn) is a radioactive element. The chart in Fig. 4.2 shows the number of protons and neutrons in the nuclei of the elements formed when radon decays.

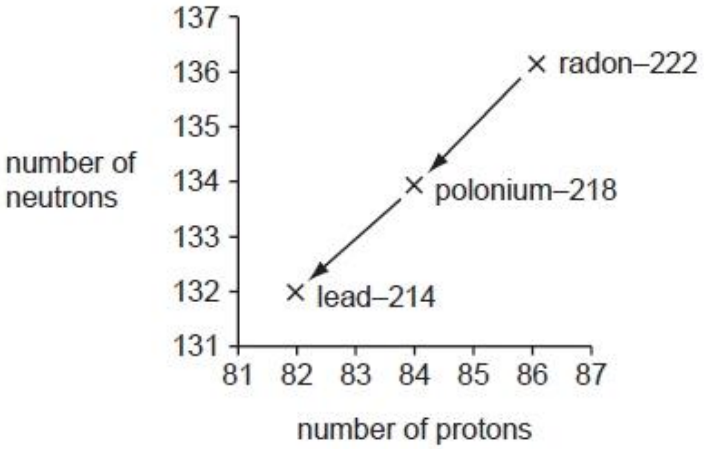


Fig. 4.2

(i) Describe how the graph shows that radon-222 (^{222}Rn) and polonium-218 (^{218}Po) emit alpha particles.

.....

.....

.....

..... [2]

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(ii) State why radon and polonium are different elements.

.....

.....

[1]

(iii) Radioactive decay can also produce gamma radiation.

Explain why gamma emission does **not** result in the formation of a new element.

.....

.....

.....

[1]

(iv) Radon-222 has a half-life of 4 days.

Explain what is meant by the term *half-life.*

.....

.....

.....

[1]

(v) 1 mg of radon-222 is allowed to decay.

Calculate after how many days there would be 0.125 mg of radon-222 remaining.

Show your working.

.....

.....

.....

[2]

iGda 08w31

5 (a) Some countries use nuclear fission reactors to generate electricity.

(i) What is meant by the term *nuclear fission*?

.....

..... [1]

(ii) State **one** advantage and **one** disadvantage of generating electricity using nuclear reactors.

advantage .....

.....

disadvantage .....

..... [2]

(b) When nuclear fuel is used in a power station, ionising radiation is released.

Table 5.1 shows some information about three types of ionising radiation.

Table 5.1

radiation	ionising power	deflection by electric field
alpha	very strong	small
beta	moderate	large
gamma	weak	none

(i) Explain how alpha, beta and gamma radiations can be separated from each other by passing them across an electric field.

.....

..... [4]

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(ii) Explain why alpha radiation is the most ionising.

.....

..... [1]

(iii) Describe the effect of ionising radiation on living things.

.....

..... [1]

(iv) Why are radioactive sources stored in lead containers?

..... [1]

Topic 15 MS

iGda 14w31

8 (a) (i) (ionising) radiation constantly present in the natural environment/ surroundings of the Earth (which is emitted by natural and artificial sources) ; [1]

(ii) 800 (cpm) ; [1]

(iii) evidence of using background radiation 100, e.g. starting at 800 *(max 2 marks if this not shown)* ;
3 half-lives (or correct use of 3 in the calculation) ;
60 (days) ; [3]

(iv) *number of protons*: 98
number of neutrons: 155
number of electrons: 98 ; [1]

(v) α - loses 2 protons and 2 neutrons ;
β - proton gain, neutron loss ; [2]

iGda 14s31 Q8

(b) (i) photographic film radiation badge / dosimeter ; [1]

(ii) cancer / mutation / radiation burns ; [1]

iGda 13w31

11 **(a)** removes electrons from atom / produces a charged particle ; [1]

(b) ultraviolet ;
fluorescent tubes / security marking / tanning / sterilisation / detecting biological fluids ; [2]

(c) 3×10^8 m/s ; [1]

(d) **(i)** time for half radioactive atoms to decay / time for count rate of radioactive material to halve ; [1]

(ii) find time when count rate was a particular value and find the time when count rate was half this value ;
time difference is the half-life ; [2]

[Total: 7]

iGda 12w31 Q7

(b) gamma not deflected ;
because gamma has no charge ;
alpha deflected one way and beta the opposite ;
because alpha and beta have opposite charges ;
opposite charges attract ; [5]

(c) **(i)** nucleus splits ; [1]

(ii) cancer / radiation burns / mutation / damages cells / damages DNA ; [1]

(iii) work behind protective screen ;
wear protective clothing ; [2]

iGda 12s31

7 **(a)** split ; [1]

(b) **(i)** electron ; [1]

(ii) 51 neutrons ;
39 protons ; [2]

(iii) ionisation occurs ;
electron(s) lost ; [2]

(c) **(i)** 47 ± 1 cps ; [1]

(ii) **Z** ; [1]

[Total: 8]

iGda 10w31 Q9

(d) (i) Geiger counter / Geiger-Müller tube / any other suitable ; [1]

(ii) ionisation within cells / damages cells / kills cells / damages DNA / causes mutation / radiation burns / cancer / radiation sickness ; [1]

iGda 10s31

3 (a) ionising ;
removes electrons ;
damages DNA / mutation ;
effect (e.g. cancer / burns / radiation sickness) ; [max 3]

(b) (i) nuclei split / nuclear fission ; [1]

(ii) nuclear / radioactive / toxic waste ;
problems of disposal / storage ;
or
security of fissionable / radioactive material ;
use in terrorism ;
or
accident / malfunction ;
effect of radioactive materials on environment / humans ; [max 2]

[Total: 6]

iGda 09w31 Q5

(b) (i) beta ;
alpha would be completely stopped and gamma not stopped at all ; [2]

(ii) lead ; [1]

iGda 09s31 Q4

4 (a) (i) 5.1 (± 0.1) ; [1]

(ii) (directly) proportional ; [accept if described in correct numbers] [1]

(b) alpha stopped by/beta not stopped by, paper/few cms of air ; [1]

(c) (i) protons and neutrons both go down (by two) ;
alpha particle is 2 protons and 2 neutrons ; [2]

(ii) different, numbers of protons/atomic number ;
[reject if also neutrons] [ignore electrons] [1]

(iii) gamma emission does not change any particles (protons/neutrons)/is just a wave/is just energy ; [1]

(iv) time taken for half atoms to decay/time taken for count rate to decrease by half ; [1]

(v) 3 half-lives ;
12 days ; [2]

[Total: 10]

iGda 08w31

5 (a) (i) nucleus (of atom) splits ; [1]

(ii) advantage – no global warming / CO_2 emissions / no reduction in fossil fuels reserves / *or* small amount of fuel produces large amount of, electricity / energy ;

disadvantage – radiation leaks / high decommissioning costs / waste disposal / expensive to build / expensive to maintain / expensive to keep safe ; [max 2]

(b) (i) alpha and beta deflected in opposite directions ;
because they have opposite charges ;
alpha to negative and beta to positive ; this also gets mp1
gamma not charged and not deflected ; [4]

(ii) largest / most massive / most charged, particle ; [1]

(iii) cancer / mutations / damage DNA / radiation burns / damages cells / ; [1]

(iv) lead only lets some gamma escape / lead is good at absorbing, gamma / all types of radiation ; [1]

[Total: 10]

Topic 2

iGda 15s31 Q9

(e) The saucepan and water have a weight of 20 N. The surface of the base in contact with the cooker is 300 cm^2.

Calculate the pressure in **N/m^2** exerted by the saucepan and water on the surface of the cooker.

State the formula that you use and show your working.

formula

working

pressure = ... N/m^2 [3]

iGda 14s31 Q3

(c) The metal block needs 1820 kJ of thermal energy to raise its temperature by 2 °C.

Calculate the specific heat capacity of the metal in the block.

State the formula that you use and show your working.

formula

working

specific heat capacity = ... kJ/(kg °C) [3]

iGda 14s31

3 Fig. 3.1 shows information about two trucks, **X** and **Y**, coming to rest under the action of the same braking force.

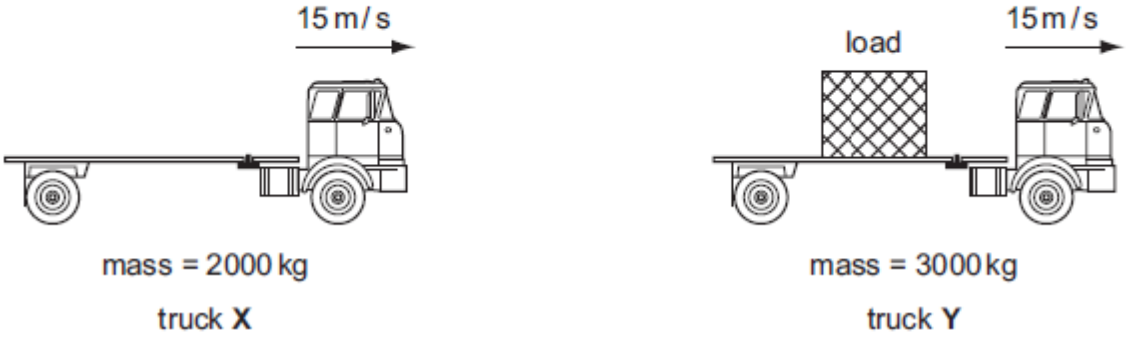

Fig. 3.1

(iii) The deceleration of truck **X** is $0.5\,m/s^2$.

Calculate the braking force on truck **X**.

State the formula that you use and show your working. State the units of your answer.

formula

working

force = ... unit ..... [2]

(b) The density of the metal used to make the load carried by truck **Y** is $2700\,kg/m^3$. The mass of the load is 1000 kg.

Calculate the volume of the load.

State the formula that you use and show your working. State the unit of your answer.

formula

working

volume = ... unit ..... [3]

iGda 13s31 Q6 (a)
Flour used to make bread is sold in bags.

(iii) Each 5 kg bag of flour has a volume of 5500 cm^3.

Calculate the average density of the bag of flour. State your answer in g/cm^3.

State the formula that you use and show your working.

formula

working

..... g/cm^3 [2]

iGda 11w31 Q7

(b) Another athlete in the race has a mass of 70 kg. Her initial forward acceleration was 1.5 m/s^2.

Calculate the force needed to give this acceleration.

State the formula that you use and show your working.

formula

working

..... [2]

iGda 10w31 Q9

(b) Fig. 9.2 is a speed-time graph for the motion of the rock. This graph ignores the effect of air resistance on the rock.

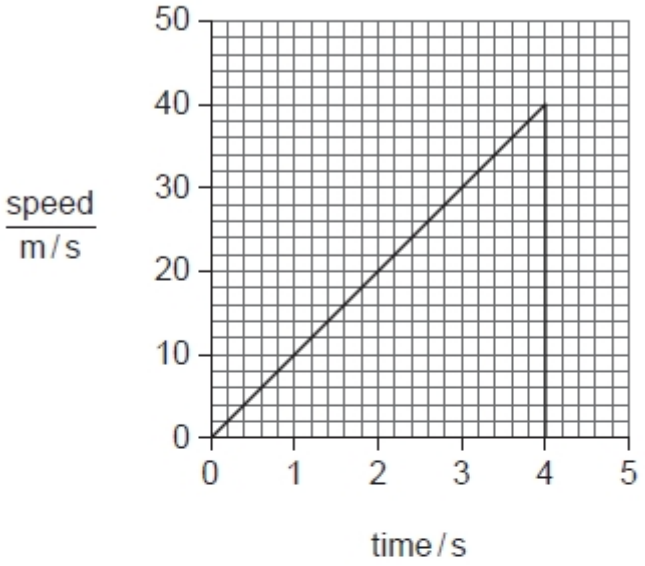

Fig. 9.2

(i) Calculate the kinetic energy of the rock as it hits the water.

State the formula that you use and show your working.

formula used

working

..... [3]

iGda 10w31 Q9

(c) The rock has an irregular shape. It has a mass of 2000 g and a volume of 700 cm^3.

(i) Calculate the density of the rock.

State the formula that you use and show your working.

formula used

working

..... [2]

(ii) Describe how you could find the volume of an irregularly shaped object such as a rock. You should state the apparatus you would use and the measurements you would need to make.

.....

.....

.....

.....

..... [2]

iGda 09w31 Q8

(c) (i) To determine the density of an elephant, its volume must be measured.

Describe a method for measuring the volume of an irregularly shaped object.

.....

.....

.....

..... [2]

(ii) The volume of an elephant is 4 m^3. Its mass is 4000 kg.

Calculate the density of this elephant.

State the formula that you use and show your working.

formula

working

..... [2]

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8 A diver is working under water, wearing a diving suit and helmet.

(a) The diving helmet has a plastic window of area 100 cm^2. The air pressure inside the helmet is the same as the water pressure outside.

(i) At a depth of 40 m, the diver breathes air at a pressure of 50 N/cm^2.

Calculate the force exerted by the air on the helmet window at this depth.

Use the formula

pressure = force / area

Show your working.

..... [1]

(ii) At the surface of the sea, the pressure of the atmosphere is 10 N/cm^2.

Estimate a value for the pressure at a depth of 10 m. Explain your answer.

.....

.....

..... [2]

Topic 2 MS

iGda 15s31 q9

(e) (pressure =) force / area ;
= 20 / 0.03 ; (evidence of cm^2 to m^2 conversion)
= 667 / 670 (N/m^2) ; [3]

iGda 14s31 Q3

(c) $E = m \times c \times \theta$ **or** $(c =) \frac{E}{m\theta}$;

$c = \frac{1820}{1000} \times 2$;

= 0.91 (kJ / kg °C) ; [3]

iGda 14s31 3(a)

(iii) (force =) mass × acceleration ;

= 2000 × 0.5 = 1000 N ; [2]

(b) (volume =) $\frac{\text{mass}}{\text{density}}$;

$= \frac{1000}{2700}$;

$= 0.37\ m^3$; [3]

iGda 13s31 Q6 (a)

(iii) (density =) mass / volume ;
= 5000 / 5500 = 0.91 (g/cm^3) ; [2]

iGda 11w31 Q7

(b) force = mass × acceleration ;
= 70 × 1.5 = 105 N ; [2]

iGda 10w31 Q9

(b) (i) KE = ½ mv^2 ;
speed is 40 m / s ;
= ½ × 2 × 1600 = 1600 J ; [3]

iGda 10w31 Q9

(c) (i) density = mass / volume ;
= 2000 / 700 = 2.86 g/cm^3 ; [2]

(ii) use, displacement can / measuring cylinder / graduated container ;
place object in and measure, displaced water / difference in volume ; [2]

iGda 09w31 Q8

(c) (i) immerse in water ;
measure volume of liquid displaced ; [2]

(ii) (density =) mass / volume ;
= 4000 / 4 = 1000 kg/m^3 ; [2]

iGda 09s31

8 (a) (i) = 5000 N ; [1]

(ii) 20 N/cm^2 ;
change of 10 N/cm^2 for each 10 m depth ; [2]

Topic 3

iGda 15s31 q1

(c) Sometimes the scientists pull a flat sledge across the ice and snow carrying some of their equipment.

Fig. 1.2 shows a scientist pulling a loaded sledge across the ice.

Fig. 1.2

The scientist pulls the sledge at a constant speed of 0.8 m/s. The mass of the loaded sledge is 30 kg.

Calculate the kinetic energy of the sledge.

State the formula that you use and show your working.

formula

working

kinetic energy = ... J [2]

iGda 14s31

8 (a) Electricity can be generated by burning fossil fuels in a power station.

Describe how the energy released from the fossil fuel is used to produce electrical energy.

.....

.....

.....

..... [3]

iGda 13w31 Q5

(b) Fig. 5.3 shows the energy flow diagram for the solar-powered vehicle.

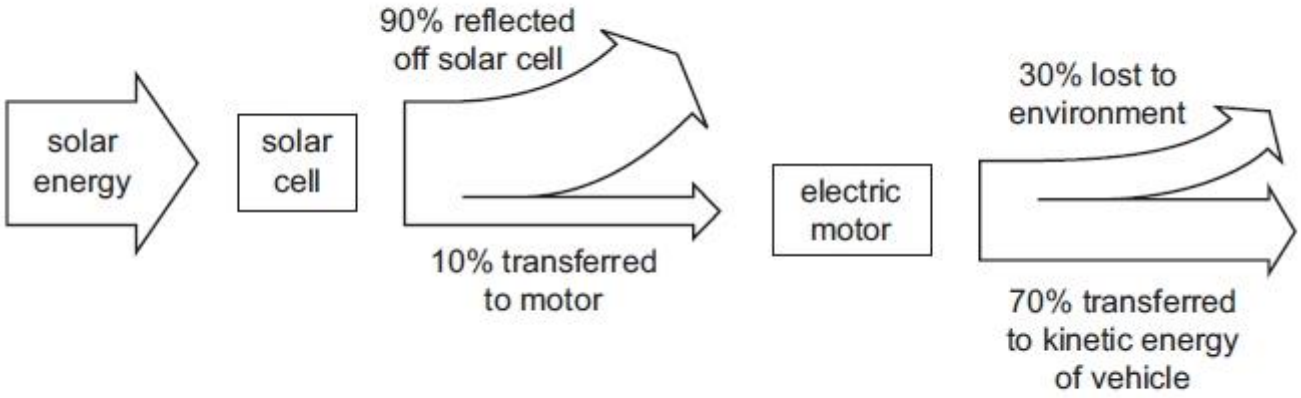


Fig. 5.3

(i) State the efficiency of the **solar cell**.

..... % [1]

(ii) During part of the journey, the solar cell receives 1 000 000 joules of solar energy.

Calculate the number of joules transferred as kinetic energy to the **vehicle**.

Show your working.

..... J [2]

iGda 13s31

6 (a) In a store, two workers are lifting 5 kg bags of flour onto the shelves. There are five shelves, 0.4 m apart. The lowest shelf is 0.4 m from the floor.

Fig. 6.1 shows the two workers.

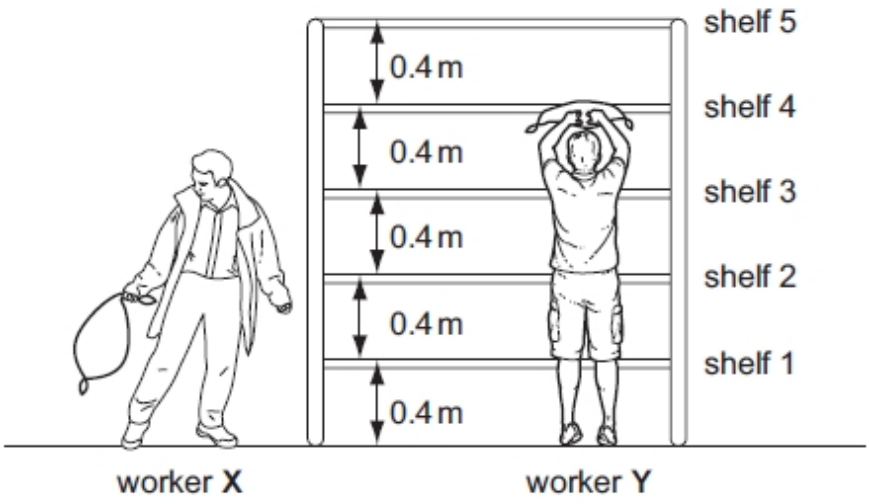


Fig. 6.1

(i) Worker **X** lifts three bags from the floor to shelf 2. Worker **Y** lifts one bag from the floor to shelf 5.

Worker **X** says that he has done more work than worker **Y**.

Use calculations of the work done to explain whether or not he is correct.

State the formula that you use.

formula

.....

..... [2]

(ii) Each worker lifts one bag from the floor to shelf 2. Worker **X** does this more quickly than worker **Y**.

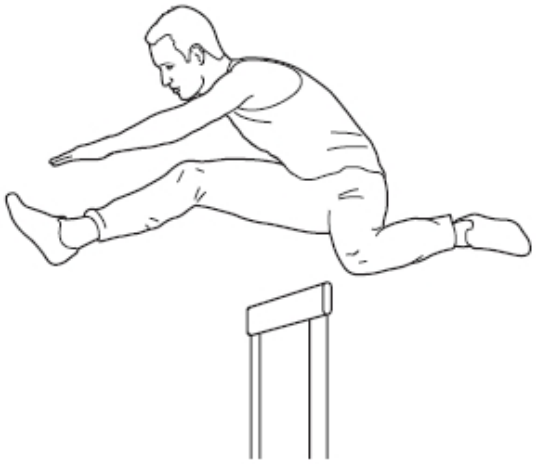
Which worker exerted the higher power during their lift?

Explain your answer.

.....

..... [1]

4 **(a)** An athlete of mass 60 kg jumps 1.3 metres vertically.



Calculate the work done by the athlete to achieve this height.

State the formula that you use and show your working. The gravitational field strength of the Earth is 10 N / kg.

formula used

working

..... [3]

(b) Using your answer to part **(a)**, state the gain in potential energy of the athlete when he jumps 1.3 metres.

..... [1]

(c) The work done in jumping vertically was completed in 0.5 s.

Calculate the power developed.

State the formula that you use and show your working.

formula used

working

..... [2]

iGda 12s31

1 Sugar cane is a food crop grown in Australia. It is harvested and then transported on small trains to the processing plant.

Fig. 1.1 shows one of the trains carrying sugar cane.

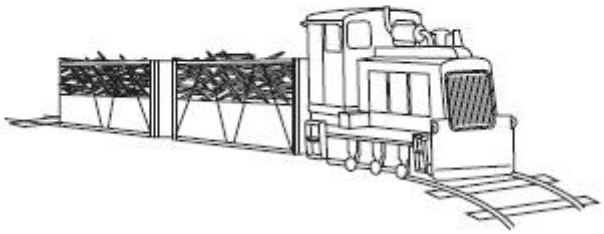


Fig. 1.1

(a) The mass of the engine and empty trucks is 20000 kg and the mass of the sugar cane transported is 10000 kg.

The train travels at a speed of 0.5 m/s.

(i) Calculate the kinetic energy of the loaded train.

State the formula that you use and show your working.

formula used

working

..... [2]

(ii) To travel at this speed, a driving force of 1000000 N is needed.

Calculate the work done by the engine when the train travels 1 km.

State the formula that you use and show your working.

formula used

working

..... [2]

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(iii) It takes the train 5 minutes to travel 1 km. Calculate the power output of the engine.

State the formula that you use and show your working.

formula used

working

..... [2]

(b) The water used to irrigate one sugar cane farm comes from a waterfall. The farmer attempts to reconstruct an experiment which may have been carried out by James Joule in 1847.

Joule attempted to show that the water at the bottom of a waterfall was hotter than water at the top of the waterfall. His reasoning was that the water had gravitational potential energy at the top of the waterfall, which would be converted to kinetic energy as it fell. This kinetic energy would be changed to heat energy when the water fell into the pool at the bottom of the waterfall.

(i) 1 kg of water has 300 J of gravitational potential energy at the top of the waterfall.

State the maximum kinetic energy that 1 kg of water will have when it reaches the bottom of the waterfall. Explain your answer.

maximum kinetic energy .....

explanation .....

..... [1]

iGda 11w31 Q7

(c) The power output of the athlete is 600 W.

Calculate the amount of work done by the athlete over 5 seconds.

Show your working.

..... [2]

iGda 11w31 Q2

(b) The top of a water slide is 10 m above the water in the pool. This is shown in Fig. 2.2.

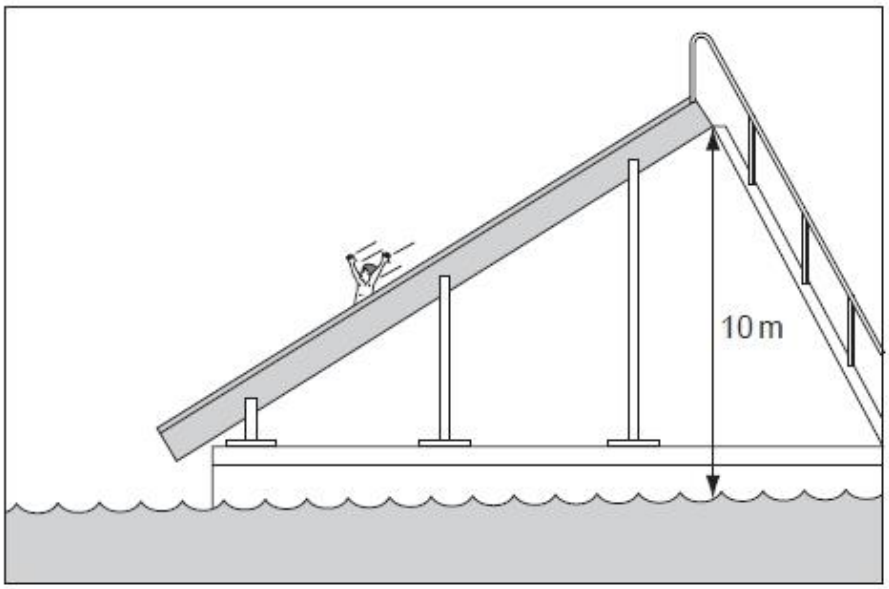

Fig. 2.2

A boy has a mass of 50 kg. He climbs from the pool to the top of the slide. When he slides down and reaches the bottom of the slide, his speed is 12 m/s.

Calculate the kinetic energy of the boy as he reaches the bottom of the slide.

State the formula that you use and show your working.

formula used

working

..... [2]

(c) The boy then climbs to the top of another water slide which is 20 m high.

(i) When the boy is at the top of the slide, does his weight differ from his weight at the top of the 10 m slide?

Explain your answer.

.....

..... [1]

(ii) Suggest how the kinetic energy of the boy at the bottom of the 20 m slide may differ from his kinetic energy at the bottom of the 10 m slide.

Explain your answer.

.....

.....

..... [1]

iGda 11s31 Q7

(b) The mass of the aircraft is 140 000 kg.

Calculate the kinetic energy of the aircraft as it travels at 100 m/s.

State the formula that you use and show your working.

formula used

working

..... [2]

iGda 11s31 Q4

(c) Fig. 4.1 shows the energy transferred each second by a television.

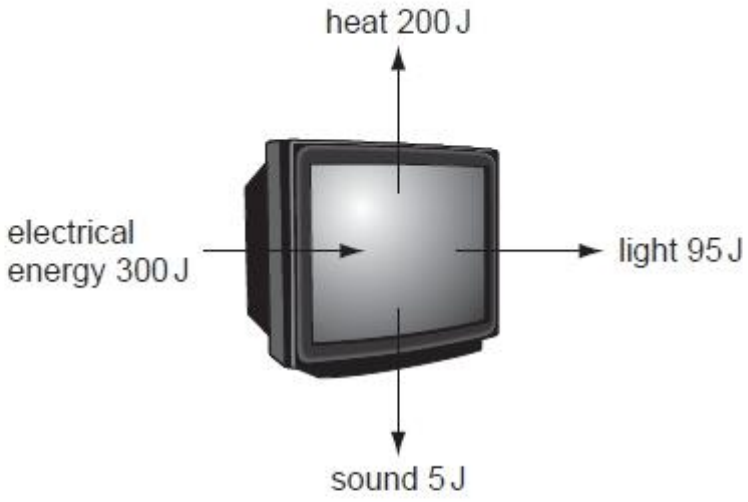

Fig. 4.1

(i) Name the form of energy that is lost as waste energy by the television.

..... [1]

(ii) State the effect of the waste energy on the air around the television.

..... [1]

(iii) Calculate the energy efficiency of the television.

Show your working.

..... % [2]

iGda 10w31

2 Fig. 2.1 shows a mobile phone (cell phone).

mobile phone
containing a battery

Fig. 2.1

(a) Energy is stored inside the mobile phone in a battery.

Describe the energy changes taking place when the battery is being charged.

.....

..... [2]

iGda 09w31 Q8

(b) An elephant lifts a mass of 300 kg through a vertical distance of 2 m.

Calculate the work done by the elephant.

State the formula that you use and show your working.

formula

working

..... [2]

iGda 08w31 Q8

8 An airline passenger enters an airport.

(b) He then moves up an escalator (moving staircase) as shown in Fig. 8.1.

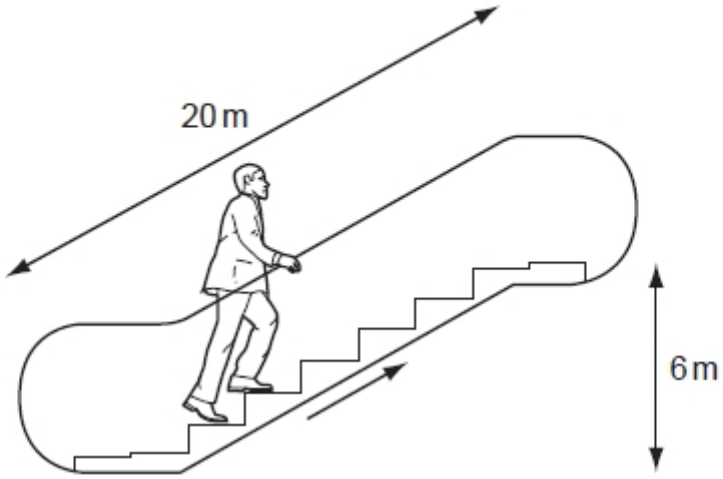

Fig. 8.1

(i) The passenger weighs 900 N. Calculate the work done lifting the passenger a vertical distance of 6 m up the escalator.

State the formula that you use and show your working.

formula

working

..... [2]

(ii) State the potential energy the passenger has gained when he reaches the top of the escalator.

..... [1]

Topic 3 MS

iGda 15s31 q1

(c) (KE =) ½mv^2 ;
= ½ × 30 × 0.8 × 0.8 = 9.6 (J) ; [2]

iGda 14s31

8 **(a)** (chemical to) thermal/heat energy ;
heat water to produce steam ;
(drives) turbine and generator ;
reference to kinetic energy ;
[max 3]

iGda 13w31 Q5

(b) (i) 10% ; [1]

(ii) 1,000,000 × 0.10 × 0.70 ;
= 70,000 J ; [2]

iGda 13s31

6 (a) (i) (work =) force × distance ;
X's work is 120 J and **Y**'s work is 100 J (so **X** does more work) ; [2]

(ii) worker **X** (no mark)
power = work ÷ time, or power α 1 ÷ time, or power is, rate of doing work ÷ work done per second, or how quickly work is done, so worker **X** uses more power ; [1]

iGda 12w31

4 (a) weight / force = 600 N ;
(work done =) force x distance ;
= 600 × 1.3 = 780 J ; [3]

(b) 780 J ; [1]

(c) (power =) work / time ;
780 / 0.5 = 1560 W ; [2]

[Total: 6]

iGda 12s31

1 (a) (i) (KE =) ½ mv^2 ;
= ½ × 30000 × 0.5 × 0.5 = 3750 J ; [2]

(ii) (work done =) force × distance
= 1000000 × 1000= 1000000000 J ; [2]

(iii) (power =) work / time ;
= 1000000000 / 300 = 3300000 W ; [2]

(b) (i) 300 J **AND** all potential energy will be converted into kinetic energy / energy is conserved ; [1]

iGda 11w31 Q7

(c) work = power × time ;
= 600 × 5 = 3000 J ; [2]

iGda 11w31 Q2

(b) (KE =) ½ mv^2 ;
= ½ × 50 × 12 × 12 = 3600 J ; [2]

(c) (i) no – weight is determined by gravitational attraction of a mass / gravity is the same at both points ;
OR
yes – weight is determined by gravitational attraction of a mass but this depends on height / distance between mass and centre of gravitational force ; [max 1]

(ii) KE will be greater because, more potential energy converted into KE / has been accelerating for longer / his speed is greater ; [max 1]

iGda 11s31 Q7

(b) (KE =) ½ mv^2 ;
= ½ × 140000 × 100 × 100 = 7 × 10^8 J ; [2]

iGda 11s31 Q4

(c) **(i)** heat/thermal ; [1]

(ii) increase temperature/air is heated/air rises/convection current ; [1]

(iii) efficiency = useful energy output/energy input **or** = 100/300 ;
= 33 (%) ; [2]

iGda 10w31

2 **(a)** electrical energy to chemical energy ;
(also some of) electrical energy to heat ; *ignore light* [2]

iGda 09w31 Q8

(b) (work done =) force × distance ;
= 3000 × 2 = 6000 J ; [2]

iGda 08w31 Q8

(b) **(i)** (work =) force x distance ;
= 900 x 6 = 5400 J ; [2]

(ii) 5400 J ; allow ecf [1]

Topic 5

iGda 14w31 Q3

(c) As the car drives along, the temperature of the air in the tyres increases.

Use the idea of particles to explain why this will result in an increase in tyre pressure.

.....

.....

.....

.....[3]

iGda 11w31 Q7

(d) After the race, the athletes are sweating. The sweat evaporates from the surface of their skin.

Describe the process of evaporation in terms of particles.

.....

.....

.....

.....

..... [3]

iGda 15s31 Q9 (B)

(b) While water is heated, a small amount of water evaporates. When the temperature of the water reaches 100 °C, the water boils.

State **two** ways in which boiling differs from evaporation.

1 .....

.....

2 .....

..... [2]

(d) Fig. 9.3 shows three different ways in which particles may be arranged in substances.

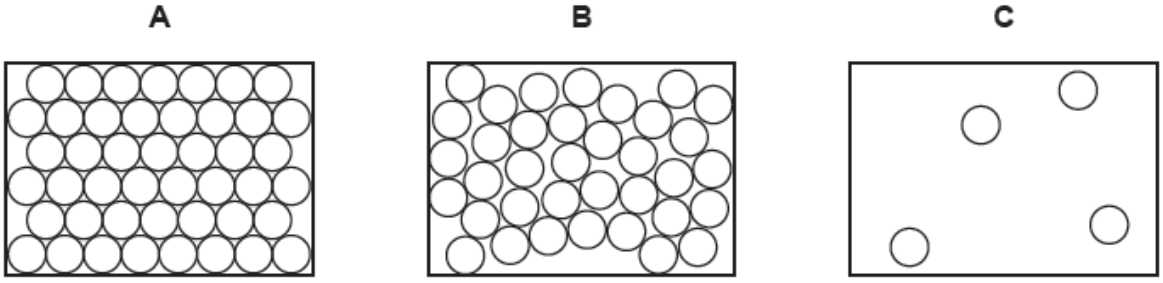

Fig. 9.3

State which diagram best represents the way particles are arranged in the liquid water in the saucepan.

Explain your answer.

diagram .....

explanation .....

..... [1]

iGda 15s31

9 **(a)** A cook places a metal saucepan containing water onto a hot-plate on an electric cooker.

The saucepan and water are shown in Fig. 9.1.

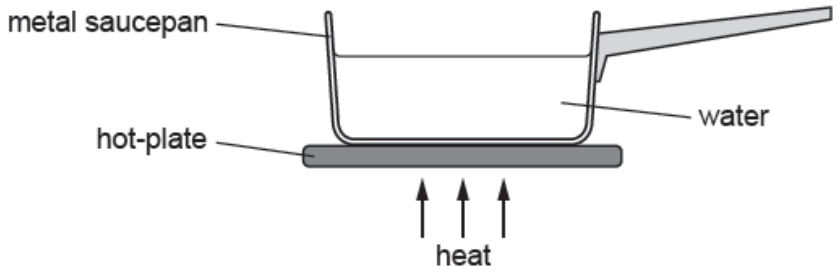

Fig. 9.1

(i) Thermal energy can be transferred by conduction, convection and radiation.

The thermal energy is transferred **through the metal saucepan** by conduction.

Describe this process in terms of particles.

.....

.....

..... [2]

(ii) Fig. 9.2 is a scale diagram showing the energy transformations involved in heating the water.

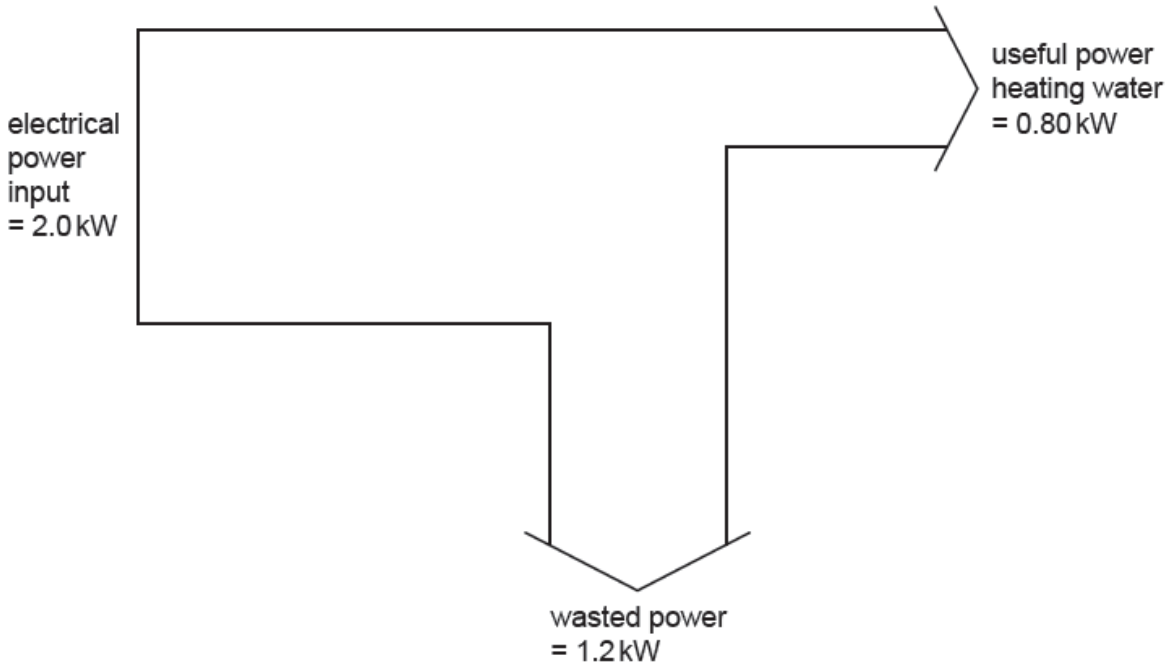

Fig. 9.2

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Calculate the efficiency of heating water in this way.

Show your working and give your answer as a percentage.

efficiency = ...% [2]

iGda 14w31 Q6

(d) A large hot meteorite falls into a lake, warming the water without causing the water to evaporate or boil.

(i) Describe the difference between evaporation and boiling.

.....

.....

.....

.....[2]

(ii) The meteorite is made of iron and has a mass of 32000 kg.

It has a temperature 1520 °C before it enters the lake. After it enters the lake its temperature falls to 20 °C.

Calculate the thermal energy transfer, in kJ, from the hot meteorite to the water.

The specific heat capacity of iron is 450 J/kg °C.

State the formula that you use and show your working.

formula

working

..... kJ [3]

iGda 13w31

(b) The mass of air in the refrigerator is 0.19 kg.

The air in the refrigerator is cooled by 4 °C.

The specific heating capacity of air is 1.01 J/kg °C.

Calculate the heat energy removed from the air when it is cooled.

State the formula that you use, show your working and state the unit of your answer.

formula

working

..... unit ..... [2]

(c) (i) Some ice from the freezing compartment is allowed to melt at 0 °C.

Explain why energy is required to melt the ice even though the temperature remains at 0 °C.

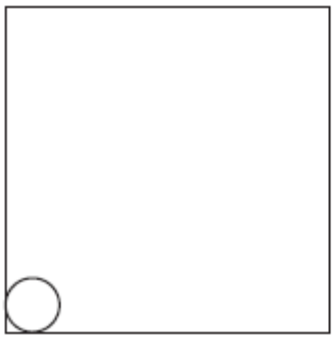
.....

.....

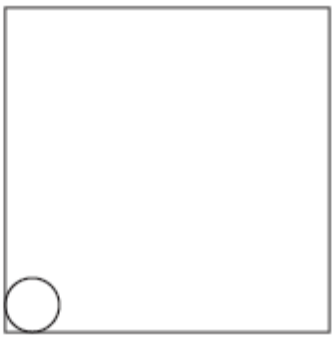
..... [1]

(ii) Complete the diagrams to show the arrangement of water molecules in solid ice and in liquid water.

One molecule has been drawn for you in each box. Each diagram should contain at least twelve water molecules.



solid ice



liquid water

[2]

(b) The water used to irrigate one sugar cane farm comes from a waterfall. The farmer attempts to reconstruct an experiment which may have been carried out by James Joule in 1847.

Joule attempted to show that the water at the bottom of a waterfall was hotter than water at the top of the waterfall. His reasoning was that the water had gravitational potential energy at the top of the waterfall, which would be converted to kinetic energy as it fell. This kinetic energy would be changed to heat energy when the water fell into the pool at the bottom of the waterfall.

(i) 1 kg of water has 300 J of gravitational potential energy at the top of the waterfall.

(ii) Assuming that all the kinetic energy of the water is converted to thermal (heat) energy, calculate the temperature rise in the 1 kg of water. The specific heat capacity of water is 4200 J/kg °C.

State the formula that you use and show your working.

formula used

working

..... [3]

iGda 11w31 Q2

(d) The mass of water in the pool is 50 000 kg. The specific heating capacity of water is 4200 J/kg °C. The water is heated from 20 °C to 25 °C.

Calculate the energy needed to heat the water.

State the formula that you use and show your working.

formula used

working

..... [3]

iGda 11s31 Q1

(iii) It takes 2 hours to heat up 280 000 cm^3 of water from 20 °C to 50 °C. The density of water is 1000 kg/m^3.

Calculate the specific heating capacity of water.

State the formula that you use and show your working.

formula used

working

..... [4]

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5 (a) Fig. 5.1 shows some apparatus set up to measure the specific heat capacity of aluminium.

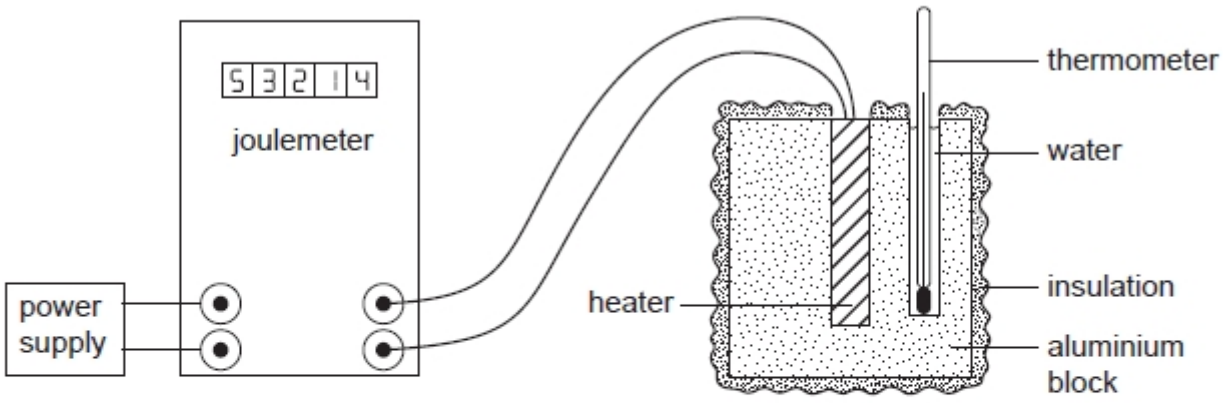

Fig. 5.1

The block is heated electrically and the electrical energy input is measured using a joulemeter. The temperature of the block and the total electrical energy supplied are measured at intervals.

The results are shown on Fig. 5.2.

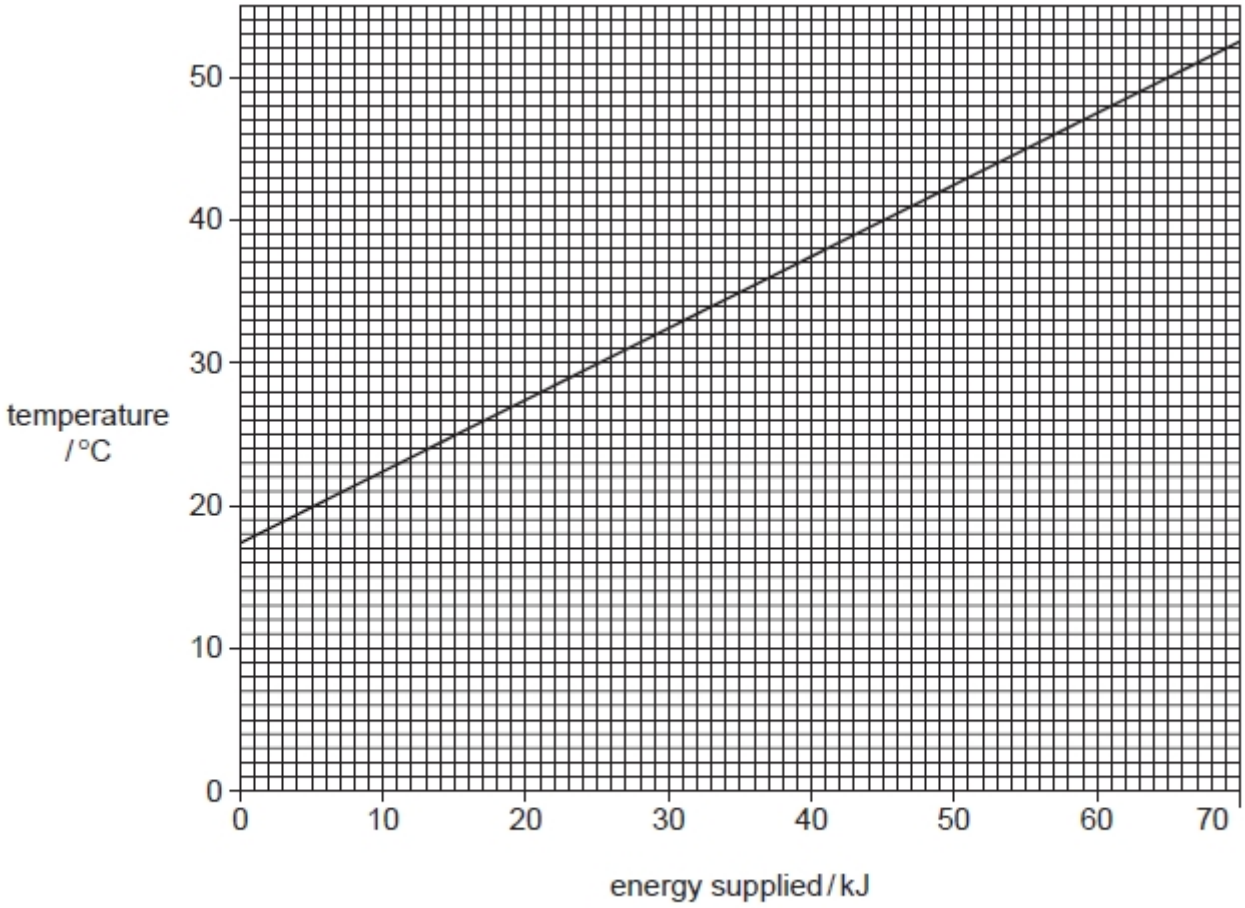

Fig. 5.2

(i) State the relationship between the temperature and the energy supplied.

.....

..... [1]

(ii) Use the graph to calculate the energy needed to raise the temperature of the block from 25 °C to 45 °C.

Show your working on the graph.

..... [2]

(iii) The mass of the aluminium block is 2 kg.

Use the formula

energy = mass x specific heat capacity x temperature change

to calculate the specific heat capacity of aluminium.

Show your working.

..... [3]

iGda 08s31 Q5 (b)

(iii) Explain in terms of particles why the pressure of the air in the tyres increases when the temperature increases.

.....

.....

..... [2]

Topic 5 MS

iGda 14w31 Q3

(c) (as temperature increases) **kinetic** energy / velocity of molecules / particles / atoms increases ;
increased force / energy of collisions ;
increased frequency of collisions ;
(collisions with) walls / surface of tyre ; [max 3]

iGda 11w31 Q7

(d) heat transferred into (water) particles (from surroundings) ;
(water) changes from liquid to gas ;
ref. attraction between particles in the liquid ;
fastest moving / more energetic, particles escape ;
(escape) at surface / ref. to process happening at temperature below boiling point;
average energy of rest of particles reduced / heat removed from liquid ; [max 3]

iGda 15s31 q9 (B)

(b) evaporation can occur at any temperature / boiling only happens at the boiling point ;
evaporation happens only at the surface / boiling occurs throughout the liquid ;
during boiling all / most molecules have enough energy to leave / evaporation lets only the molecules with the highest kinetic energy out ;
evaporation can occur using the internal energy of the system / boiling requires a(n external) source of heat ;
evaporation produces cooling / boiling does not produce cooling ;
evaporation is a slow process / boiling is a rapid process ; [max 2]

(d) (**B**) no mark
because particles are closely packed and randomly arranged ; [1]

iGda 15s31

9 **(a)** **(i)** particles gain thermal energy and vibrate faster / more ;
this vibration passes through the metal saucepan ; [2]

(ii) (efficiency =) useful energy output / energy input ; (or working)
= 40 (%) ; [2]

iGda 14w31 Q6

(d) **(i)** evaporation occurs at any temperature / boiling only occurs at the boiling point of a liquid ;
evaporation – only most energetic particles can escape from surface / boiling – all particles have enough energy to escape ; [2]

(ii) (thermal energy transferred / heat) = $mc\Delta T$;
= $32000 \times 450 \times 1500$;
= 2.16×10^{10} J = 2.16×10^{7} kJ ; [3]

iGda 13w31

(b) (energy =) mass × SHC × temp. change ;
= $0.19 \times 1.01 \times 4 = 0.77$ J ; [2]

(c) **(i)** energy required, for work done against forces of attractions / to break the intermolecular
forces / to break the intermolecular bonds ;
energy required for particles to break free from a solid state ;
reference to latent heat of fusion ; [max 1]

(ii) solid – all particles touching, regular arrangement particles of similar size ;
liquid – at least half particles touching, irregular arrangement particles of similar size ; [2]

iGda 12s31 Q1 (b)

(ii) (temperature change =) energy / mass × shc ;
= 300 / 1 × 4200 ;
= 0.07 °C ; [3]

iGda 11w31 Q2

(d) energy = mass × shc × change in temperature ;
= 50 000 × 4 200 × 5 ;
= 1 050 000 000 J ; [3]

iGda 11s31 Q1

(iii) energy = shc × mass × temperature change (or rearranged) ;
mass = 280 kg or 280 000 g ***and*** temperature change = 30 ;
energy = 36 000 000 J **or** 2 × 5 × 60 × 60 ; (allow ecf from **(ii)**)
correct substitution into formula ; (allow ecf)
4286 J / kg °C ; (allow 4290 or 4300) (allow ecf) [max 4]

iGda 09w31

5 **(a)** **(i)** temperature **rise directly** proportional to energy input
or temperature (rise) proportional to energy input ; [1]

(ii) working ;
40 kJ ; [2]

(iii) working 40/2 × 20 ; *ecf from (ii)*
= 1 ; *ecf if 2000 used in calculation*
kJ / kg °C ;
can work in joules throughout – ensure units in answer are appropriate [3]

iGda 08s31 Q5 (b)

(iii) kinetic energy of particles increases/move faster ;
more frequent collisions with tyre walls ; [max 2]

Topic 6

iGda 15s31 q1

(e) The scientists are investigating polar bears which live in the cold Arctic region. Polar bears have black skin covered in thick white fur.

Explain why white fur keeps a polar bear warmer than black fur.

.....

..... [1]

iGda 14w31 Q6

(c) Infra-red waves transfer energy.

Fig. 6.2 shows an experiment.

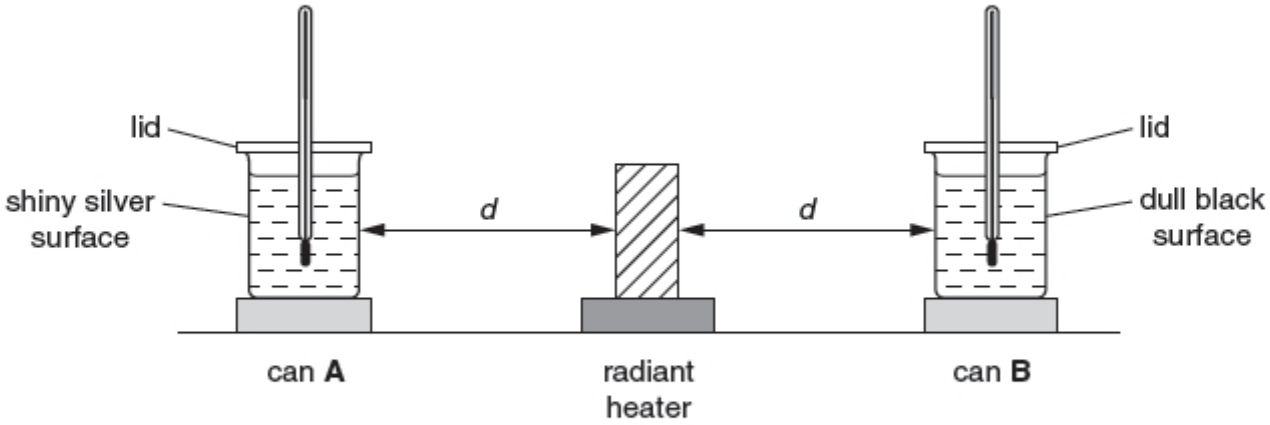

Fig. 6.2

Two similar cans, **A** and **B** contain equal amounts of water which start off at the same temperature.

Can **A** has a shiny silver surface and can **B** has a dull black surface.

A thermometer is placed into each can. The cans stand on cork mats and are placed at the same distance *d* from a radiant heater emitting infra-red radiation.

The temperature of the water is measured every minute for twelve minutes.

Fig. 6.3 shows how the temperature of the water changes for the two cans.

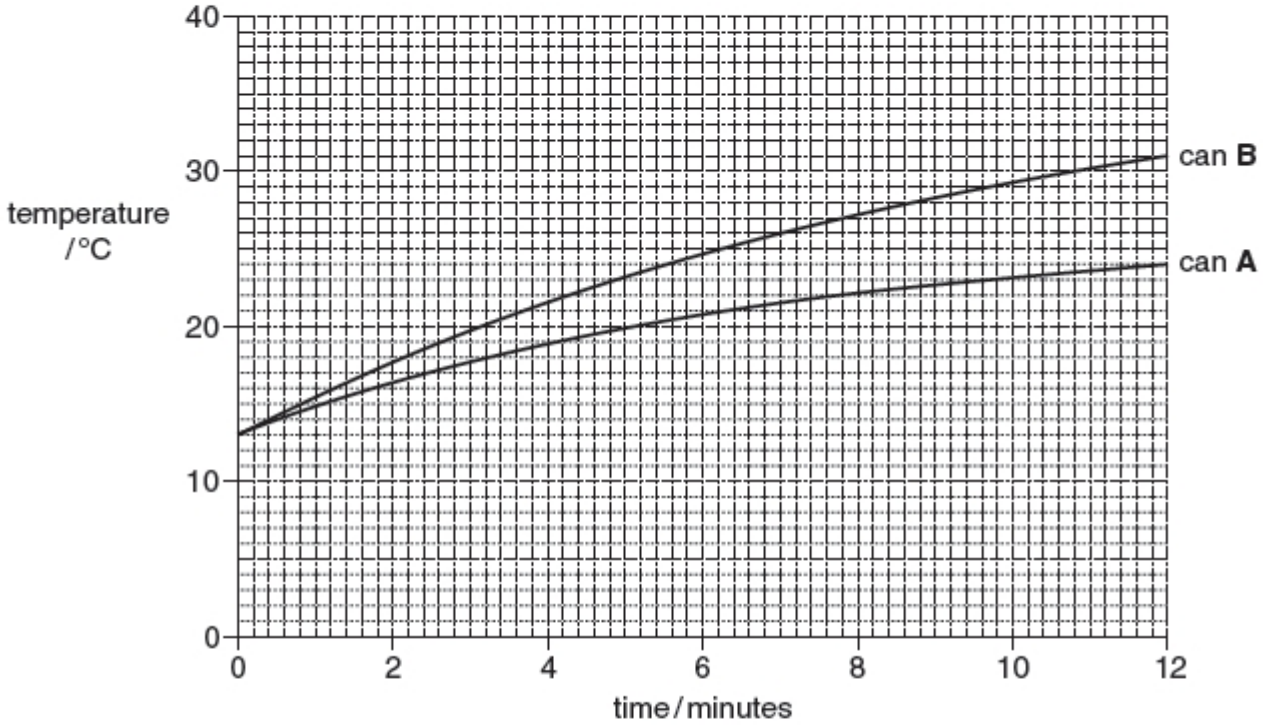

Fig. 6.3

(i) Explain why the two cans

have lids,

.....

are placed on cork mats.

.....

[2]

(ii) Explain why the temperature changes differ for the two cans.

.....

.....[1]

www.SmashingChemistry.com

2 Fig. 2.1 shows the inside of a refrigerator.

The temperature inside the freezing compartment is -20 °C and the temperature in the rest of the refrigerator is +5 °C.

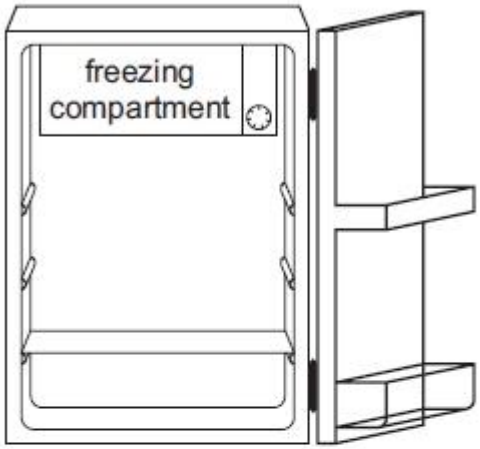

Fig. 2.1

(a) (i) The air in the refrigerator is cooled by convection.

Draw **one** arrow on Fig. 2.1 to show the movement of the air cooled by the freezing compartment. [1]

(ii) Explain this movement in terms of particles and density.

.....

.....

..... [2]

(d) A refrigerator can be warmed up by radiation energy absorbed by the outside surface of the refrigerator. Such absorption needs to be kept as low as possible.

The four refrigerators shown in Fig. 2.2 are identical except for the outside surface.

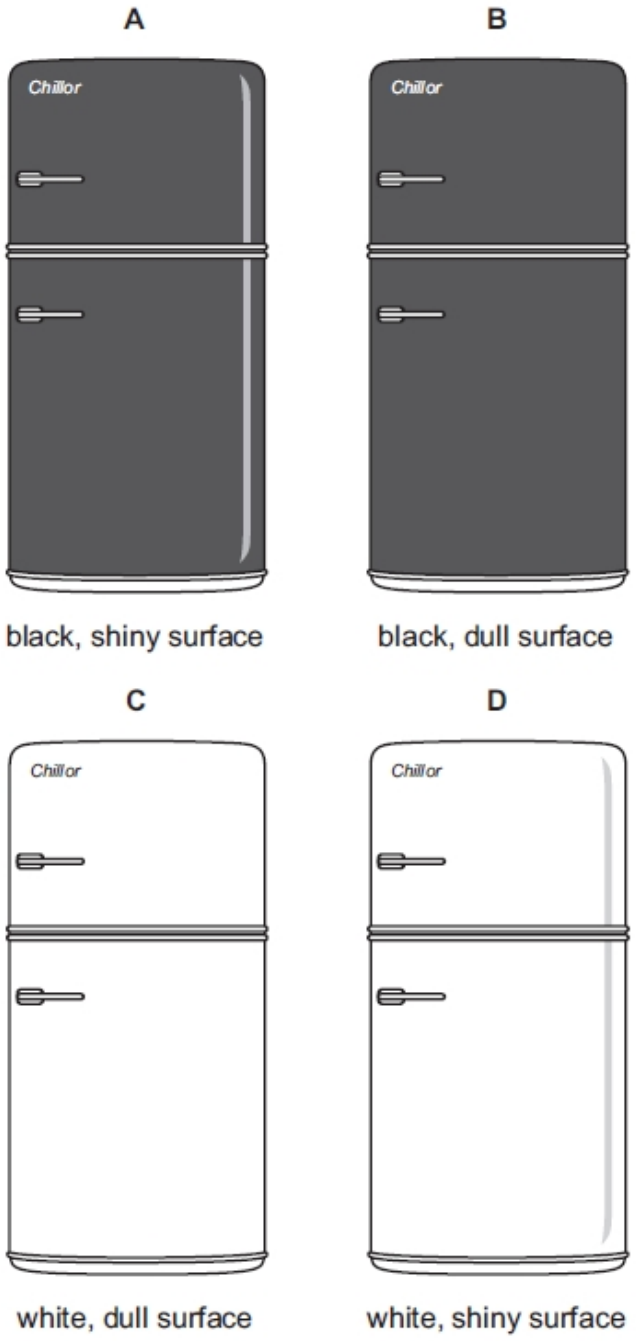

Fig. 2.2

State which refrigerator is most effective at keeping the contents cool.

Explain your answer.

.....

.....

..... [2]

iGda 12w31 Q10

(c) Energy travels to the Earth from the Sun.

State whether this transfer of energy is by conduction, convection or radiation.

Explain your answer.

.....

.....

..... [2]

iGda 11w31

4 **(a)** Fig. 4.1 shows a 230 V 60 W light bulb.

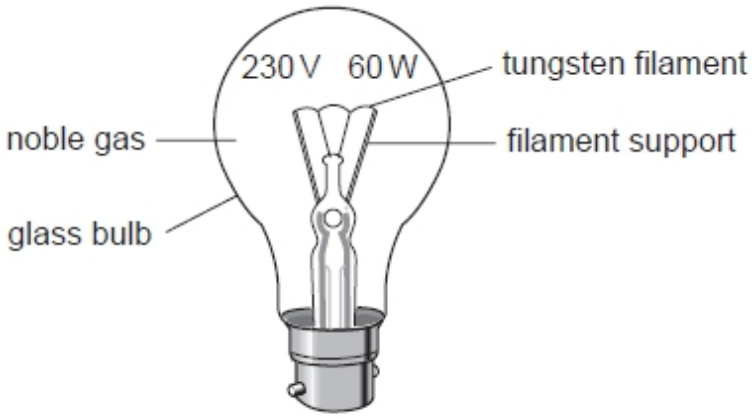

Fig. 4.1

When the light bulb is switched on, the tungsten filament glows white hot at a temperature of 2400 °C.

Explain how thermal energy from the hot tungsten filament is transferred to the rest of the light bulb.

.....

.....

.....

.....

..... [3]

(b) Light bulbs like this are not efficient at converting electrical energy into light energy.

Calculate the percentage efficiency of a 60 W light bulb if 54 W of power is lost from the bulb as heat.

Show your working.

% efficiency = ... [2]

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1 (a) Fig. 1.1 shows a hot water storage tank in a house. The water is heated by an electric immersion heater at the bottom of the tank.

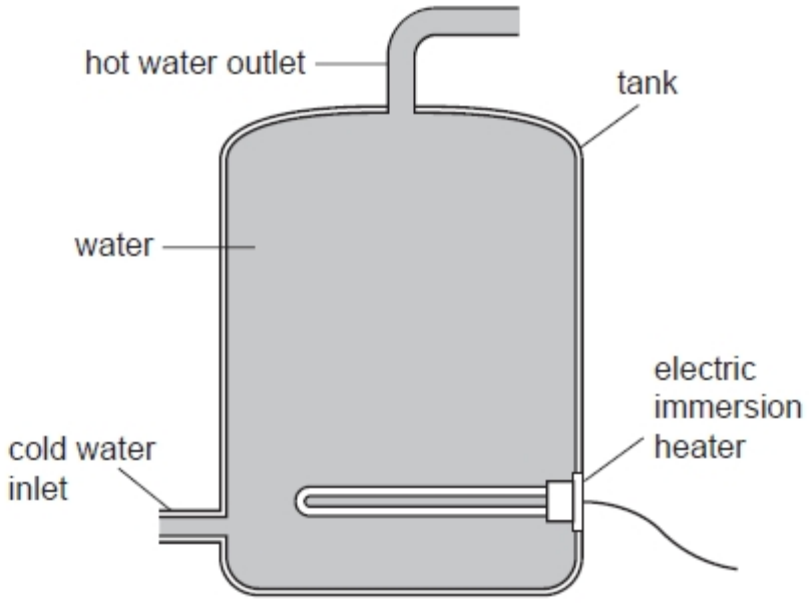

Fig. 1.1

(i) The heater is placed at the bottom of the tank and heats all the water.

Explain why only some of the water would be heated if the heater is placed at the top of the tank.

.....

.....

.....

..... [2]

iGda 10s31

5 (a) Many houses are built with cavity walls with a gap between the outside wall and the inside wall. This gap is often filled with insulating board made of foam between two shiny metal foil surfaces.

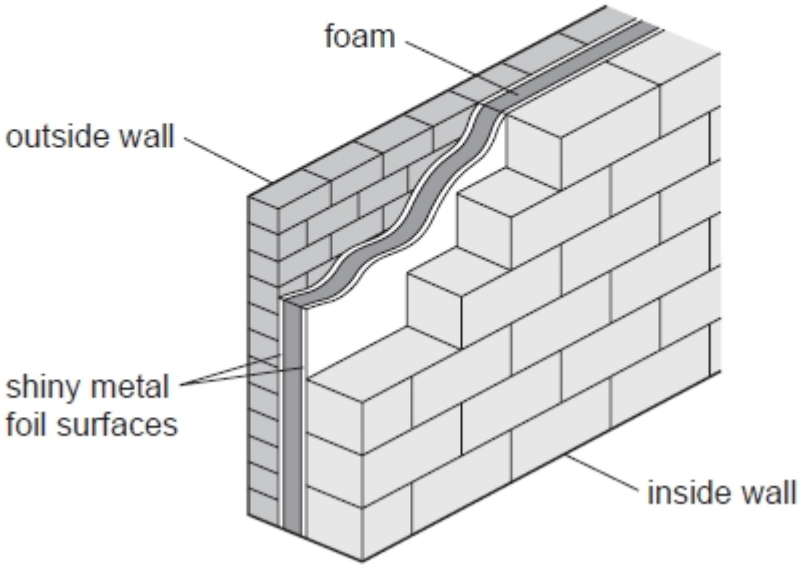

Fig. 5.1

The cavity wall insulation helps to reduce heat transfer, through the wall.

Use the ideas of conduction, convection and radiation to explain how cavity wall insulation helps reduce heat transfer.

.....

.....

.....

.....

..... [3]

iGda 08w31

8 An airline passenger enters an airport.

(a) He buys some hot food at the restaurant and carries it away in a polystyrene container.

Explain why a polystyrene container is used to keep food hot.

.....

..... [1]

Topic 6 MS

iGda 15s31 q1

(e) black surfaces emit more thermal energy/heat energy than white surfaces ; [1]

iGda 14w31 Q6

(c) (i) *lid* – prevent (heat loss) by convection/evaporation ;
cork mat – is an insulator/prevents conduction ; [2]

(ii) can **B** / dull / black surfaces are better absorbers;
OR
can **A** / shiny / silver surfaces are worse absorbers (reflect heat) ; [max 1]

iGda 13w31

2 (a) (i) arrow going downwards ; [1]

(ii) cooler air gas contracts/particles closer together/particles move slower/particles have less kinetic energy/particles are less energetic ;
cold air is denser (therefore moves down) ; [2]

(d) refrigerator **D**/white and shiny refrigerator (no mark)
white/light surfaces are worst absorbers/reflect most radiation ;
shiny surfaces are worst absorbers/reflect most radiation ; [2]

[Total: 10]

iGda 12w31 Q10

(c) radiation ;
(only) radiation can travel through vacuum/conduction and convection need medium ; [2]

iGda 11w31

4 (a) conduction from filament to filament support/gas ;
radiation from filament (to the materials of the lamp) ;
convection of the (noble) gas ; [3]

(b) (60 – 54) ÷ 60 ;
= 10% ; [2]

iGda 11s31

1 (a) (i) hot water rises/cold water sinks/hot water stays on top of cold water ;
ref. to convection ;
hot water less dense/cold water more dense ; [max 2]

iGda 10s31

5 (a) foam/air, is a poor conductor ;
foam, stops convection of air/traps air ;
radiation reflected by, shiny surfaces/foil/metal ; [3]

iGda 08w31

8 (a) (good thermal) insulator / poor conductor ; [1]

Topic 8

iGda 15s31

5 **(a)** Fig. 5.1 shows a torch (flashlight) shining at a plane mirror.

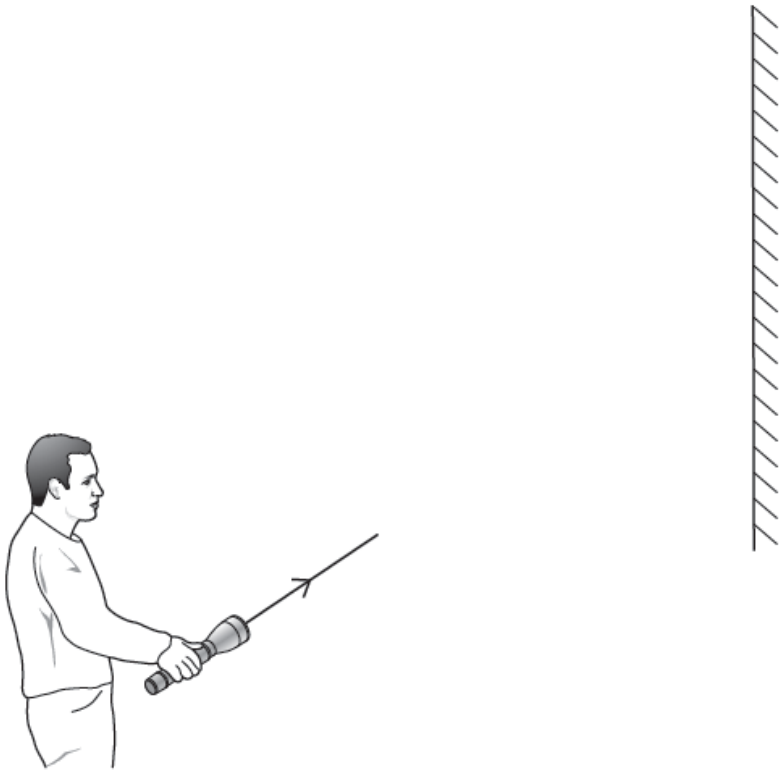

Fig. 5.1

(i) A ray of light reflects off the mirror.

Use a ruler to complete the diagram to show the ray of light reflecting off the mirror. [2]

(ii) Label the angle of incidence on your diagram in Fig. 5.1. [1]

iGda 14w31 Q6

(b) Infra-red waves can pass through optical fibres.

(i) Fig. 6.1 shows a length of optical fibre.

An infra-red ray goes in at one end and emerges at the other end.

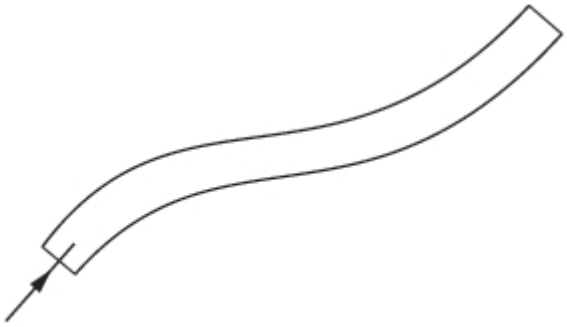

Fig. 6.1

On Fig. 6.1, use a ruler to draw the path of the ray along the optical fibre. [1]

(ii) State **one** use of optical fibres in medicine.

.....[1]

iGda 13w31 Q5

(c) The driver needs to see a vehicle following behind.

Fig. 5.4 shows a ray of light from the vehicle behind reflected into the driver's eye from a rear-view mirror.

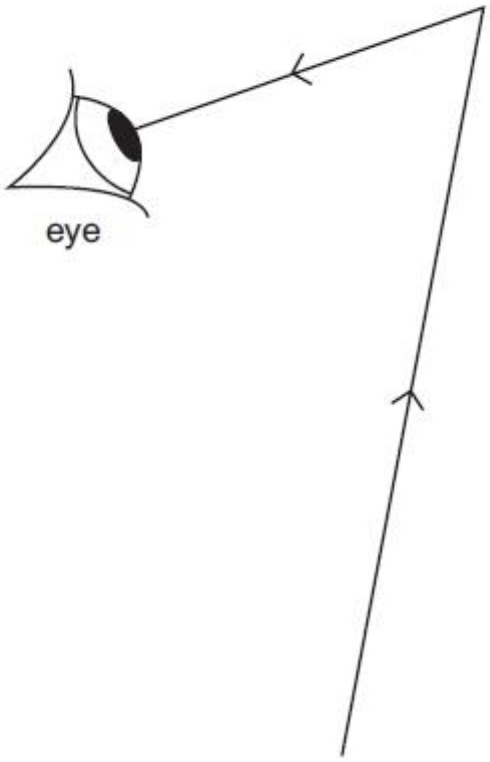

Fig. 5.4

(i) Complete the diagram to show the rear view mirror in its correct position. [2]

(ii) On the diagram, show and mark the angle of incidence with its value. [2]

(d) Sunlight can be focused onto smaller areas of a solar panel to improve efficiency.

Fig. 5.5 shows two parallel rays of sunlight being focused by a lens. The lens has a focal length of 5 cm.

Complete the diagram to show the rays of sunlight being focused by the lens.

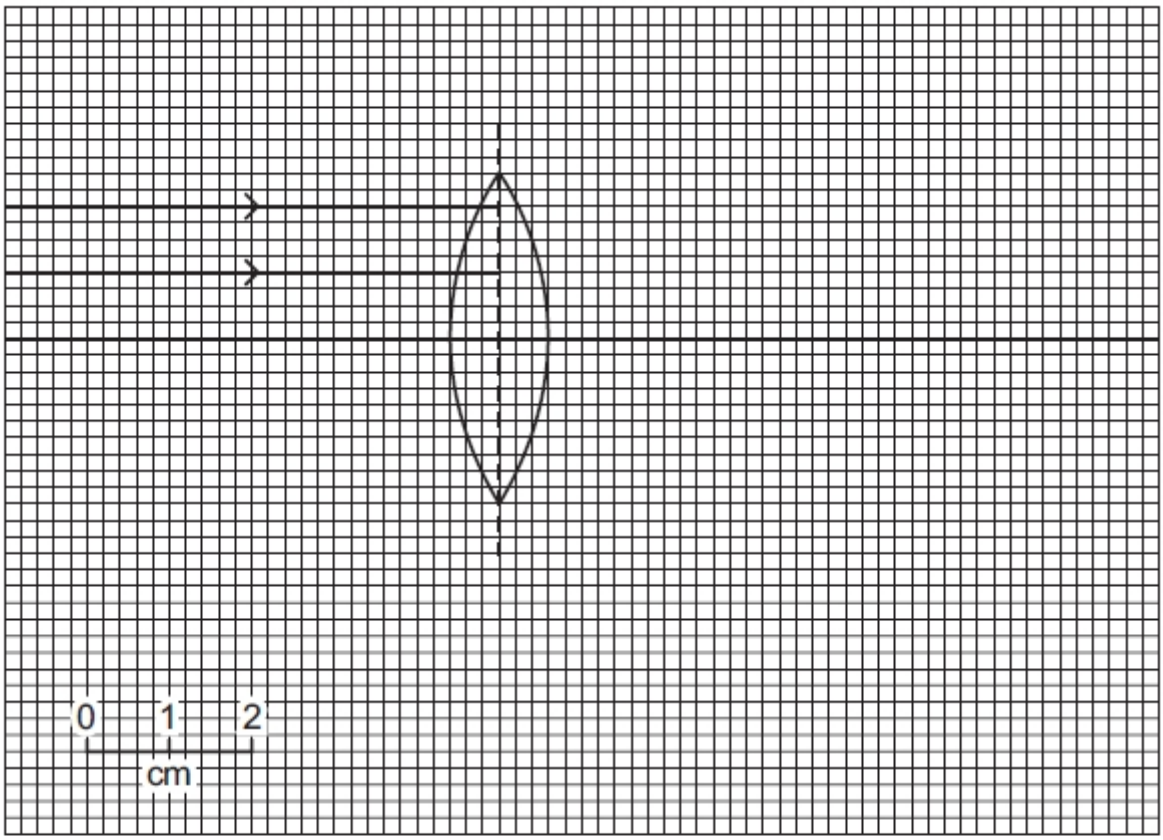

Fig. 5.5

[2]

iGda 13s31

12 (a) Electromagnetic waves are transverse waves.

Draw labelled diagrams to explain the difference between a transverse wave and a longitudinal wave.

[3]

(b) Fig. 12.1 shows a person using a periscope to look over a wall.

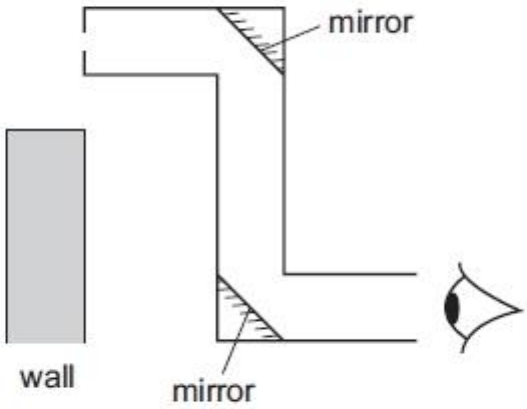

Fig. 12.1

(i) On Fig. 12.1 draw a ray diagram to explain how the person can see over the wall.

[3]

(ii) An image formed in a plane mirror is called a virtual image.

Explain the meaning of the term *virtual image*.

.....

..... [1]

(c) Fig. 12.2 shows a lens being used to observe an object **O**.

The focal length of the lens is 3.0 cm. The diagram is drawn full scale.

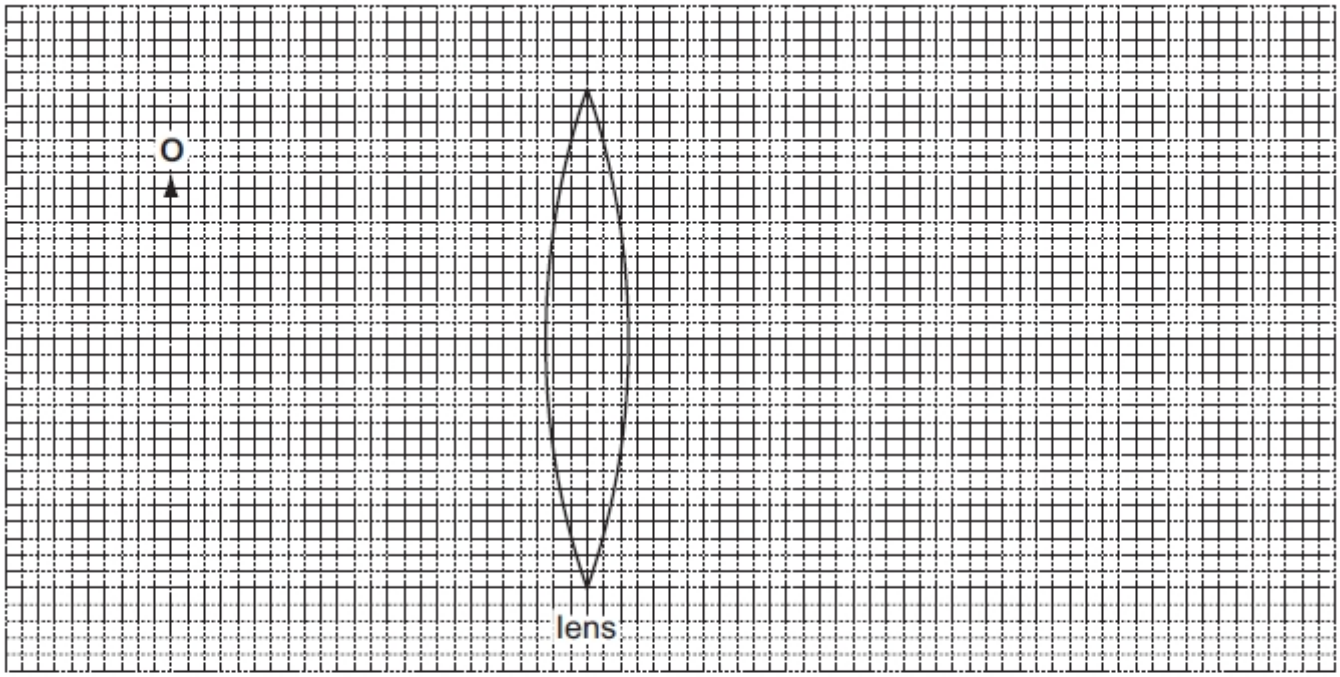

Fig. 12.2

(i) On Fig. 12.2 draw **two** rays from the top of the object **O** that meet at the image.

Label the image **X**. [3]

(ii) Measure the height of the object **O** and the height of the image **X**.

object height ..... image height ..... [1]

(iii) Calculate the magnification.

Show your working.

[2]

(d) Many bush fires are caused by pieces of glass that have been carelessly thrown away.

Fig. 10.1 shows parallel rays of light passing through a piece of glass. The piece of glass acts as a lens and focuses the light on the ground.

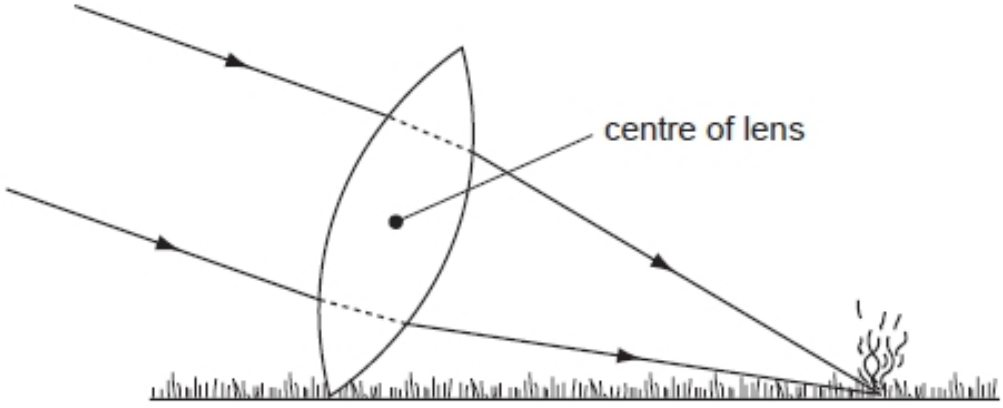

Fig. 10.1

(i) On Fig. 10.1, use the letter **P** to label the principal focus of the piece of glass. [1]

(ii) Measure the focal length of the piece of glass in Fig. 10.1.

..... mm [1]

(iii) The glass acting as a lens produces a real image of the Sun.

Explain what is meant by the term *real image*.

.....

..... [1]

iGda 12s31 Q4

(b) The two incomplete diagrams below show rays of light travelling through a rectangular glass block.

(i) Fig. 4.1 shows a ray of light passing out of a glass block.

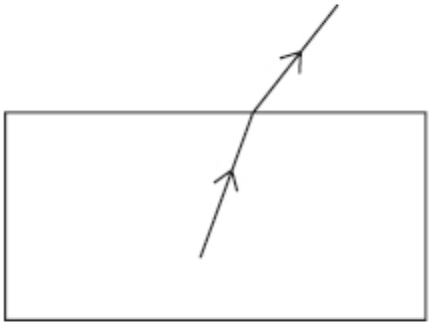

Fig. 4.1

On Fig. 4.1, label the angle of incidence, ***i***, and the angle of refraction, ***r***. [2]

(ii) Fig. 4.2 shows a ray of light that does not pass out of the glass block. This is called total internal reflection.

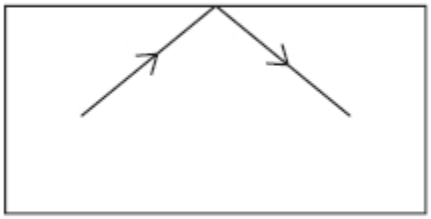

Fig. 4.2

On Fig. 4.2, label the angle of reflection. [1]

(iii) Describe **one** way in which total internal reflection of light is used.

.....

.....

..... [2]

iGda 10s31 Q2

(f) The climber is able to start a fire by focusing rays of sunlight onto some dried twigs and grass, using a lens (magnifying glass).

On Fig. 2.2, draw two rays of light from the Sun entering the lens and being brought to a focus.

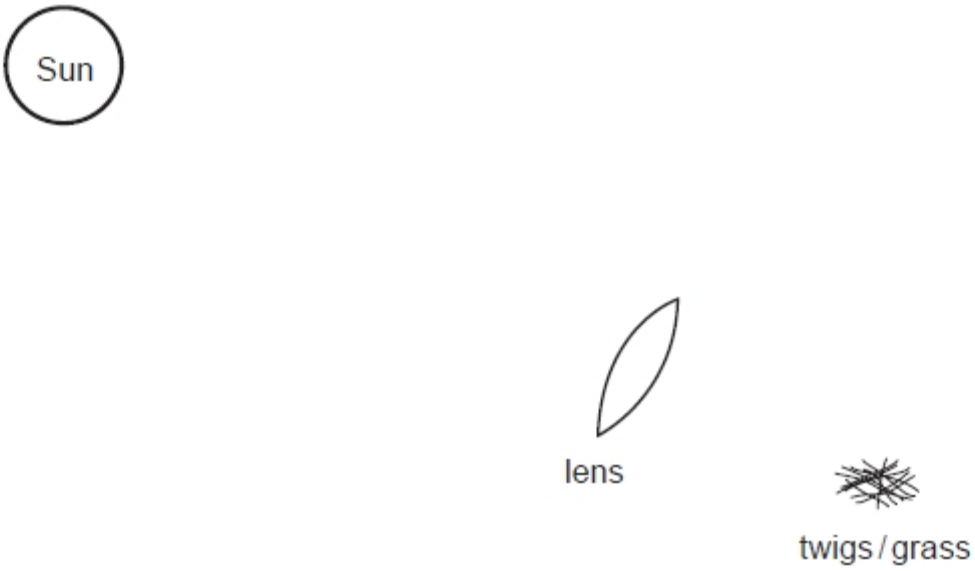

Fig. 2.2

[3]

iGda 08s31 Q9

(c) A man in a boat sees a dolphin under the water. Draw a ray of light on Fig. 9.2 to show how light travels from the dolphin's head to the man's eye.

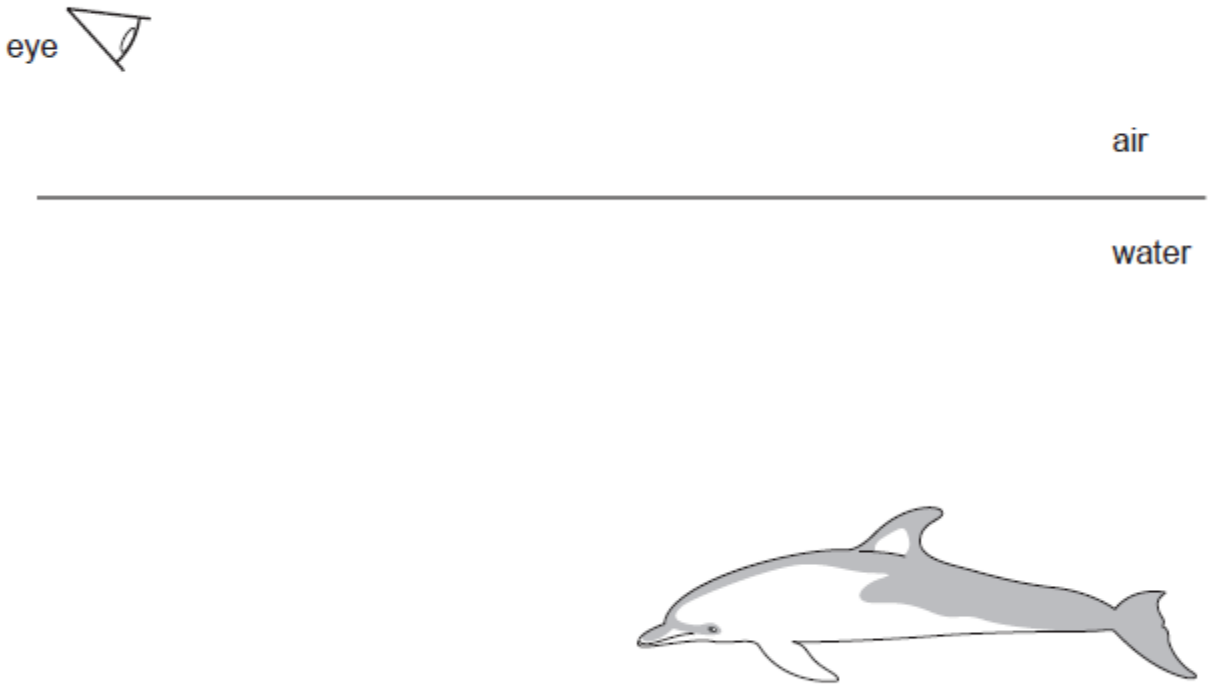

Fig. 9.2

[3]

iGda 15s31

5 (a) (i) ray of light reflecting off mirror ;
at approx. correct angle ; [2]

(ii) angle of incidence correctly labelled ; [1]

iGda 14w31 Q6

(b) (i) reflection shown and angles approximately correct ; [1]

(ii) e.g. (non-surgical) internal investigations/optical fibres passed into/inside body ; [1]

iGda 13w31 Q5

(c) (i) mirror drawn as straight line in correct position ;
at correct angle ; [2]

(ii) normal drawn and angle identified ;
30° ; [2]

(d) parallel rays brought to a focus on principal axis ;
at 5 cm ; [2]

iGda 13s31

12 (a) *transverse* – vibration at right angles to motion ;
electromagnetic waves do not need a medium ;
e.g. vibration ⇳ ~~~~~~ ⇨ direction of wave motion

longitudinal – vibration in direction of motion ;
series of compressions and rarefactions ;
e.g. vibration ⇔ III I I III I ⇨ direction of wave motion [max 3]

(b) (i) accuracy ;
straight lines ;
arrow(s) in right direction ; [3]

(ii) one which cannot be projected on to a screen etc. ; [1]

(c) (i) any two of:
one ray from top of object parallel with principal axis, then through principal focus ;
one ray from top of object through optical centre of lens ;
one ray from top of object through principal focus on object side of lens then parallel with principal axis ; (for 2 marks)
image drawn and labelled in the correct place ; [max 3]

(ii) object height = 2.0 cm, image height = 2.8 to 3.4 cm ; [1]

(iii) magnification = height of image / height of object ;
3.1 / 2.0 = 1.6 ; [2]

[Total: 13]

iGda 12w31

(d) (i) labelled where rays meet ; [1]

(ii) 59 ±1 mm ; [1]

(iii) an image which can be projected onto a screen ; [1]

iGda 12s31 Q4

(b) (i) normal drawn ;
angle of incidence labelled **AND** angle of refraction labelled ; [2]

(ii) angle of reflection drawn and labelled ; [1]

(iii) optical fibres / reflectors / periscopes ;
use described ; [2]

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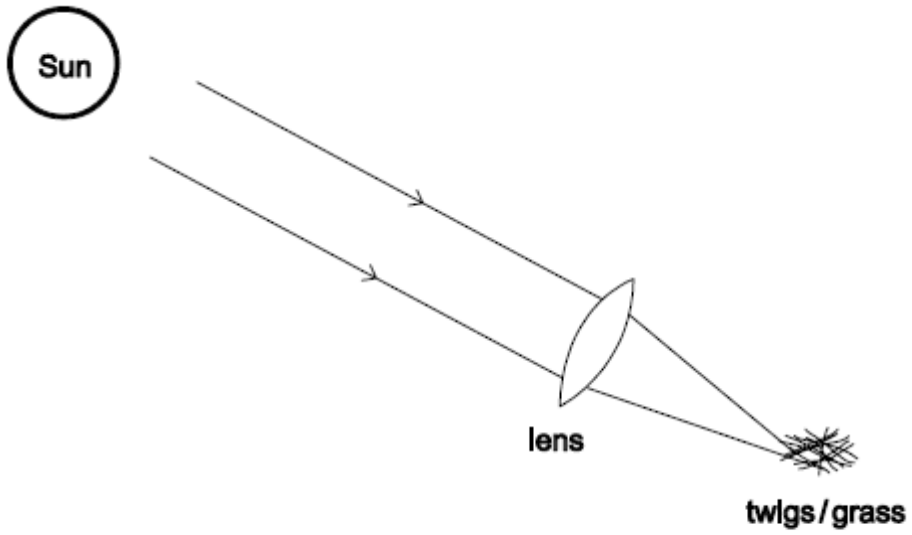
(f) two straight parallel rays drawn entering the lens ;
two straight rays brought to a focus at the twigs / grass ;
arrows correctly shown ; [3]



[Total: 15]

iGda 08s31 Q9

(c) straight lines with arrows ;
bending at surface ;
entering eye ; [3]

Topic 9

iGda 15s31 Q5

(b) Some large torches have two lamps.

These lamps can be connected to the battery in series or in parallel.

(i) Complete the circuit diagrams in Fig. 5.2 to show a series circuit and a parallel circuit for a torch containing two lamps.

Each circuit must contain a switch which switches both lamps on and off at the same time.

Fig. 5.2

[3]

(ii) Each lamp in the torch has a resistance of 5 Ω.

Calculate the combined resistance of two lamps when placed in parallel.

State the formula that you use and show your working.

formula

working

resistance = ... Ω [2]

(b) In the Arctic, harmful ultraviolet radiation is able to reach the surface of the Earth. The scientists at the research station are exposed to this ultraviolet radiation. Ultraviolet radiation is ionising radiation.

(i) State **one** danger to human beings of being exposed to large quantities of ultraviolet radiation.

..... [1]

(ii) Ultraviolet radiation is part of the electromagnetic spectrum.

Name **one** other radiation which is part of the electromagnetic spectrum and state a use for this radiation.

radiation .....

use .....
[1]

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6 (a) Infra-red waves are part of the electromagnetic spectrum.

State **two** properties that are the same for all electromagnetic waves.

1 .....

2 .....[2]

iGda 14s31 Q8

(c) Gamma radiation is one form of ionising radiation. Gamma radiation is part of the electromagnetic spectrum.

State the part of the electromagnetic spectrum which is used for

terrestrial television communications, ...

mobile telephone (cell phone) communications,

.....

television remote control. .....

[1]

iGda 12w31

7 (a) State which type of electromagnetic wave

(i) can be detected by the human eye, ... [1]

(ii) is used in a remote control for a television, ... [1]

(iii) is strongly absorbed by the water in cells. ..... [1]

iGda 11s31

7 (a) Fig. 7.1 shows how radar is used to detect aircraft. Radar uses microwaves with a frequency of about 10000 MHz. Short microwave pulses are sent from the transmitter, reflected from the aircraft and received. The time it takes for the wave pulse to make the journey there and back is measured.

Microwave pulses travel at 300 000 000 m/s.

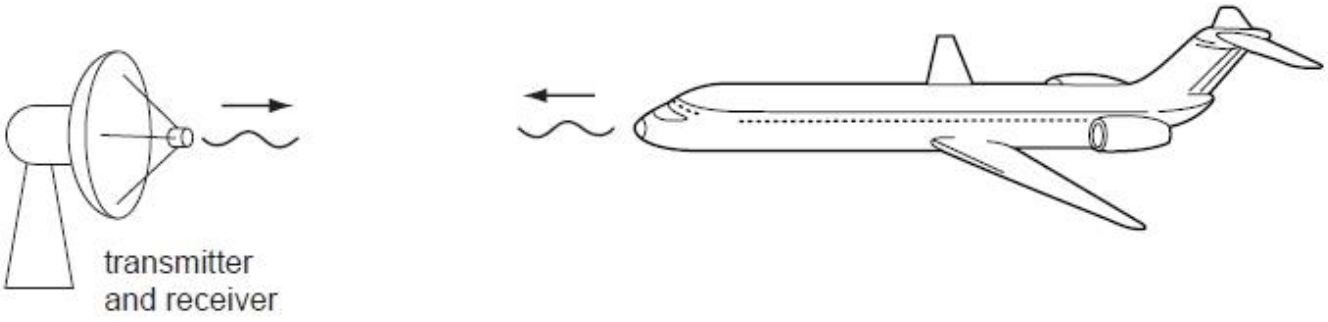

Fig. 7.1

(i) Calculate the wavelength of the microwaves.

State the formula that you use and show your working.

formula used

working

..... [2]

iGda 10s31

2 (a) A climber is exposed to ultraviolet radiation from the Sun. He knows that ultraviolet radiation is harmful.

(i) State how ultraviolet radiation is harmful to humans.

.....

..... [1]

(ii) Describe **one** way in which the climber could protect himself from the ultraviolet radiation.

.....

..... [1]

iGda 08w31 Q8

8 An airline passenger enters an airport.

(d) Radar uses microwaves with a frequency of about 10000 MHz (10^{10} Hz). A short pulse is sent from a transmitter, reflected by an aircraft and picked up by a receiver next to the transmitter.

(i) Explain the meaning of the term *frequency*.

.....

..... [1]

(ii) Microwaves travel at 300000000 m / s ($3x10^{8}$ m / s).
Calculate the wavelength of the microwaves.

State the formula that you use and show your working.

formula

working

..... [2]

Topic 9 MS

iGda 15s31 Q5

(b) (i) correct series circuit ;
correct parallel circuit ;
switch in correct place and all symbols correct ; [3]

(ii) $1/R_T = 1/R_1 + 1/R_2$ (or $R_T = \frac{R_1R_2}{R_1 + R_2}$) / relevant working ;
2.5 (Ω) ; [2]

iGda 15s31 q1

(b) (i) cancer / mutation / damage to DNA / damage to cells / sunburn ; [1]

(ii) radiation and correct use ;
[both required for mark] [1]

iGda 14w31

6 (a) travel at same speed (3×10^8 m / s) ;
travel in a vacuum / ORA ;
transverse waves ; [2 max]

iGda 14s31 Q8

(c) radio waves
micro waves
infrared (all three in order) ; [1]

iGda 12w31

7 (a) (i) visible light ; [1]

(ii) infra-red ; [1]

(iii) microwaves ; [1]

iGda 11s31

7 (a) (i) (λ =) v / f **or** $v = f \times \lambda$;
300 000 000 / 10 000 000 000 = 0.03 m ; [2]

iGda 10s31

2 (a) (i) causes, skin cancer / eye damage / burns / mutation in skin / damage to DNA in skin ; [1]

(ii) protective clothing / sun block ; [1]

iGda 08w31 Q8

(d) (i) number of waves per unit time ; [1]

(ii) velocity = frequency x wavelength /wavelength = velocity/frequency ;
300 000 000/10 000 000 000 = 0.03 m ; [2]

(iii) digital series of pulses / on off *or* analogue has complete range of values ; [1]