SCOTTISH QUALIFICATIONS AUTHORITY

2006 Physics

Standard Grade – General

Finalised Marking Instructions

Physics – Marking Issues

The current in a resistor is 1·5 amperes when the potential difference across it is 7·5 volts. Calculate the resistance of the resistor.

	Answers	**Mark + Comment**	**Issue**
1.	V=IR 7·5=1·5R R=5·0 Ω	(½) (½) (1)	Ideal answer
2.	5·0 Ω	(2) Correct answer	GMI 1
3.	5·0	(1½) Unit missing	GMI 2 (a)
4.	4·0 Ω	(0) No evidence/wrong answer	GMI 1
5.	_____ Ω	(0) No final answer	GMI 1
6.	$R = \frac{V}{I} = \frac{7·5}{1·5} = 4·0\,\Omega$	(1½) Arithmetic error	GMI 7
7.	$R = \frac{V}{I} = 4·0\,\Omega$	(½) Formula only	GMI 4 and 1
8.	$R = \frac{V}{I} =$ _____ Ω	(½) Formula only	GMI 4 and 1
9.	$R = \frac{V}{I} = \frac{7·5}{1·5} =$ _____ Ω	(1) Formula + subs/No final answer	GMI 4 and 1
10.	$R = \frac{V}{I} = \frac{7·5}{1·5} = 4·0$	(1) Formula + substitution	GMI 2 (a) and 7
11.	$R = \frac{V}{I} = \frac{1·5}{7·5} = 5·0\,\Omega$	(½) Formula but wrong substitution	GMI 5
12.	$R = \frac{V}{I} = \frac{75}{1·5} = 5·0\,\Omega$	(½) Formula but wrong substitution	GMI 5
13.	$R = \frac{I}{V} = \frac{7·5}{1·5} = 5·0\,\Omega$	(0) Wrong formula	GMI 5
14.	V = IR 7·5 = 1·5 × R R = 0·2 Ω	(1½) Arithmetic error	GMI 7
15.	V = IR $R = \frac{I}{V} = \frac{1·5}{7·5} = 0·2\,\Omega$	(½) Formula only	GMI 20

DO NOT WRITE IN THIS MARGIN

	K&U	PS

Marks

1. Which part of a television receiver picks up all signals?

A Tuner

B Modulator

C Decoder

D Amplifier

E Aerial

Answer **E** **1**

2. The nucleus of a uranium atom contains

A electrons only

B neutrons only

C electrons and protons only

D protons and neutrons only

E electrons, protons and neutrons.

Answer **D** **1**

3. What is the unit of equivalent dose?

A becquerel

B joule

C kilogram

D sievert

E watt

Answer **D** **1**

NOTES

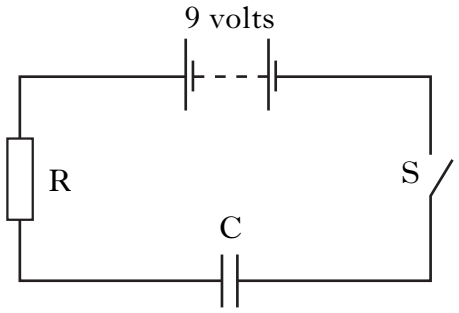
Question Nos. 1,2 and 3

DO NOT WRITE IN THIS MARGIN

	K&U	PS

Marks

4. An uncharged capacitor C is connected to a resistor R, a 9 volt battery and a switch S as shown.



When switch S is closed the voltage across the capacitor

A remains at 0 volt

B gradually rises from 0 volt to 9 volts

C immediately drops from 9 volts to 0 volt

D gradually drops from 9 volts to 0 volt

E remains at 9 volts.

Answer **B** **1**

5. Which of the following is a unit of heat?

A degree celsius

B joule

C joule per kilogram

D joule per kilogram per degree celsius

E watt

Answer **B** **1**

6 Which of the following is the shortest distance?

The distance from the Earth to the

A nearest star in our galaxy

B edge of our galaxy

C Moon

D Sun

E nearest planet.

Answer **C** **1**

NOTES

DO NOT WRITE IN THIS MARGIN

K&U	PS

Marks

7. Radio waves from space can be detected by a

A Geiger-Müller tube

B photographic plate

C scintillation counter

D telescope

E tuner.

Answer **D** **1**

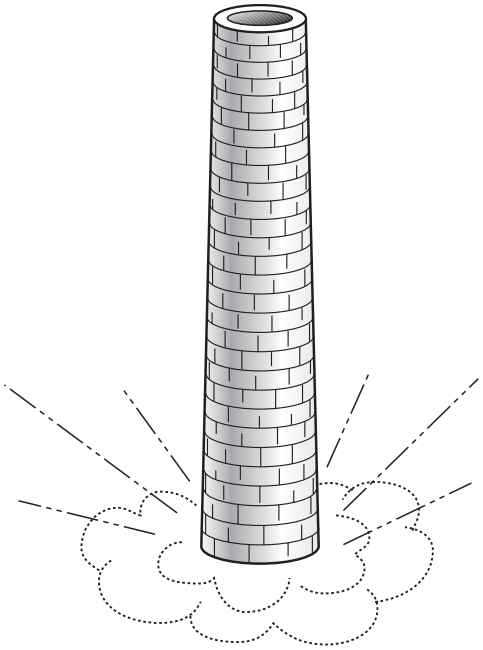
NOTES

DO NOT WRITE IN THIS MARGIN

	K&U	PS

Marks

8. A factory chimney is demolished using explosives.



A crowd of people watches from a safe distance. A person in the crowd hears the sound 2·5 seconds after seeing the explosion.

(*a*) Explain why there is a delay between seeing the explosion and hearing the sound.

Light travels faster (than sound) OR Sound travels slower than light

NOT "Sound travels slower" only **1**

(*b*) Calculate the distance between the chimney and the person in the crowd. (The speed of sound in air is 340 metres per second.)

Space for working and answer

$$\textbf{speed} = \frac{\textbf{distance}}{\textbf{time}} \quad \textbf{(½)}$$

$$\textbf{340} = \frac{\textbf{distance}}{\textbf{2·5}} \quad \textbf{(½)}$$

distance = 850 metres (1)

2

(*c*) Why should the demolition worker who sets off the explosives wear ear protectors to reduce the noise level to below 80 decibels?

(Sound levels) greater than/beyond 80 decibels (1)

can cause damage to hearing (1)

2

NOTES

Accept answers giving values for the speeds eg light speed = 3×10^8 m/s, sound speed = 300 – 350 m/s

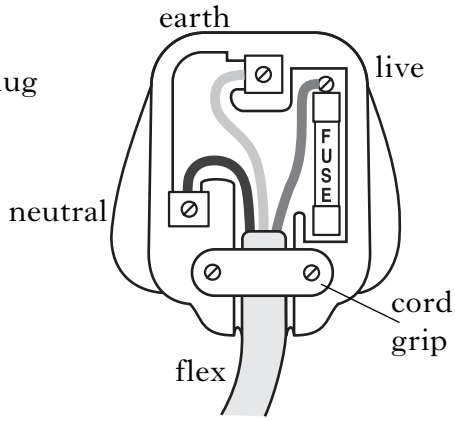
2 statements required **one identifying danger level (80 – 90 dB)**
one indicating that damage to hearing is caused (eg deafness/ear damage)

DO NOT WRITE IN THIS MARGIN

K&U	PS

Marks

9. The flex of a mains appliance has a 3-pin plug fitted as shown.



The flex contains three wires—live, neutral and earth.

(*a*) Circle the correct answer for each of the questions about the wires.

(i) The colour of the insulation around the live wire is

{blue / **brown** / green/yellow} . **1**

(ii) The colour of the insulation around the neutral wire is

{**blue** / brown / green/yellow} . **1**

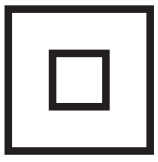
(iii) The {**earth** / live / neutral} wire is a safety device. **1**

(*b*) **Explain** why the flex must be held in place by the cord grip.

To stop the flex being pulled out (from the plug)/stop wires getting loose (1)
This could expose the (live) wire/be dangerous/cause fire

cause a short circuit/cause fault (1) **2**

(*c*) Another appliance has only two wires in its flex. This appliance carries the following symbol.



(i) Name this symbol.

double insulation (symbol) **1**

(ii) Which wire is not needed in this flex?

earth (wire)/green and yellow (wire) **1**

NOTES

2 statements required **one to describe "function" of cord grip**
eg to stop flex being pulled out

one to describe fault result eg short circuit etc

DO NOT WRITE IN THIS MARGIN

K&U	PS

Marks

10. Read the following passage.

The temperature of the human body is maintained at about 37 degrees celsius. An increase or a decrease in body temperature of as little as 5 degrees celsius can be very serious.

Doctors often use ear thermometers to measure body temperature. Ear thermometers measure the infrared radiation emitted from the eardrum and surrounding tissue.

One type of ear thermometer has a scale that ranges from 32 degrees celsius to 42 degrees celsius. The temperature sensor used in this thermometer is a device that has a resistance which changes as the temperature changes.

Use information **given in the passage** to answer the following questions.

(*a*) Name the type of radiation given out by the human body.

infrared (radiation)/IR/heat/thermal **1**

(*b*) Give a reason why the scale of the ear thermometer ranges from 32 degrees celsius to 42 degrees celsius only.

this is the range of human body temperature

OR "a change of 5°C is serious" **1**

(*c*) Suggest a temperature sensor that could be used in the ear thermometer.

(NTC/PTC) thermistor/temperature dependent resistor **1**

NOTES
Not "temperature **Do NOT accept "higher/lower temperatures are serious"** **NOT photodiode/heat dependent resistor**

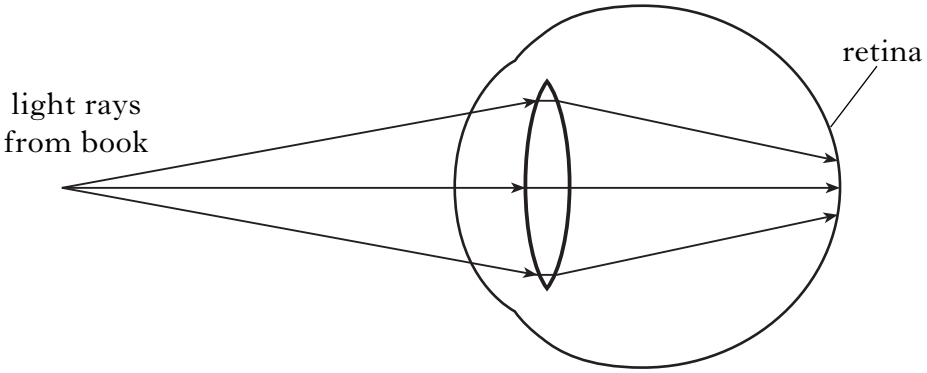
DO NOT WRITE IN THIS MARGIN

K&U	PS

Marks

11. A student has a sight defect and is unable to see near objects clearly.

(*a*) The following diagram shows what happens to light rays when the student is reading a book.



(i) By referring to the diagram, explain why the student sees a blurred image.

the rays are not focused on/brought together

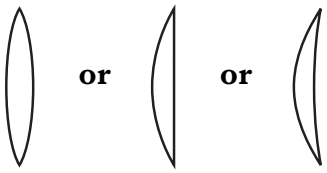
at the retina/back of eye **1**

(ii) Name this sight defect.

long sight **1**

(iii) In the space below, draw the shape of the lens that would correct this sight defect.

Space for diagram



1

(iv) When this sight defect has been corrected, the student looks at a picture printed in the book.

Which statement describes the image on the retina of the student's eye compared to the actual picture?

A The image is the same way up and larger.
B The image is upside down and larger.
C The image is the same way up and smaller.
D The image is upside down and smaller.

Answer **D** **1**

NOTES

Accept **"rays do not come to a point on retina"**
"rays are not meeting/joining at retina"
"rays are focussing/converging behind retina"
"image is formed behind retina"

if the diagram is redrawn, then the lens must be drawn <u>outside</u> the eye

NOT concave lens

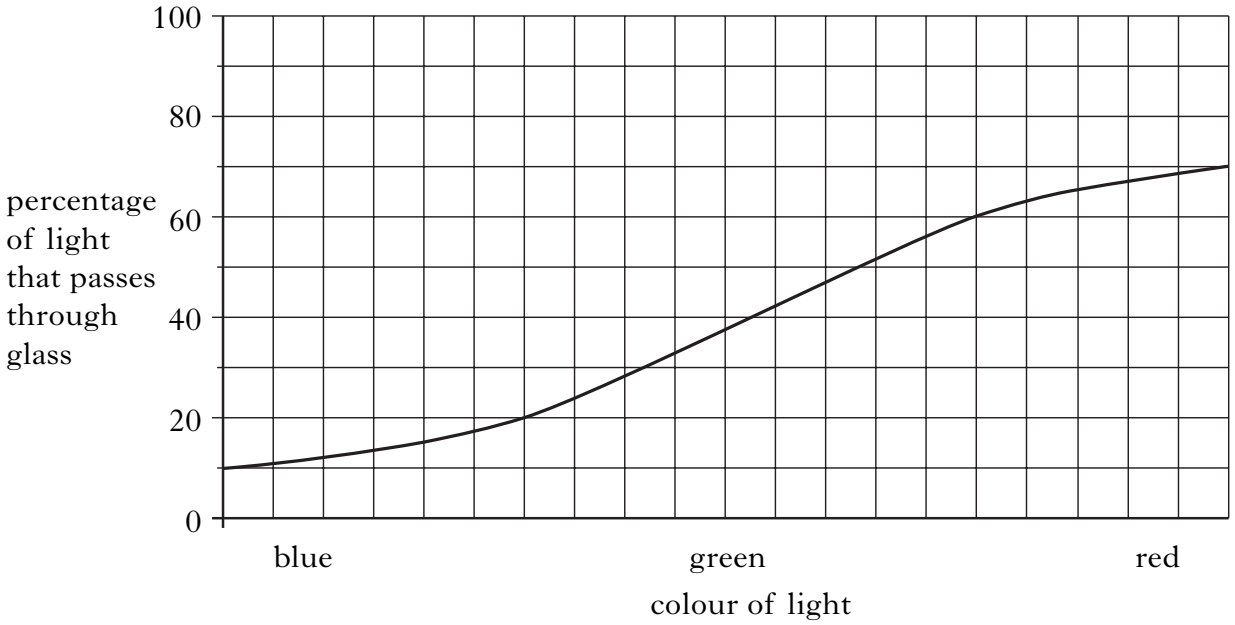
DO NOT WRITE IN THIS MARGIN

	K&U	PS

Marks

11. (continued)

(*b*) Another student has a different eye defect. This student is prescribed spectacles that have red tinted glass. The graph below shows the percentage of light of different colours that passes through this glass.



(i) Which colour of light is blocked most by the tinted glass?

blue **1**

(ii) List the three colours given on the graph in order of **decreasing** wavelength.

red – green – blue (all 3 needed in order) **1**

R G B – OK

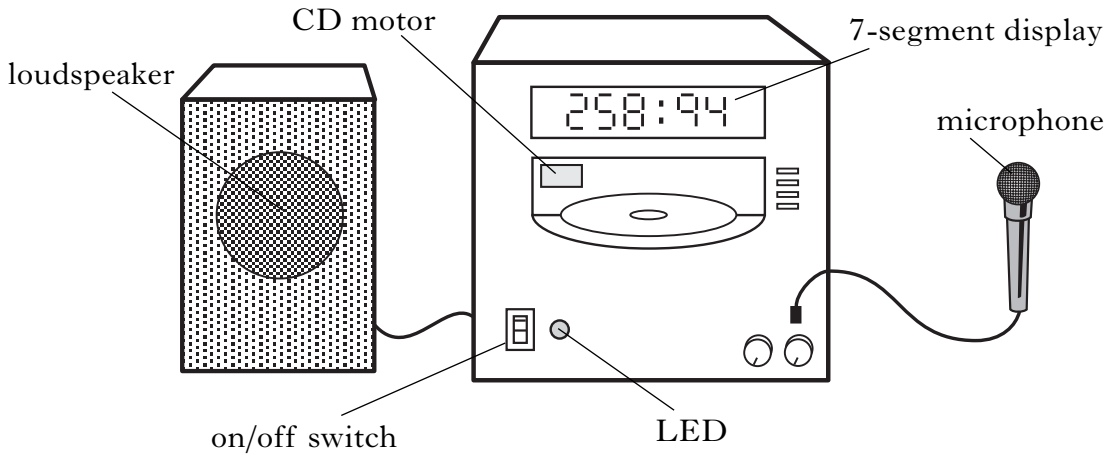
NOTES

DO NOT WRITE IN THIS MARGIN

K&U	PS

Marks

12. A karaoke machine contains various input and output devices.



(*a*) State **two** output devices labelled on the diagram.

Device 1 **2 × (1)**

Device 2 **any 2 from: (loud)speaker/(CD) motor/LED/7-segment display** **2**

(*b*) State **two** input devices labelled on the diagram.

Device 1 **microphone**

Device 2 **(on/off) switch** **2 × (1)** **2**

(*c*) The karaoke machine has an LED.

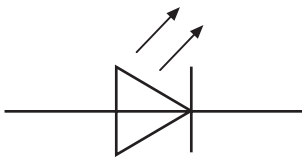
(i) State the useful energy transfer that takes place in the LED.

electrical/electric to **light** **1**

NOT "electricity" **(both needed)**

(ii) In the space below draw the symbol for an LED.

Space for symbol



1

NOTES

if more than 2 given then apply ± rule

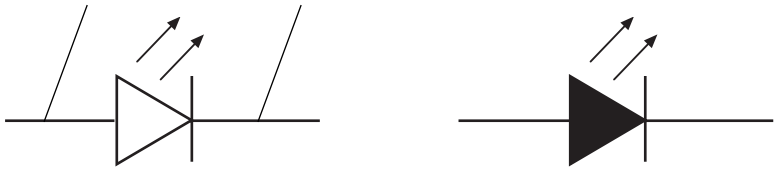
NOT CD

NO (½) marks

Accept: $E_E \rightarrow E_L$

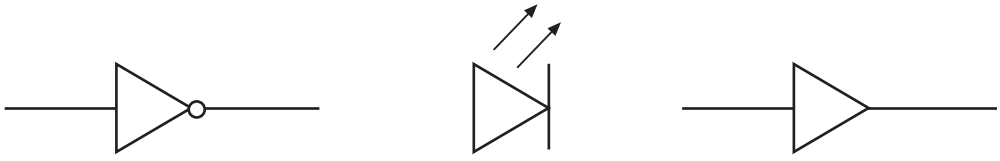
both horizontal lines needed

Accept:



must be 2 arrows only, in outward direction

NOT



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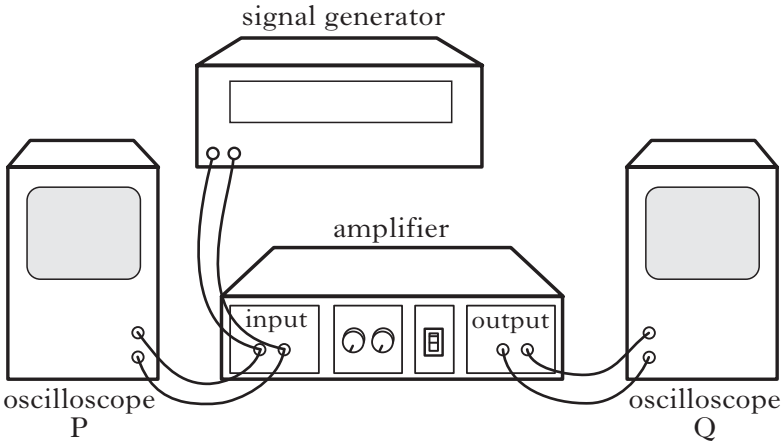
K&U	PS

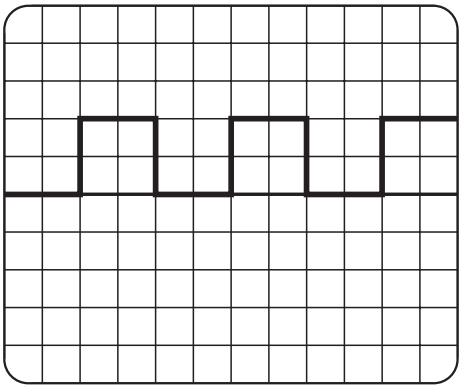
Marks

13. A technician uses a signal generator and two oscilloscopes as shown to test an amplifier.



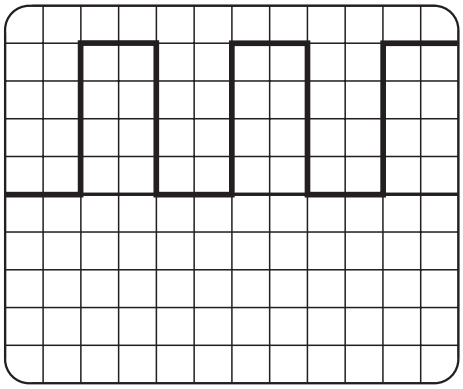
(*a*) The screens of both oscilloscopes are shown below.

input signal to amplifier



oscilloscope P

output signal from amplifier



oscilloscope Q

same frequency (1)

increased amplitude (1)

The settings on both oscilloscopes are identical.

(i) Complete the diagram to show the amplified output signal seen on oscilloscope Q. **2**

(ii) Circle the correct answer in the statement below.

The signal shown on oscilloscope P is { analogue / decimal / (digital) }. **1**

(*b*) Which of the following devices contains an amplifier?

lamp **(radio)** **relay** **transformer**

radio (accept circled or written in) **1**

NOTES

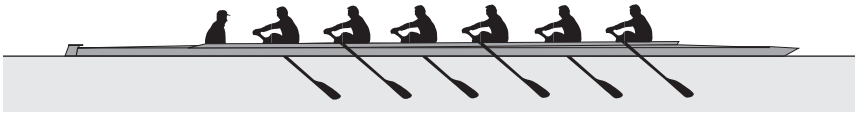
output signal can start below centre line
if an analogue output signal is drawn, then
increased amplitude mark is possible, <u>not</u> frequency mark

DO NOT WRITE IN THIS MARGIN

K&U	PS

Marks

14. A rowing crew takes part in a race.



The time for their boat at each stage of the race is shown.

		Time from start	
		minutes	*seconds*
Start:	0 metres	00	00
	500 metres	01	40
	1000 metres	03	50
	1500 metres	05	50
Finish:	2000 metres	07	45

(*a*) **Describe** how to find the average speed of the boat from the start of the race to the finish.

identify (2000 m) OR measure total distance (1)

identify (7 min 45 s) OR measure total time (1)

average speed = $\frac{\text{total distance}}{\text{total time}}$ (1)

OR average speed = $\frac{2000\,(1)}{7\text{ mins }45\text{ s}\,(1)}$ (1) **3**

(*b*) Calculate the average speed of the boat during the first 500 metres of the race.

Space for working and answer

average speed = $\frac{\text{distance}}{\text{time}}$ (½)

= $\frac{500}{100}$ (½) (1 m 40 s = 100 s)

= 5 metres/second (1)

2

NOTES

if wrong conversion to seconds, treat as unit error (-½)

DO NOT WRITE IN THIS MARGIN

K&U	PS

Marks

14. (continued)

(*c*) The crew supplies a force to move the boat forward. When the boat is moving, a force opposes the motion of the boat.

(i) Name the force that opposes the motion of the boat.

friction/(air) resistance/drag **1**

(ii) During the first 500 metres, there is a constant unbalanced force acting on the boat.

Describe the motion of the boat during this section of the race.

(constant) acceleration **1**

(iii) During one stage of the race, the speed of the boat is constant.

What can be said about the forces acting on the boat during this stage?

(the forces are) balanced **1**

NOTES

NOT: water, air, wind by themselves–must have resistance

Accept: "speeding up", "getting faster", "increasing speed"
NOT: "slowing down"

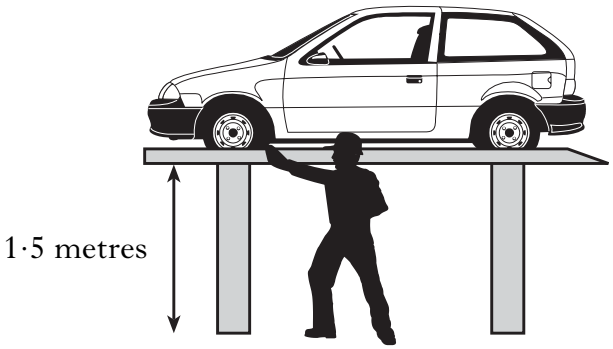
Do NOT Accept: "same, "equal", "equal on both sides"
– must state <u>full</u> explanation eg "equal and opposite"

DO NOT WRITE IN THIS MARGIN

K&U	PS

Marks

15. A car is being repaired in a garage. The car is on a ramp and is raised to a height of 1·5 metres.



The car has a mass of 1200 kilograms.

(*a*) Calculate the weight of the car.

Space for working and answer

W = mg (½)

= 1200 × 10 (½)

= 12 000 newtons (1)

2

(*b*) Calculate how much gravitational potential energy the car has gained when it is 1·5 metres above the garage floor.

Space for working and answer

E_P = mgh (½)

= 1200 × 10 × 1·5 (½)

= 18 000 joules (1)

2

(*c*) The car is raised in 12 seconds.

(i) Calculate the minimum power needed to lift the car 1·5 metres in 12 seconds.

Space for working and answer

$$\mathbf{P = \frac{E}{t}} \quad \textbf{(½)}$$

$$\mathbf{= \frac{18000}{12}} \quad \textbf{(½)}$$

= 1500 watts (1)

2

(ii) In practice, the power needed to raise the car in this time is greater than the minimum power.

Explain why.

energy is needed to overcome friction

OR energy is needed to lift the "dead weight"/machinery

1

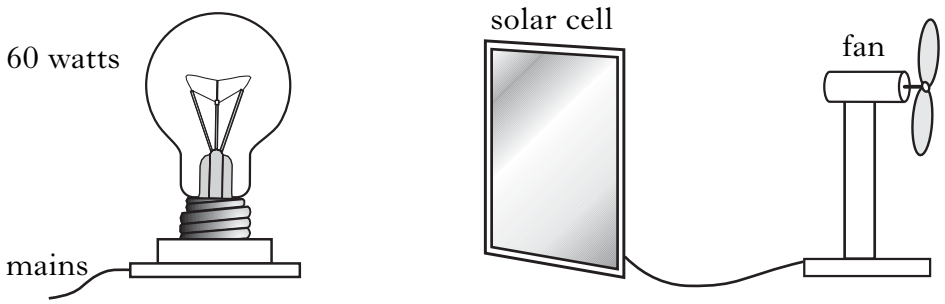
NOTES
Accept answers using **g = 9·8 (11 760 N)** **g = 9·81 (11 772 N)** **Accept answers using** **g = 9·8 (17 640 J)** **g = 9·81 (17 658 J)** **Accept answers using** **g = 9·8 (1470 W)** **g = 9·81 (1471·5 W)** **Accept:** **"energy lost due to friction/resistance", "energy lost due to heat loss"** **"to initially accelerate the ramp"** **Do not accept:** **"energy lost due to sound",** **"because not efficient"**

DO NOT WRITE IN THIS MARGIN

K&U	PS

Marks

16. A fan operates using a solar cell and a light bulb.



(*a*) What energy transformation takes place in the **solar cell**?

light ..... to ..... **electrical** **(both needed)** **1**

(*b*) When the lamp is on, the fan turns slowly.

(i) Suggest **two** changes that could be made which would make the fan turn faster.

any 2 from:
Change 1 ..... **decreased distance from lamp to solar cell/larger/bigger area solar cell/solar cell square on to lamp/ greater**

Change 2 ..... **power rating of lamp** **2**

(ii) The 60 watt lamp operates for 2 minutes.

Calculate how much energy is transformed by the lamp in this time.

Space for working and answer

E = Pt **(½)**
= 60 × 2 × 60 **(½)**
= 7200 joules **(1)**

2

(*c*) Solar energy is a renewable source of energy.

(i) Name **one** other renewable source of energy.

one from: tidal/wave/biomass/other suitable **1**

(ii) Name a non-renewable source of energy.

one from: coal/oil/gas/peat/nuclear **1**

NOTES

Accept: $E_L \rightarrow E_E$ **NOT: heat → electrical**
solar → electrical

Accept: **higher/bigger Wattage or Power, more solar cells, brighter lamp or quote value, mirror behind lamp, tilt solar cell towards lamp**

NOT: **increase voltage, more lamps**

if wrong conversion into seconds treat as unit error (-½)

Accept: **hydro, geothermal, wind, wood, biodiesel**

NOT: **water, windmill, turbines**

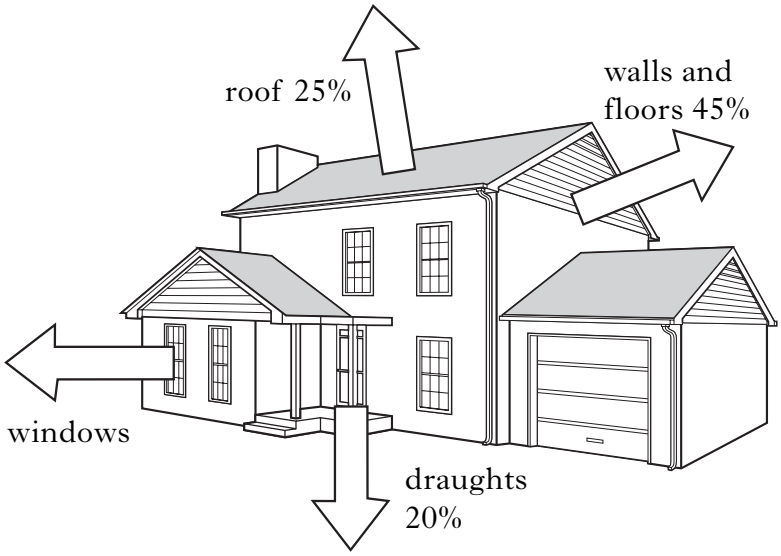
Accept: **fossil fuel**

DO NOT WRITE IN THIS MARGIN

K&U	PS

Marks

17. The diagram shows all the ways in which heat is lost from a house.



(*a*) Using information from the diagram, calculate the percentage of heat lost through windows.

Space for working and answer

heat loss through roof and walls/floors/draughts
= 25 + 45 + 20 (1)
= 90(%)
∴ heat loss through windows = 100 – 90 = 10(%) (1)

2

(*b*) Various windows of area one square metre are tested for rate of heat loss. The results are shown in the table.

Window	*Rate of heat loss* (joules per second)
single glazed	80
double glazed	60
triple glazed	50

(i) How many joules of heat are lost per square metre from a single glazed window every second?

80 (J)
..... **1**

NOTES

*Question Nos. 17(*a*) and (*b*)(i)*

DO NOT WRITE IN THIS MARGIN

K&U	PS

Marks

17. (*b*) (continued)

(ii) All the windows in a particular house are single glazed. Every second a total of 500 joules of heat is lost through the windows in this house.

(A) Calculate the total area of the windows.

Space for working and answer

Total area = $\frac{\text{total heat loss}}{\text{heat loss per square metre}}$ (½)

= $\frac{500}{80}$ (½)

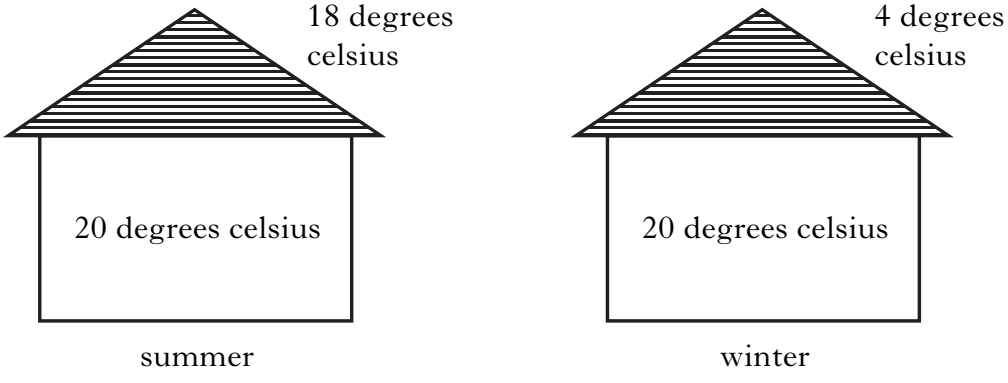
= 6·25 metres squared/m^2 (1)

2

(B) Describe **one** way of reducing heat loss through the windows in this house.

any one suitable: double glazing/curtains/ triple glazing/ blinds/shutters/draught excluders/close window **1**

(*c*) A householder keeps the temperature in a house at 20 degrees celsius all year.



At which time of the year is the rate of heat loss from this house greater?

Explain your answer.

in winter (1)

because the temperature difference is greater (1)

2

NOTES
if 80 not used then wrong substitution **Accept 6·3 metres squared** **INDEPENDENT MARKS** **can show calculated results eg temperature difference in summer is 2 °C** **and temperature difference in winter is 16 °C** **Do not accept "heat difference"**

DO NOT WRITE IN THIS MARGIN

K&U	PS

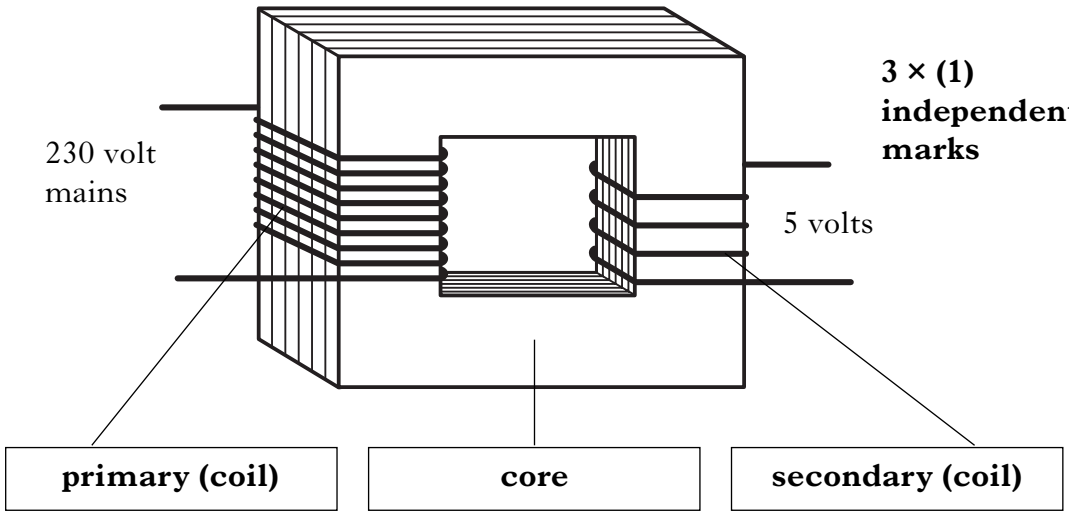
Marks

18. A 5 volt battery in a mobile phone is recharged from the mains using a charger containing a step down transformer.

(*a*) The transformer consists of three parts.

core **primary coil** **secondary coil**

Label each of these parts on the diagram below.



3 × (1) independent marks

3

(*b*) There are 11 500 turns on the primary coil of the transformer.

Calculate the number of turns on the secondary coil.

Space for working and answer

$$\frac{n_S}{n_P} = \frac{V_S}{V_P} \quad (½)$$

$$\frac{n_S}{11\ 500} = \frac{5}{230} \quad (½)$$

n_S = 250 (1) no unit but deduct (½) if wrong unit

2

(*c*) **Explain** why a transformer cannot be used to step down the voltage from a battery.

transformers only operate on a.c. (1)

battery supplies d.c. (1)

2

NOTES

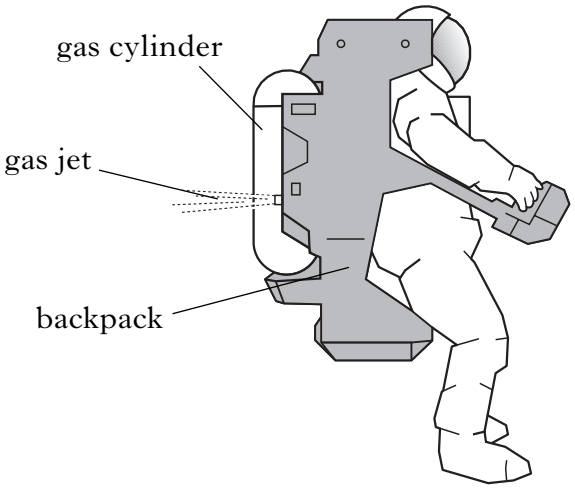
if $\frac{V_S}{V_P}$ calculated as intermediate step and rounded up, then 230 turns is answer

DO NOT WRITE IN THIS MARGIN

K&U	PS

Marks

19. A spacecraft is far out in space. An astronaut wearing a backpack leaves the spacecraft. The astronaut uses the backpack to move around. The backpack contains a pressurised gas cylinder connected to a valve. When the valve is opened, a jet of gas is released.



(*a*) Complete the passage below by circling the correct answer.

When the astronaut opens the valve, the cylinder pushes gas backwards.

The gas pushes the { **(cylinder)** / jet / spacecraft } forwards. **1**

(*b*) The astronaut and backpack have a combined mass of 120 kilograms. The jet of gas exerts a constant thrust of 24 newtons.

(i) Calculate the acceleration of the astronaut when the jet is switched on.

Space for working and answer

F = ma (½)
24 = 120 a

a = 0·2 m/s² (1)

2

(ii) The jet is now switched off.
Describe the motion of the astronaut.

Explain your answer.

constant speed in a straight line/constant velocity (1)

because there is no unbalanced force (1)

OR forces are balanced **2**

[*END OF MARKING INSTRUCTIONS*]

NOTES

must have "in a straight line" or "in the same direction"
Accept: "no forces acting"
NOT: because of inertia, motion is continuous