SCOTTISH QUALIFICATIONS AUTHORITY

2005 Physics

Intermediate 1

Finalised Marking Instructions

These Marking Instructions have been prepared by Examination Teams for use by SQA Appointed Markers when marking External Course Assessments.

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 x 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

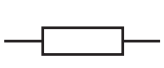
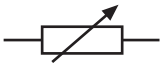
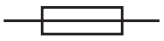
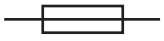
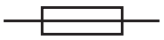
Marks

1. Which row gives the correct colours of the insulation on the three wires in a mains flex?

	blue	*green/yellow*	*brown*
A	live	neutral	earth
B	earth	live	neutral
C	neutral	live	earth
D	earth	neutral	live
E	neutral	earth	live

Answer **E** **1**

2. Which row shows the correct symbols for both components?

	variable resistor	*fuse*
A		
B		
C		
D		
E		

Answer **E** **1**

3. Which list contains input devices only?

A LDR, switch, buzzer
B LED, switch, thermistor
C LDR, thermistor, microphone
D LED, loudspeaker, lamp
E Motor, switch, thermistor

Answer **C** **1**

DO NOT WRITE IN THIS MARGIN

Marks

4. An AND gate has two inputs X and Y and one output Z.

Which row gives possible logic levels for this gate?

	Input X	*Input Y*	*Output Z*
A	0	0	1
B	1	0	0
C	1	1	0
D	1	0	1
E	0	1	1

Answer **B** **1**

5. The resistance of an LDR increases as

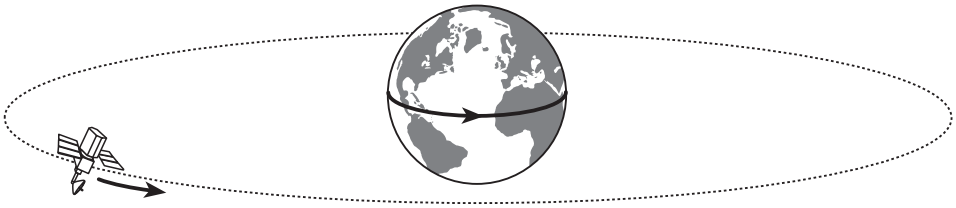
A the temperature increases
B the light level increases
C the temperature decreases
D the light level decreases
E the sound level increases.

Answer **D** **1**

DO NOT WRITE IN THIS MARGIN

Marks

6. The diagram shows a satellite orbiting the Earth. The Earth turns once in 24 hours. The satellite stays above the same point on the Earth's surface.



(*a*) What name is given to this type of satellite?

geostationary

1

(*b*) What is the time taken by this type of satellite to complete one orbit around the Earth?

24 hours OR 1 day

1

(*c*) What type of aerial is needed to receive a strong television signal from this satellite?

curved reflector (aerial)
OR
dish (aerial)
OR
sketch

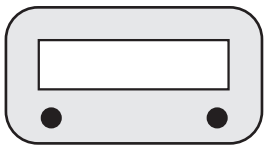
1

DO NOT WRITE IN THIS MARGIN

Marks

7. A village fire-fighting crew is formed by local volunteers. In an emergency they have to get to the fire station quickly.

(*a*) Some firefighters receive the call out message by pager. A pager receives text messages in the same way as a mobile phone.



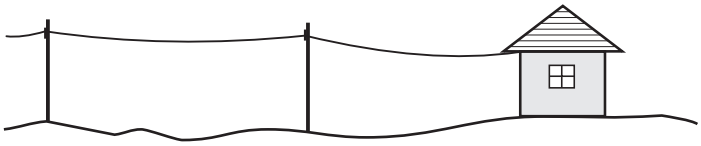
(i) What type of signal carries the message to the pager?

radio (signal) OR microwaves **1**

(ii) What is the speed of this signal?

300 000 000 metres per second (Note: $\frac{1}{2}$ unit deduction) **1**

(*b*) Some firefighters receive the call out message at home by telephones connected by metal wires.



(i) What type of signal travels in the wires?

electrical (signal) **1**

(ii) What is the speed of this signal?

(nearly) 300 000 000 metres per second
(Note: $\frac{1}{2}$ unit deduction) **1**

Marks

7. (continued)

(*c*) One firefighter is working in the open air at a distance of 830 metres from the fire station. He hears the sound from a siren which is on the roof of the fire station. The sound takes a time of 2·5 seconds to travel from the fire station to the firefighter.

Calculate the speed of the sound from the siren.

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

= $\frac{830}{2{\cdot}5}$ (½)

= 332 metres per second (1)

2

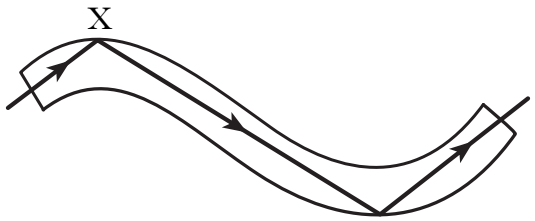
(*d*) The fire station receives the emergency signal along an optical fibre link.

(i) What type of signal travels in the optical fibre link?

light (signal)

1

(ii) The diagram shows part of the optical fibre. State what happens to the signal at point X on the diagram.



total internal (½) reflection (½)

1

(iii) What is the speed of the signal in the optical fibre?

(nearly) 200 000 000 metres per second

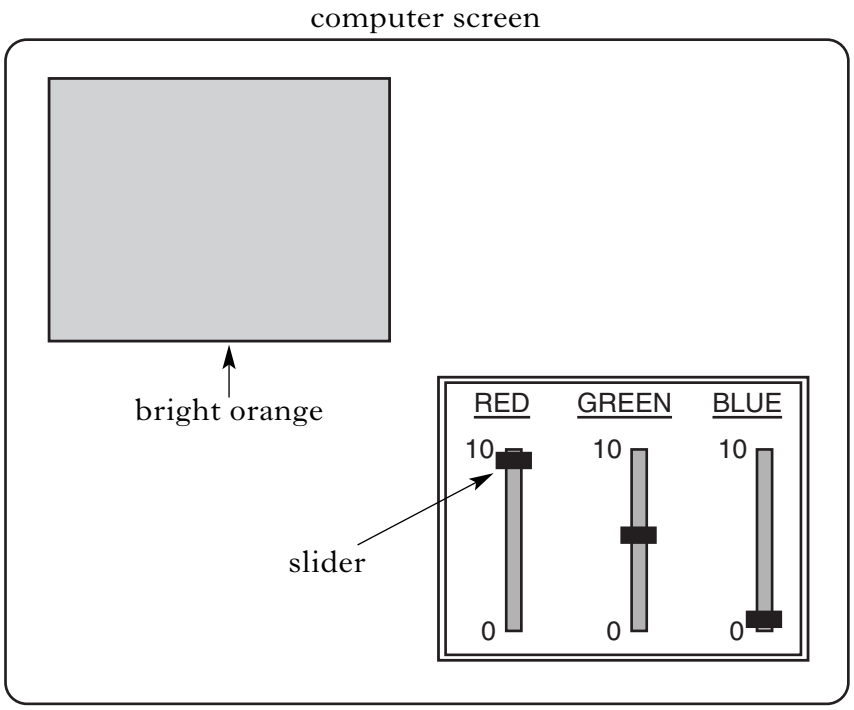
(Note: $\frac{1}{2}$ unit deduction)

1

Marks

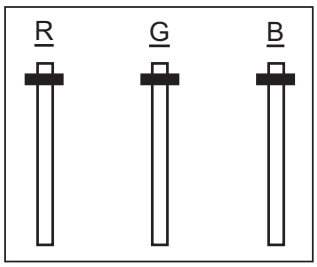
8. (*a*) A computer program can produce any colour by mixing different levels of red, green and blue light on the screen. Three sliders change the brightness of each of these colours on a scale of 0 to 10.

The settings shown here produce a bright orange colour.



On each of the diagrams below, mark the three slider positions to produce the following.

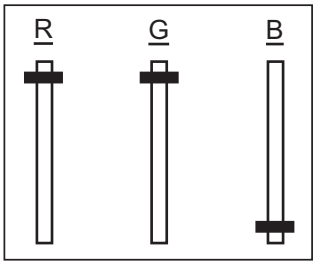
(i) Bright White



all three sliders within top quarter of their range.

1

(ii) Bright Yellow



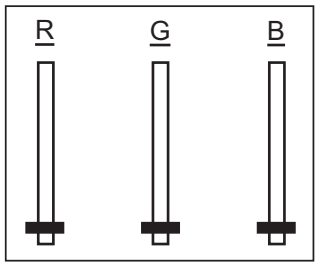
red and green sliders within top quarter of their range and blue slider within bottom quarter of its range.

1

Marks

8. (*a*) (continued)

(iii) Black

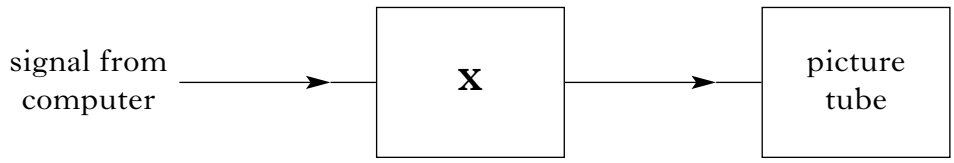


all three sliders within bottom quarter of their range.

1

(*b*) A computer monitor contains a picture tube which is similar to one in a television set. The computer sends a signal to the monitor.

(i) The diagram below shows the monitor system. Part X is not named.



Which of the following is part X? **Circle your answer**.

aerial **amplifier** **tuner** **loudspeaker** **1**

- -

(ii) What is the purpose of part X?

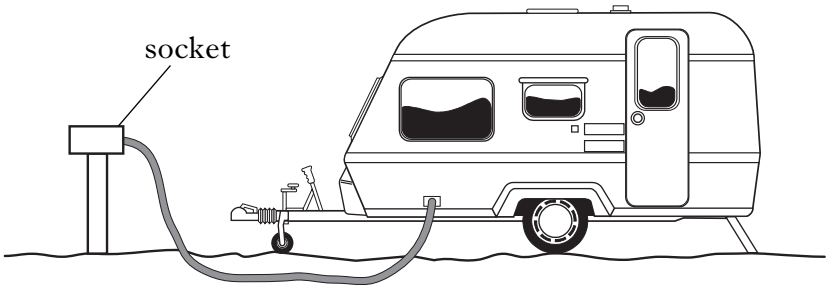
to increase strength
OR
energy
OR
amplitude of signal

1

[Turn over

Marks

9. A caravan is connected to a mains electrical socket at a campsite.



(*a*) The campsite socket is fitted with a circuit breaker which has the following label attached.

230 volts 50 hertz a.c.
Maximum current 10 amperes
If circuit breaker operates, contact campsite reception.

What is the purpose of the circuit breaker?

to cut out OR trip OR disconnect circuit (1)
if current is too high OR if there is an overload (1)

2

(*b*) The caravan contains the following 230 volt mains electrical appliances.

920 watt water heater	230 watt television
115 watt fridge	1840 watt fan heater

(i) State whether these appliances are connected in series or in parallel.

parallel

Explain your answer.

all have 230 V OR independent control OR independent failure

2

DO NOT WRITE IN THIS MARGIN

Marks

9. (*b*) (continued)

(ii) Show by calculation that the operating current in the water heater is 4 amperes.

$$\text{current} = \frac{\text{power}}{\text{voltage}} \quad (\tfrac{1}{2})$$

$$= \frac{920}{230} \quad (1)$$

$$= 4 \text{ (amperes)} \quad (\tfrac{1}{2})$$

2

(iii) Calculate the resistance of the water heater.

$$\text{resistance} = \frac{\text{voltage}}{\text{current}} \quad (\tfrac{1}{2})$$

$$= \frac{230}{4} \quad (\tfrac{1}{2})$$

$$= 57{\cdot}5 \text{ ohms} \quad (1)$$

2

(iv) While the water heater is operating, the fan heater is also switched on. What will happen to the circuit breaker? Use a calculation to justify your answer.

calculation of current for fan heater = 8 (amperes) (1)
total current = 12 (ampere) (1)

conclusion that circuit breaker will trip (1)

OR

$$\text{current} = \frac{\text{total power}}{\text{voltage}} \quad (\tfrac{1}{2})$$

$$= \frac{2760}{230} \quad (\tfrac{1}{2})$$

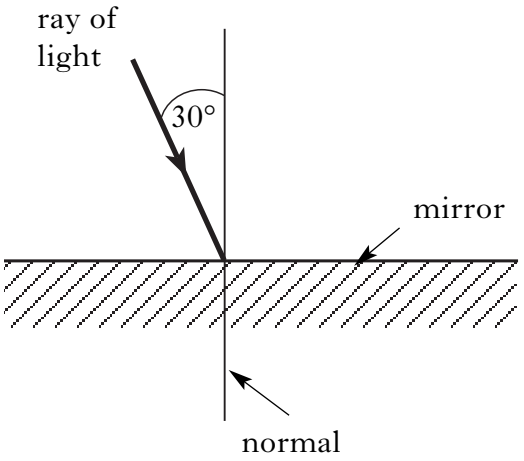
$$= 12 \text{ (amperes)} \quad (1)$$

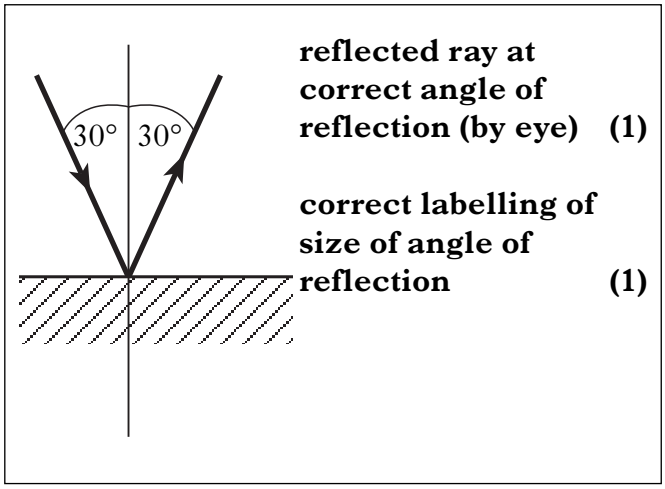
conclusion that the circuit breaker will trip (1)

3

Marks

10. A student aims a ray of light at a mirror as shown. The angle of incidence of the light is 30°.



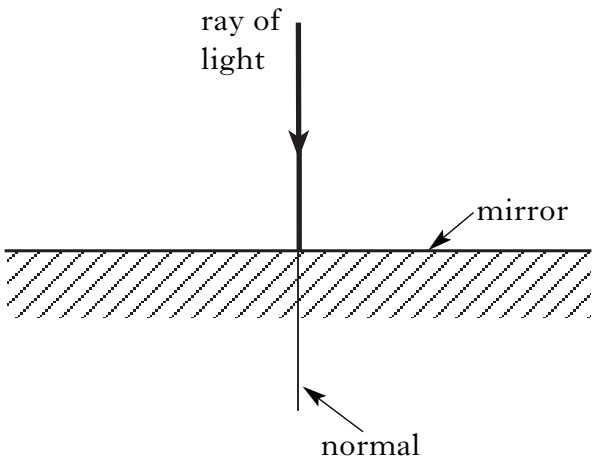


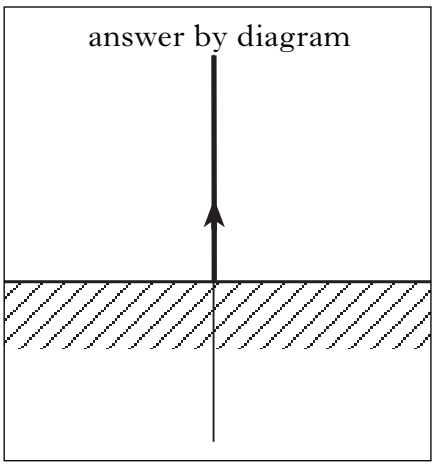
reflected ray at correct angle of reflection (by eye) (1)

correct labelling of size of angle of reflection (1)

(*a*) On the diagram above, draw the reflected light ray. Mark the size of the angle of reflection on the diagram. **2**

(*b*) The student now alters the angle of the ray so that it strikes the mirror along the normal.





Describe below (or show on the diagram above) the new direction of the reflected ray.

back along the normal

(note: could be shown by diagram if absolutely clear)

1

Marks

10. (continued)

(*c*) (i) State **one** difference between the light produced by a laser and light from an ordinary lamp.

laser parallel

OR

very concentrated/focused

OR

single colour

1

(ii) Lasers have many uses. They can be found in hospitals, factories, shops and homes.

Describe **one** use of a laser. You may include a diagram, if you wish.

any medical or non-medical use (1)

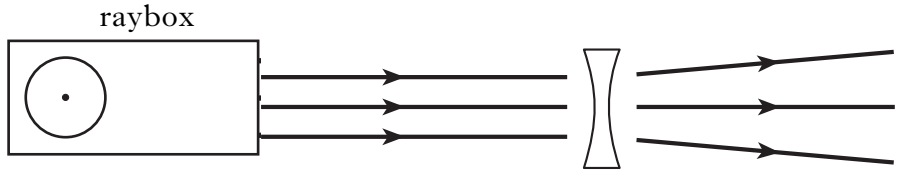
description (1)

2

DO NOT WRITE IN THIS MARGIN

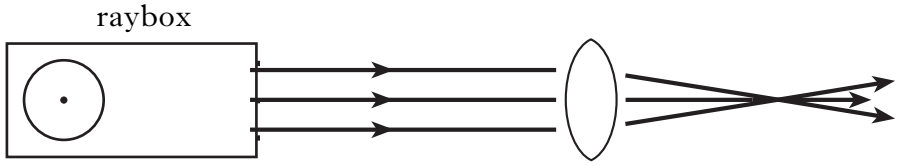
Marks

11. (*a*) A student arranges a raybox to produce 3 parallel rays of light.
A lens placed in the path of the rays causes them to diverge as shown.
Complete the diagram to show the shape of this lens.



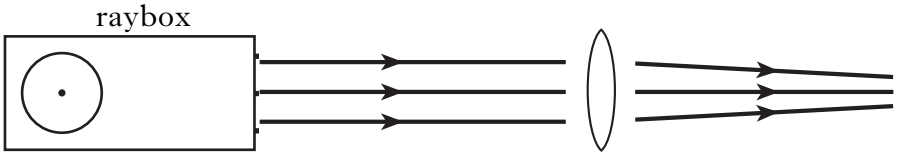
concave lens shape in correct orientation — **1**

(*b*) The student now replaces the first lens with another one. It causes the rays to converge as shown below.
Complete the diagram to show the shape of this lens.



convex lens shape in correct orientation — **1**

(*c*) This lens is replaced by a third lens. It has the following effect on the rays.



In what way is the shape of this lens different from the lens in part (*b*)?

thinner/narrower/less curved
(note: accept drawing if less curved than a convex lens shown in (*b*)) — **1**

(*d*) What type of lens would be chosen by an optician to correct long sight?

convex OR converging OR correct drawing — **1**

Marks

12. (*a*) The following list shows some tasks done by hospital staff.

A measuring the weight of a baby

B producing a scan of an unborn child

C treating a footballer's strained leg muscle

D treating a brain tumour without surgery

E treating a child's eczema

F detecting a break in an arm-bone

G measuring a patient's body temperature

From the above list, choose **one** use for each of the following by placing one of the letters A–G in the box.

Infrared **C OR G** **(½)** X-rays **D OR F** **(½)**

Ultrasound **B OR C** **(½)** Ultraviolet **E** **(½)** **2**

(*b*) Which one of these cannot pass through a vacuum? **Circle your answer**.

Infrared **X-rays** **Ultrasound** **Ultraviolet** **1**

Marks

13. An engineering company has a gamma radiation source for testing welded joints.

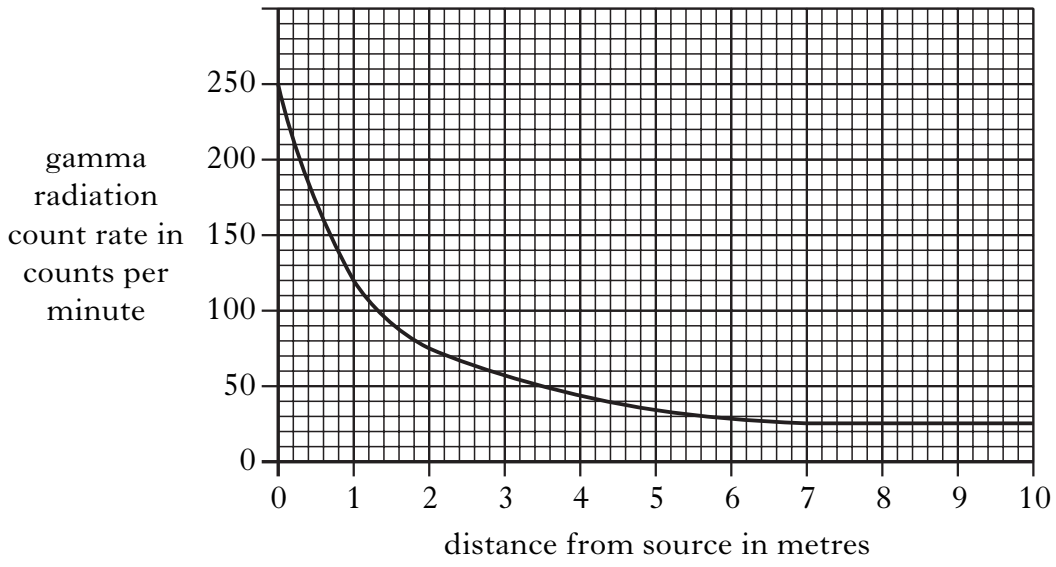
(*a*) Give **one** precaution which is taken to reduce the risk to the workers from the radiation.

Distance
OR
shielding
OR
time
OR
other correct answer

1

(*b*) A safety officer measures the count rate from the gamma radiation at different distances from the source.

The graph shows how the count rate varies with distance.



(i) What distance from the source gives a count rate of 50 counts per minute?

3·4 – 3·6 metres (1) (note: ½ unit deduction)

1

Marks

13. (*b*) (continued)

(ii) Explain why the count rate does not drop to zero at large distances from the source.

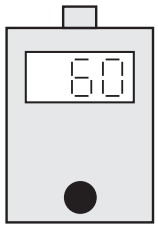
background count
OR
there is gamma radiation in our surroundings
OR
there is gamma radiation always around us

1

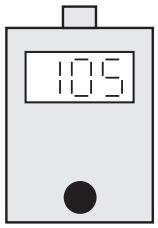
Marks

14. (*a*) The diagrams show two sound level meter readings taken in a factory. One was taken close to a drilling machine. The other was taken in the office.

(i) In the box below each diagram, write where the measurement was taken.



office (½)



drilling machine (½)

1

(ii) What is the unit of sound level?

decibel OR dB

1

(iii) Explain why ear protection should be worn by people working near the drilling machine.

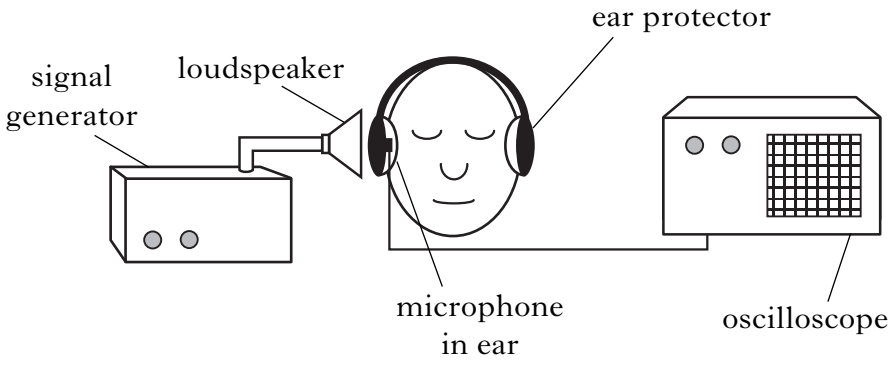
sound level is very high OR over 80 dB OR loud (1)

this causes damage to the ears OR hearing (1)

(Note: second mark can be gained for a correct description of the ACTION of the protectors)

2

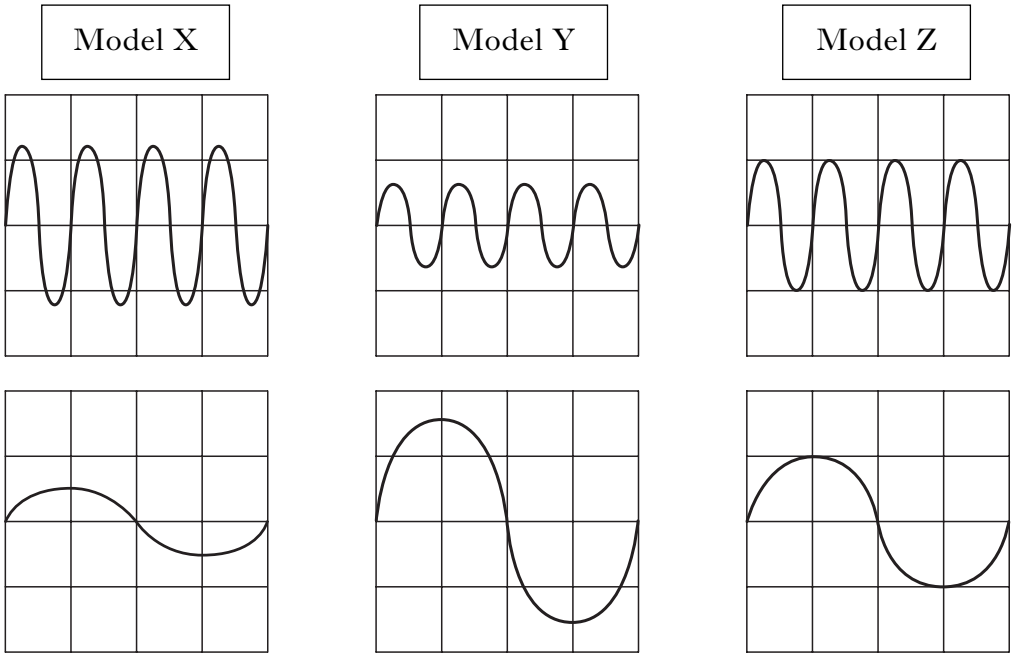
(*b*) The factory technician tests different types of ear protector. A dummy head is fitted with a small microphone inside one ear. The microphone is connected to an oscilloscope.



Three different models of ear protector are tested. Each model is tested at high and low frequencies. For each model, the two oscilloscope traces are shown on the next page.

Marks

14. (*b*) (continued)



(i) Which model of ear protector gives best protection against high frequency sound? You **must** explain your answer.

model Y **(1)**
high frequency signal has smallest height/smallest amplitude/lowest volume **(1)**

(note: first mark is only available if explanation is attempted)

2

(ii) Which model of ear protector gives best protection against low frequency sound? You **must** explain your answer.

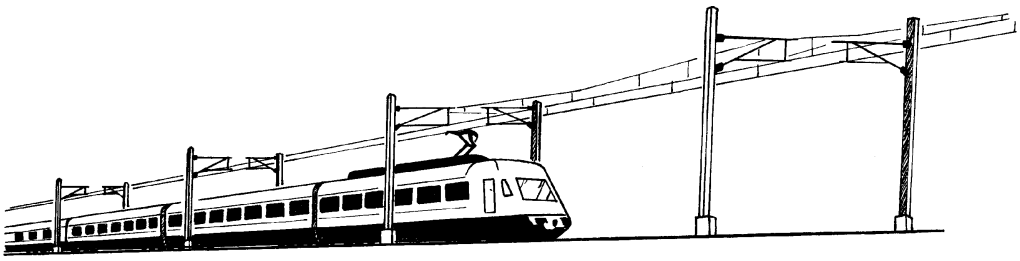
model X **(1)**
low frequency signal has smallest height/smallest amplitude/lowest volume **(1)**

(note: first mark is only available if explanation is attempted)

2

Marks

15. A high speed train takes its energy from overhead wires, supported on masts as shown.



(*a*) On one section of the journey, the train passes 180 masts in one minute.

(i) Calculate the number of masts the train passes in one second.

$\frac{180}{60}$ **(½) = 3 (½)**

1

(ii) The distances between masts are each 32 metres. Calculate the average speed of the train on this section of its journey.

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

= $\frac{96}{1}$ **(½)**

= 96 metres per second (1)

2

Marks

15. (continued)

(*b*) The train wheels are driven by electric motors. At maximum speed, the total power requirement is 12 000 000 watts.

The voltage of the overhead wires is 25 000 volts.

Calculate the current taken from the overhead wires when the train travels at maximum speed.

$$\text{current} = \frac{\text{power}}{\text{voltage}} \quad (\tfrac{1}{2})$$

$$= \frac{12\,000\,000}{25\,000} \quad (\tfrac{1}{2})$$

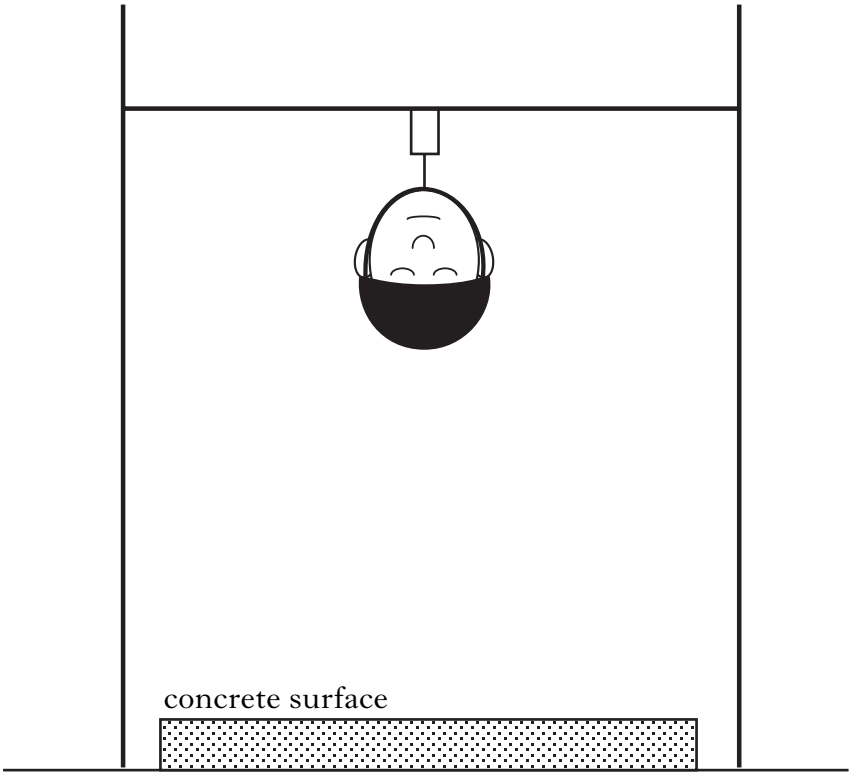
$$= 480 \text{ amperes} \quad (1)$$

2

DO NOT WRITE IN THIS MARGIN

Marks

16. A scientist tests safety helmets for cyclists. A helmet is fitted to a dummy head and dropped on to a concrete surface. A new helmet of the same type is used for each test.



(*a*) In one test, a dummy head of mass 4·8 kilograms is fitted with a helmet of mass 0·2 kilograms.

(i) Calculate the mass of the combined head and helmet.

total mass = 4·8 + 0·2 (½)

= 5·0 kilograms (½)

1

(ii) Calculate the weight of the combined head and helmet.

weight = 10 × mass (½)

= 10 × 5 (½)

= 50 newtons (1)

2

Marks

16. (*a*) (continued)

(iii) Explain what is meant by the weight of an object.

the force OR pull of the Earth on the object OR force of gravity

1

(iv) Which instrument would you use to measure weight?

newton balance OR spring balance OR newton meter

1

(*b*) Describe and explain the effect on the damage to a helmet of each of the following changes.

(i) Exchange the dummy head for one of mass 6·0 kilograms.

MORE damage (1)
more mass OR heavier OR more force (1)

2

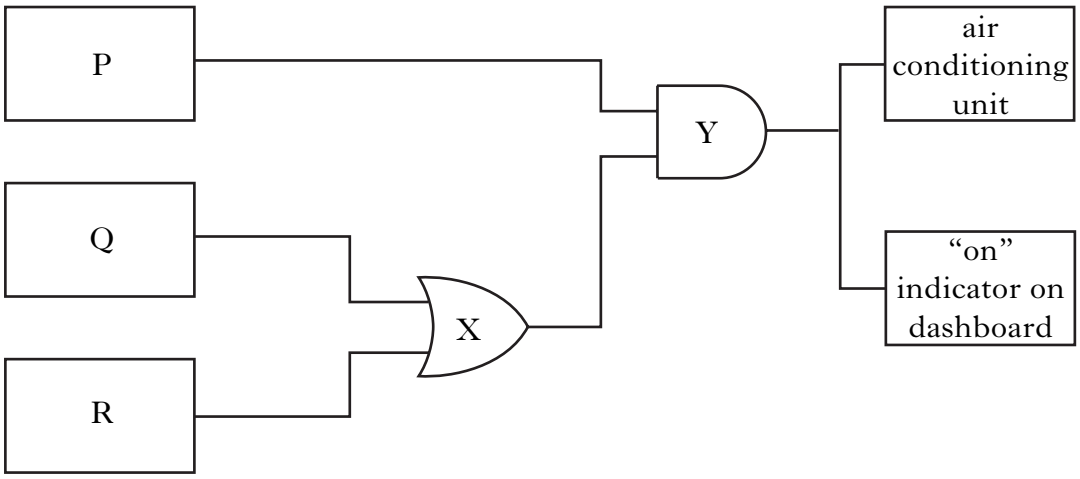
(ii) Increase the height of the drop.

MORE damage (1)
greater (impact) speed (1)

2

Marks

17. The diagram shows the electronic system which controls a car's air conditioning unit.



(*a*) (i) What type of logic gate is X?

OR (gate) **1**

(ii) What type of logic gate is Y?

AND (gate) **1**

(*b*) The air conditioning unit cools the inside of the car if it is too hot while the ignition switch is on. It also works if it is too hot while the ignition switch is off, if a separate manual switch is switched on instead.

The system includes a temperature sensor. An indicator on the dashboard lights up when the air conditioning unit is working.

Use the letters P, Q and R from the diagram above to complete the table showing the positions of the input devices in the electronic system.

Device	*Logic levels*		*Position*
Ignition switch	off **0**	on **1**	**Q (OR R)**
Manual switch	off **0**	on **1**	**R (OR Q)**
Temperature sensor	cold **0**	hot **1**	**P**

3

Marks

17. (continued)

(*c*) A list of electronic components is shown below.

electric motor	**LDR**	**microphone**	**switch**
loudspeaker	**thermistor**	**lamp**	**LED**

(i) Which component **from the list** could be used in the temperature sensor?

thermistor **1**

(ii) Which component **from the list** could be used for the air conditioning "on" indicator?

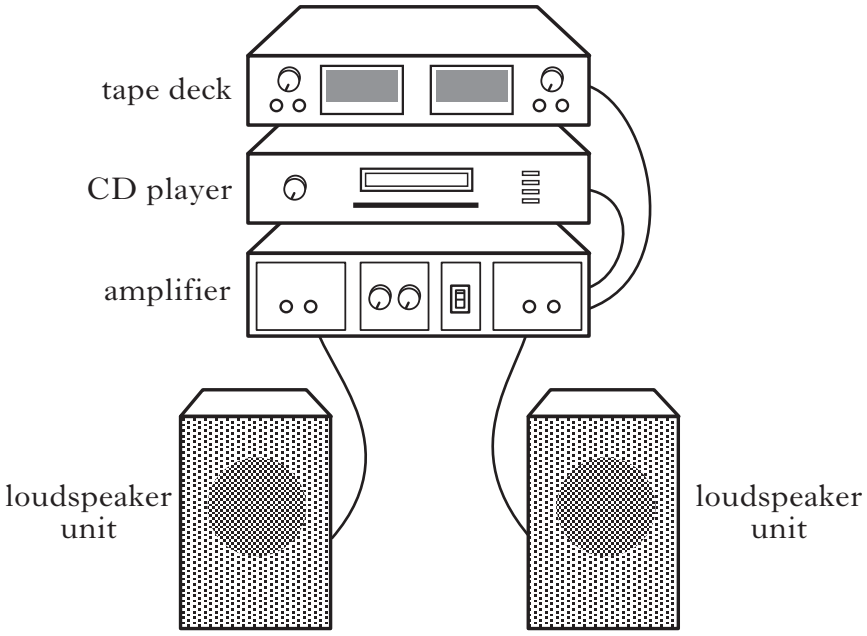
LED OR lamp **1**

(iii) The air conditioner includes an electric motor.
What is the energy change in an electric motor?

electrical to kinetic **1**

Marks

18. An engineer in a hi-fi shop demonstrates a sound system to a customer. The diagram shows the connections between the subsystems.

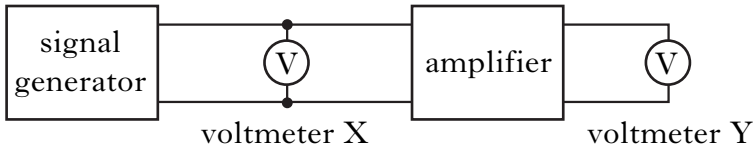


(*a*) From the diagram, name

(i) an input subsystem — **tape deck OR CD player** — **1**

(ii) an output subsystem. — **loudspeaker (unit)** — **1**

(*b*) The customer asks the engineer to measure the voltage gain of the amplifier. The engineer connects a signal generator and two voltmeters to the amplifier as shown below.



The readings on the two voltmeters are 18·0 volts and 0·002 volts.

DO NOT WRITE IN THIS MARGIN

Marks

18. (*b*) (continued)

(i) Which of these readings is taken from voltmeter Y?

18 volts (Note: $\frac{1}{2}$ unit deduction) **1**

(ii) Calculate the voltage gain of this amplifier.

voltage gain $= \dfrac{\text{output (voltage)}}{\text{input (voltage)}}$ **(½)**

$= \dfrac{18}{0{\cdot}002}$ **(½)**

$= 9\,000$ **(1)**

(note: deduct ½ for any unit given) **2**

[*END OF MARKING INSTRUCTIONS*]