FOR OFFICIAL USE

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Total Marks

# 3220/401

NATIONAL QUALIFICATIONS 2004

FRIDAY 28 MAY
9.00 AM – 10.30 AM

# PHYSICS
## STANDARD GRADE
General Level

**Fill in these boxes and read what is printed below.**

Full name of centre

Town

Forename(s)

Surname

Date of birth
Day Month Year

Scottish candidate number

Number of seat

1 All questions should be answered.

2 The questions may be answered in any order but all answers must be written clearly and legibly in this book.

3 For questions 1–5, write down, in the space provided, the letter corresponding to the answer you think is correct. There is only **one** correct answer.

4 For questions 6–18, write your answer where indicated by the question or in the space provided after the question.

5 If you change your mind about your answer you may score it out and replace it in the space provided at the end of the answer book.

6 Before leaving the examination room you must give this book to the invigilator. If you do not, you may lose all the marks for this paper.

SAB 3220/401 6/24320

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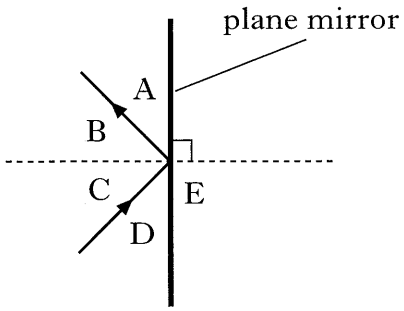
*Marks*

**1.** The diagram shows a ray of light reflected from a plane mirror.




Which of the labelled angles is the angle of reflection?

*Answer* ☐ **1**

**2.** The instrument used to measure the temperature of a human body is called

A an endoscope

B an ohmmeter

C an oscilloscope

D a stethoscope

E a thermometer.

*Answer* ☐ **1**

**3.** Which one of the following radiations is used in a laser?

A Gamma rays

B X-rays

C Visible light

D Microwaves

E Radio waves

*Answer* ☐ **1**

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*Marks*

**4.** A newton balance is used to measure

A distance

B force

C gravitational potential energy

D kinetic energy

E power.

*Answer* ☐ **1**

**5.** The International Space Station has an orbital height of 352 kilometres and a period of 92 minutes.

A geostationary satellite has an orbital height of 35 900 kilometres and a period of 1440 minutes.

Which of the following gives the orbital height of a satellite that has a period of 102 minutes?

A 144 kilometres

B 352 kilometres

C 833 kilometres

D 35 900 kilometres

E 44 100 kilometres

*Answer* ☐ **1**

**[Turn over**

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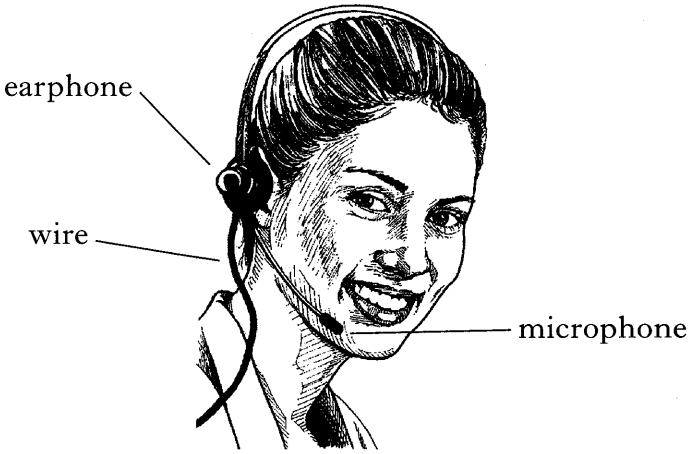
*Marks*

**6.** A worker in a telephone call centre wears a headset that has an earphone and a microphone.




(*a*) State the energy transformation that takes place in the

(i) earphone

.....

(ii) microphone.

..... **2**

(*b*) In the passage below, circle **one** phrase in each set of brackets to make the statement correct.

{An electrical signal / A light beam / A sound wave} is transmitted along the wire

at a speed {less than / equal to / greater than} the speed of sound. **2**

DO NOT WRITE IN THIS MARGIN

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*Marks*

**7.** A girl is at a fireworks display.

(*a*) The girl notices that when a firework explodes high in the air, she sees the flash before she hears the bang from the firework.

Explain why there is a delay between seeing the flash and hearing the bang.

.....

.....

..... **1**

(*b*) The girl wants to calculate how far away the firework is when it explodes. She uses a stopwatch to measure the time interval between the flash and the bang from the firework. The reading on the stopwatch is 0·8 second.

(i) What additional information is needed to calculate this distance?

..... **1**

(ii) Explain why the distance calculated by the girl is likely to be inaccurate.

.....

.....

..... **2**

**[Turn over**

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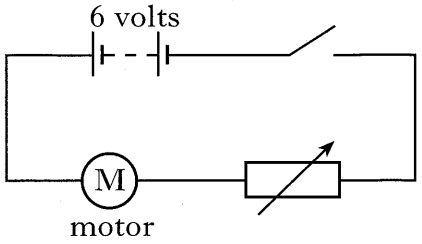
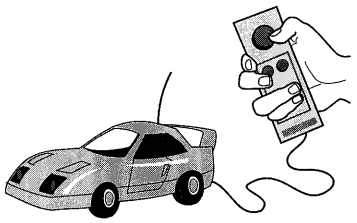
*Marks*

**8.** A model car contains an electric motor, operated by a 6 volt battery. The speed of the motor is adjusted by a hand-held control. The hand-held control contains a variable resistor.

The circuit is shown below.



(*a*) When the resistance of the variable resistor is set to 8 ohms, the voltage across the variable resistor is 2 volts.

(i) Calculate the current in the variable resistor.

*Space for working and answer*

**2**

(ii) Calculate the voltage across the motor at this setting of the variable resistor.

*Space for working and answer*

**1**

(*b*) The resistance of the variable resistor is decreased.

Explain what happens to the speed of the motor.

.....

.....

.....

..... **2**

(*c*) Give one **other** use for a variable resistor.

..... **1**

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*Marks*

**9.** A food mixer is used to prepare food.

(*a*) The double insulation symbol is displayed on the food mixer.

(i) Draw the double insulation symbol.

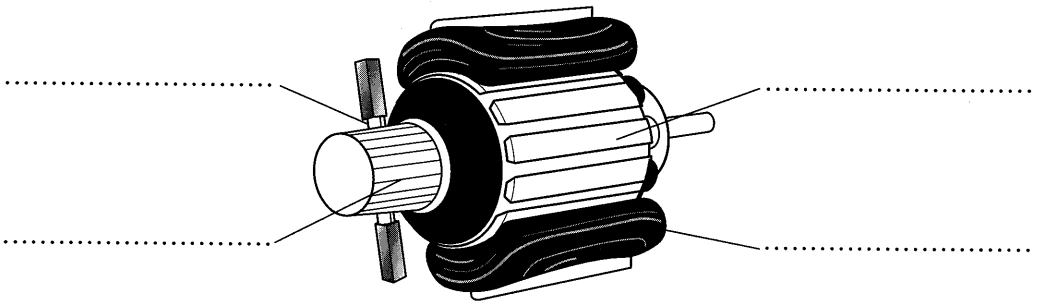
*Space for symbol*

**1**

(ii) Which wire is **not** needed in the flex of the food mixer?

..... **1**

(*b*) The diagram below shows the main parts of the electric motor used in the food mixer.



Label the diagram using the parts of the motor listed below.

**Field coil (magnet)** **Brush** **Rotating coil** **Commutator** **2**

**[Turn over**

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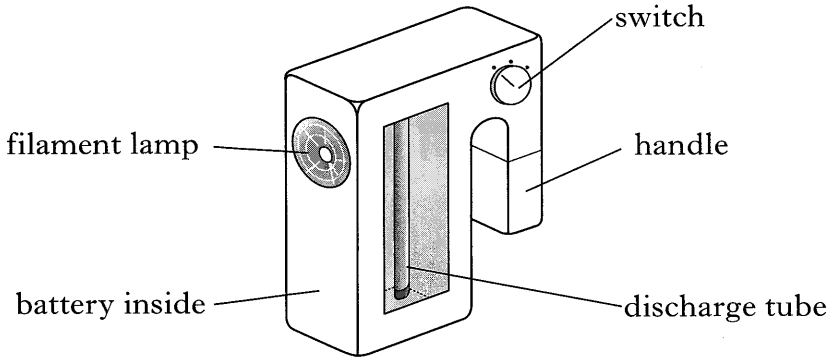
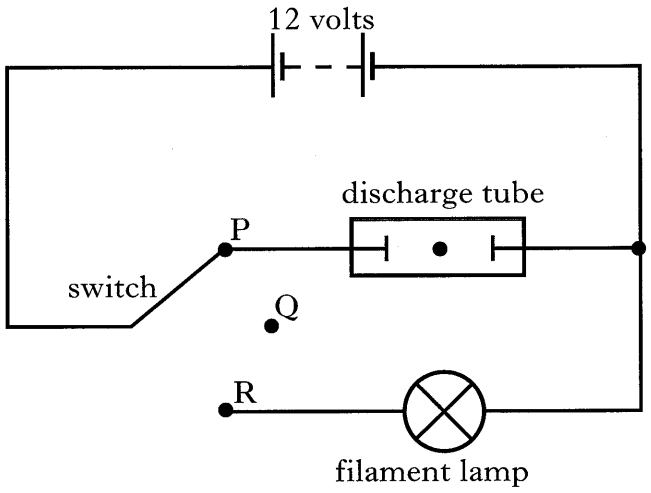
*Marks*

**10.** A camping light contains an 8 watt discharge tube, an 8 watt filament lamp and a 12 volt battery.




Camping light

The circuit diagram for the camping light is shown.




Circle the correct answer for each of the questions about the camping light.

(*a*) The camping light is **off** when the switch is in position $\left\{\begin{matrix} P \\ Q \\ R \end{matrix}\right\}$. **1**

(*b*) The operating voltage of the filament lamp is $\left\{\begin{matrix} 6 \\ 8 \\ 12 \end{matrix}\right\}$ volts. **1**

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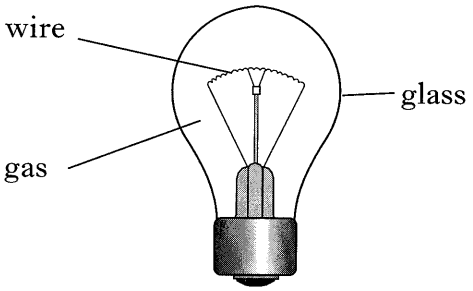
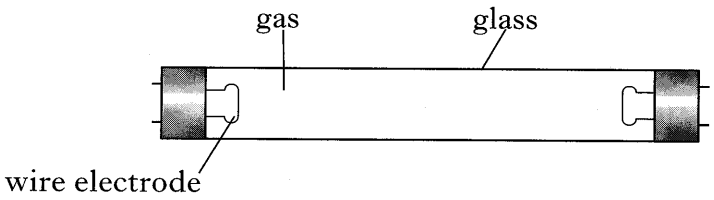
*Marks*

**10. (continued)**

(*c*) The filament lamp and the discharge tube are constructed as shown below.




Filament lamp




Discharge tube

(i) The useful energy transformation in the filament lamp takes place in the {glass / wire / gas}. **1**

(ii) The useful energy transformation in the discharge tube takes place in the {glass / wire / gas}. **1**

(iii) The electrical energy transformed each second by the discharge tube is {smaller than / the same as / greater than} the electrical energy transformed each second by the filament lamp. **1**

(iv) The heat energy produced each second by the discharge tube is {smaller than / the same as / greater than} the heat energy produced each second by the filament lamp. **1**

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*Marks*

**11.** Read the following passage about sound.

*Sound with a frequency below 20 hertz is called infrasound. Sound with a frequency above the range of human hearing is called ultrasound.*

*Elephants communicate using infrasound. Elephants can detect low level infrasound through their feet.*

*Bats use ultrasound to navigate. They send out ultrasound pulses that reflect off objects. The bats note how long it takes the pulses to return.*

*Ultrasound is also used in medicine.*

(*a*) Suggest a frequency that could be detected by an elephant through its feet.

..... **1**

(*b*) State the highest frequency that humans can hear.

..... **1**

(*c*) State the unit of sound level.

..... **1**

(*d*) A bat sends out an ultrasound pulse of frequency 45 000 hertz. The pulse is reflected and returns to the bat after 0·2 second.

Calculate the total distance that the pulse travels.
[The speed of sound in air is 340 metres per second.]

*Space for working and answer*

**2**

(*e*) Give an example of a use of ultrasound in medicine.

.....

..... **1**

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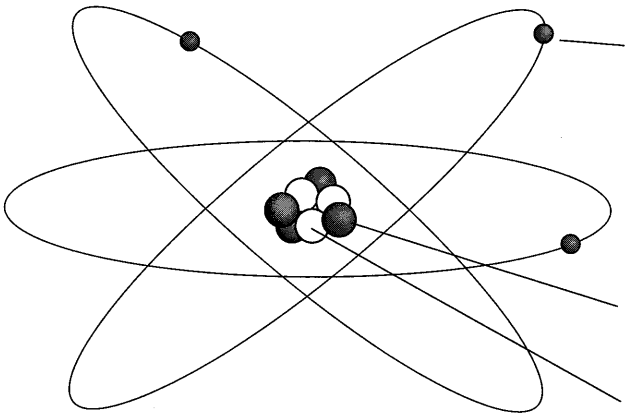
*Marks*

**12.** Two students are revising for a Physics test.

(*a*) One student draws a simple model of an atom.

Complete the diagram by adding the following labels.

**protons** **neutrons** **electrons**



..... 2

(*b*) The other student writes incomplete statements about nuclear radiation.

Complete the statements using words from the following list.

**alpha** **beta** **gamma** **becquerels** **sieverts**

(i) The radiation that has the greatest range is ..... **1**

(ii) The radiation that is absorbed by a sheet of paper is ..... **1**

(iii) Dose equivalent is measured in ..... **1**

(*c*) The students ask each other about nuclear radiation and safety.
State **two** safety precautions necessary when handling radioactive substances.

Precaution 1.....

.....

Precaution 2.....

..... **2**

**[Turn over**

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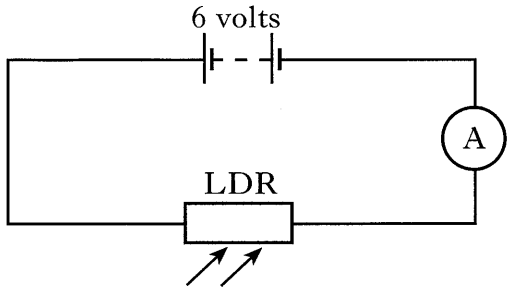
*Marks*

**13.** A company makes sunglasses. The company uses a light meter to measure how much light passes through different types of glass. The light meter contains an ammeter, an LDR and a 6 volt battery as shown.




(*a*) For one type of glass, the current in the circuit is 0·005 ampere.

(i) Calculate the resistance of the LDR.

*Space for working and answer*

**2**

(ii) The intensity of the light shining on the LDR is increased.

(A) State what happens to the resistance of the LDR.

..... **1**

(B) State what happens to the current in the circuit.

..... **1**

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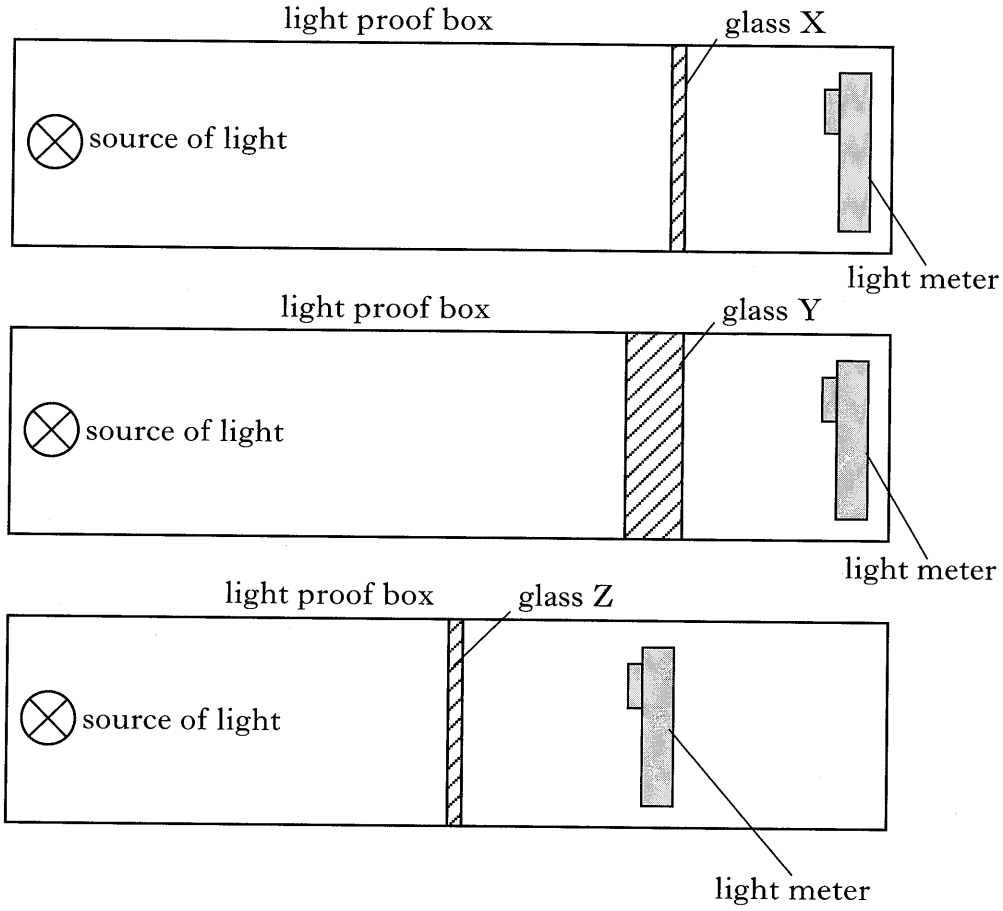
*Marks*

**13. (continued)**

(*b*) Three types of glass, X, Y and Z are tested as shown below to find out how much light passes through each. The same source of light is used in all three tests.




Give **two** reasons why this is not a fair test.

Reason 1 .....

.....

Reason 2 .....

..... **2**

**[Turn over**

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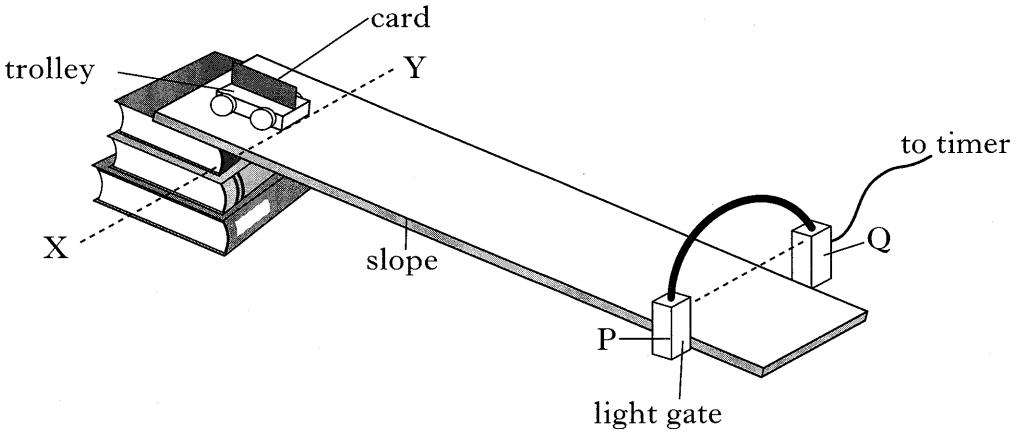
*Marks*

**14.** A student releases a trolley from rest at XY near the top of a slope. The trolley moves down the slope. A card attached to the trolley passes through a light gate at PQ near the bottom of the slope.




(*a*) The student records the following information.

| | |
|---|---|
| distance from XY to PQ | 1·25 metres |
| length of card | 0·1 metre |
| time for trolley to travel from XY to PQ | 5·0 seconds |
| time for card to pass through light gate | 0·2 second. |

(i) Show that the speed of the trolley **at PQ** is 0·5 metre per second.

*Space for working and answer*

**2**

(ii) Calculate the acceleration of the trolley down the slope.

*Space for working and answer*

**2**

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*Marks*

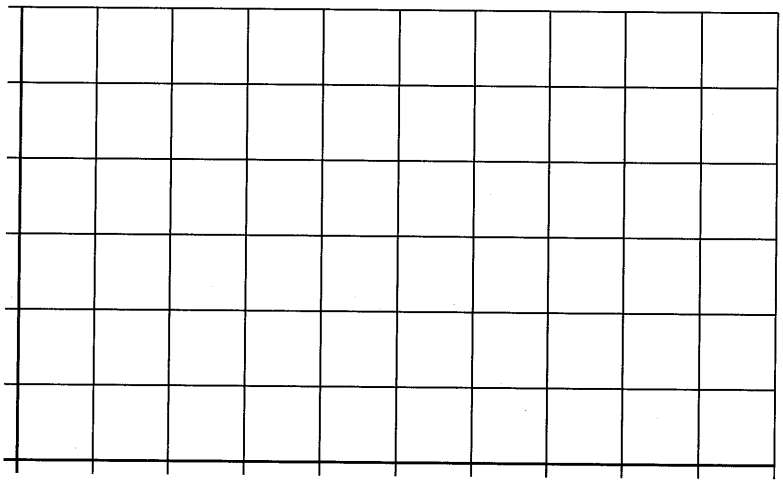
**14. (*a*) (continued)**

(iii) Draw a speed-time graph for the motion of the trolley from when it is released at XY until it passes through PQ.

Units and numerical values **must** be shown on both axes.

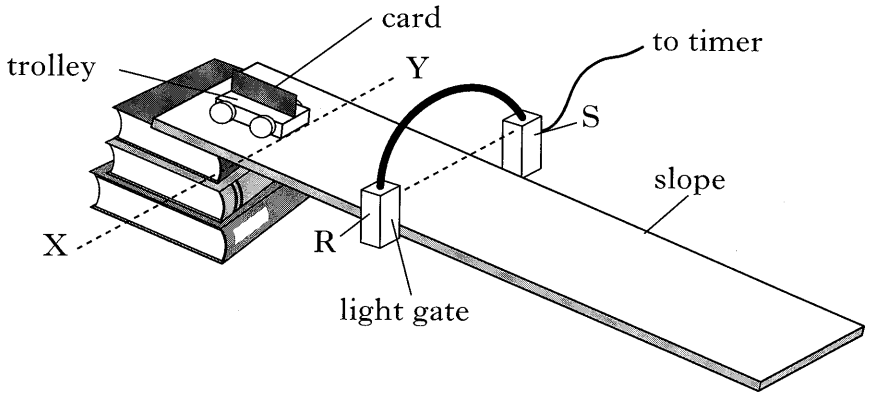
speed in .....

.....



time in ..... **3**

(*b*) The student moves the light gate up the slope to RS, as shown, and repeats the experiment.




No other changes are made to the apparatus. The trolley is again released from rest at XY.

Complete the sentences below by circling the correct answers.

Compared to the first part of the experiment:

(i) the speed of the trolley at the light gate is $\left\{\begin{matrix}\text{less}\\ \text{the same}\\ \text{greater}\end{matrix}\right\}$ **1**

(ii) the acceleration of the trolley down the slope is $\left\{\begin{matrix}\text{less}\\ \text{the same}\\ \text{greater}\end{matrix}\right\}$. **1**

DO NOT WRITE IN THIS MARGIN

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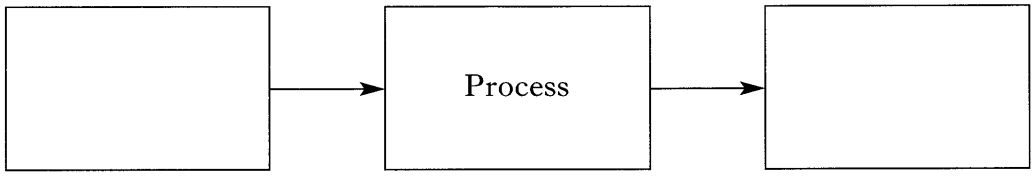
*Marks*

**15.** A student designs an electronic system that produces a sound when the temperature in a fish tank falls below a certain value.

(*a*) A block diagram of the system is shown.

Complete the block diagram by filling in the two missing labels.




**1**

(*b*) The following components are available to the student.

| | | |
|---|---|---|
| **loudspeaker** | **solenoid** | **microphone** |
| **thermistor** | **solar cell** | **electric motor** |

(i) Which device **from the list** is suitable for sensing a change in temperature?

..... **1**

(ii) Which device **from the list** is suitable for producing a sound?

..... **1**

(*c*) The student uses a transistor as the process device.

In the space below, draw the circuit symbol for a transistor.

*Space for circuit symbol*

**1**

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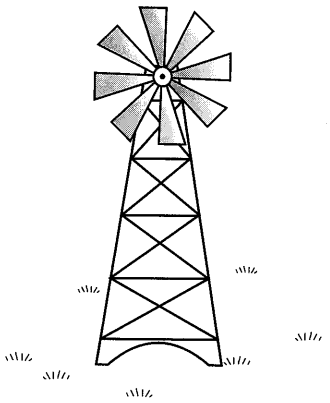
*Marks*

**16.** A farmer installs a wind-powered generator on a farm.



(*a*) On a particular day, the generator has a constant power output of 20 kilowatts.

(i) How many kilowatt-hours of electrical energy are generated in 8 hours?

*Space for working and answer*

**2**

(ii) Electrical energy from the local supply company costs the farmer 9 pence per kilowatt-hour.

Calculate how much money the farmer saves by using the generator for 8 hours.

*Space for working and answer*

**2**

(*b*) Wind is a renewable source of energy.

(i) Name one other renewable source of energy.

..... **1**

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

..... **1**

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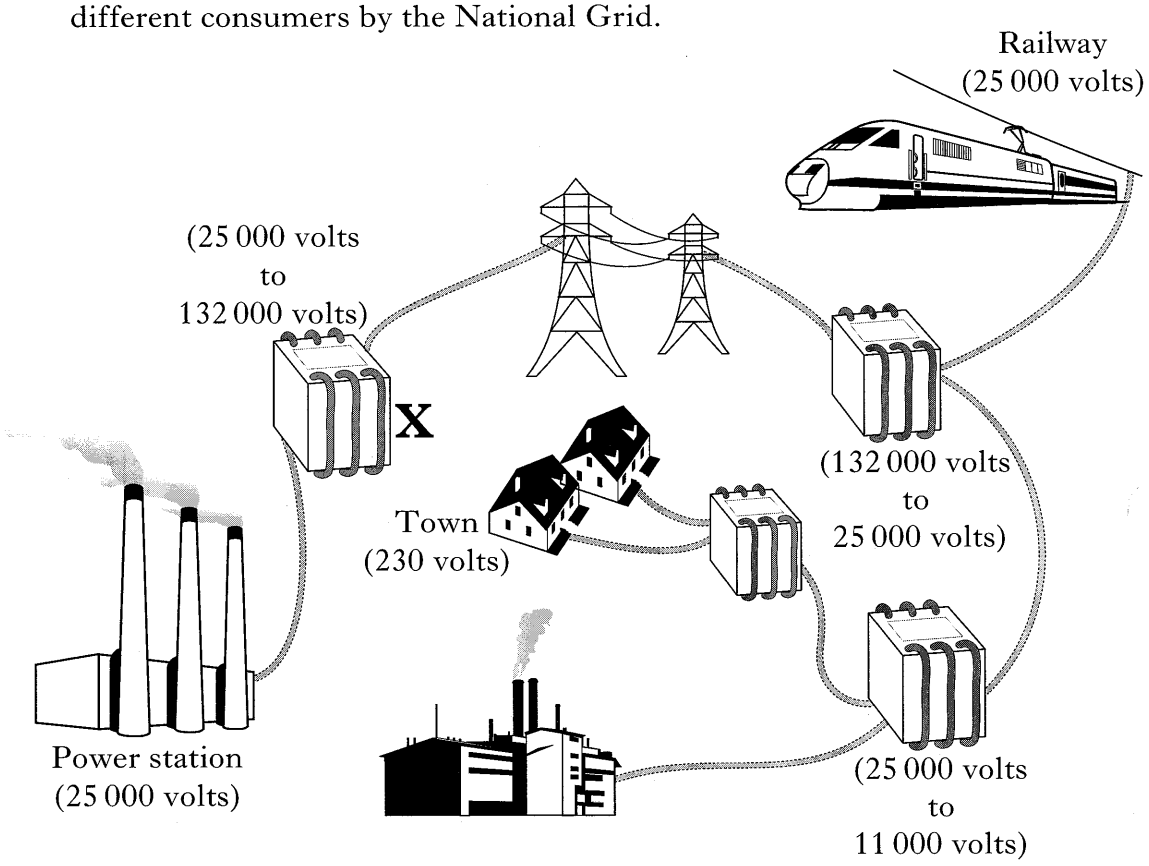
*Marks*

**17.** The diagram shows how electricity is distributed from a power station to different consumers by the National Grid.




(*a*) Name the part labelled X in the diagram and state its purpose.

.....

.....

..... **2**

(*b*) Why are high voltages used in the transmission of electrical energy?

.....

.....

..... **1**

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**17. (continued)**

*Marks*

(*c*) State the voltage at which electrical energy is used by the railway.

.....

(*d*) Calculate the ratio $\frac{\text{number of turns in primary}}{\text{number of turns in secondary}}$ in the transformer used to supply energy for the railway. **1**

*Space for working and answer*

**2**

**[Turn over**

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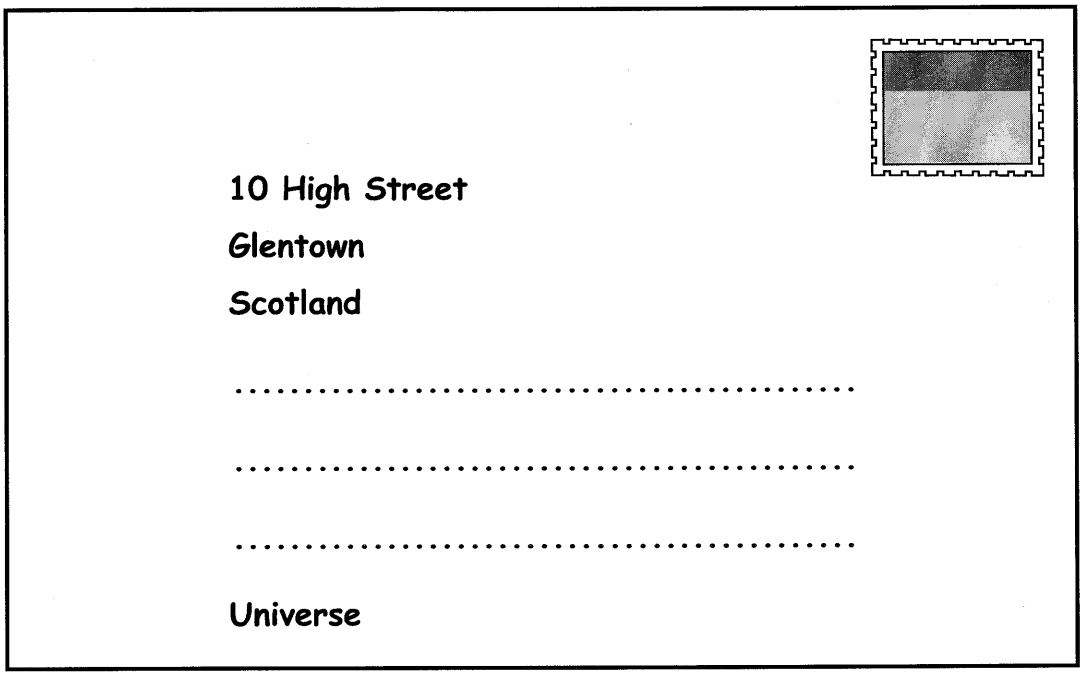
*Marks*

**18.** A boy is interested in astronomy.

(*a*) The boy writes his address in the Universe.

Complete the address given below by writing, **in the correct order**, the missing lines using terms from the following list.

**Earth** **Milky Way (our galaxy)** **Solar System**




2

(*b*) The boy reads the following passage in an astronomy book.

*You can view planets, moons and stars using a telescope.*
*Jupiter, the largest planet in our Solar System, takes 12 Earth years to orbit the Sun. The largest of Jupiter's many moons is called Ganymede.*
*Sirius, also known as the dog star, is the brightest star in the sky, apart from the Sun.*

(i) Name one astronomical object, **mentioned in the passage**, that can only be seen by reflected light.

..... 1

(ii) Name one astronomical object, **mentioned in the passage**, that generates light.

..... 1

(iii) Which object, **mentioned in the passage**, is furthest away from Earth?

..... 1

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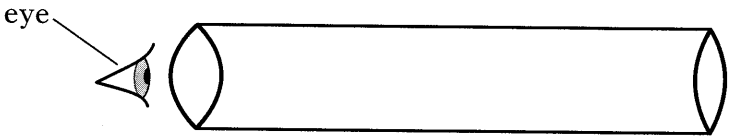
*Marks*

**18. (*b*) (continued)**

(iv) Complete the diagram of a telescope below, by naming the two lenses.




..... lens ..... lens **2**

[*END OF QUESTION PAPER*]

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**YOU MAY USE THE SPACE ON THIS PAGE TO REWRITE ANY ANSWER YOU HAVE DECIDED TO CHANGE IN THE MAIN PART OF THE ANSWER BOOKLET. TAKE CARE TO WRITE IN CAREFULLY THE APPROPRIATE QUESTION NUMBER.**

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