G

K & U	PS

Total Marks

3220/101

SCOTTISH
CERTIFICATE OF
EDUCATION
1999

FRIDAY, 14 MAY
9.00 AM – 10.30 AM

PHYSICS
STANDARD GRADE
General Level

SCOTTISH
QUALIFICATIONS
AUTHORITY
©

1. The part of a radio receiver which selects one particular frequency is the

   A aerial

   B amplifier

   C decoder

   D loudspeaker

   E tuner.

   Answer ☐ **(1)**

2. The period of a satellite orbit depends on

   A the mass of the satellite

   B the height of the satellite above the Earth

   C the average length of an Earth day

   D whether the satellite orbits above the equator or is in a polar orbit

   E the rate at which the Earth is spinning.

   Answer ☐ **(1)**

3. Skin cancer is most likely to be caused by excessive exposure to

   A radio waves

   B microwaves

   C infrared radiation

   D visible light

   E ultraviolet radiation.

   Answer ☐ **(1)**

4. Which entry gives the correct **units** used for dose equivalent and the activity of a radioactive source?

	Dose equivalent	*Activity of a radioactive source*
A	becquerel	counts per second
B	counts per second	becquerel
C	sievert	becquerel
D	sievert	counts per second
E	becquerel	sievert

   Answer ☐ **(1)**

5. Which of the following is an output device?

    A   LDR

    B   LED

    C   Microphone

    D   Solar cell

    E   Thermistor

    Answer ☐   **(1)**

6. What is the name of the glass shape used to split white light into different colours?

    A   Concave lens

    B   Convex lens

    C   Prism

    D   Rectangular block

    E   Semi-circular block

    Answer ☐   **(1)**

7. The intensity of the light at the LDR in the circuit shown below is **increased**.
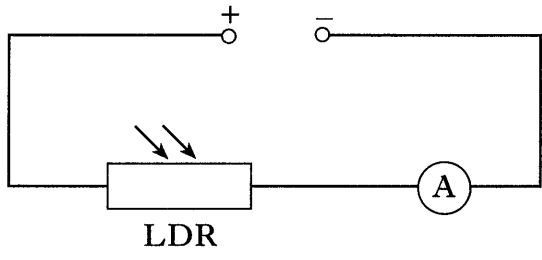
    Complete the following sentence by inserting **increases** or **decreases** or **stays the same**.

    The reading on the ammeter ....   **(1)**

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

    Space for drawing

    (1)

9. Astronomers use refracting telescopes and radio telescopes to detect certain types of radiation from space.
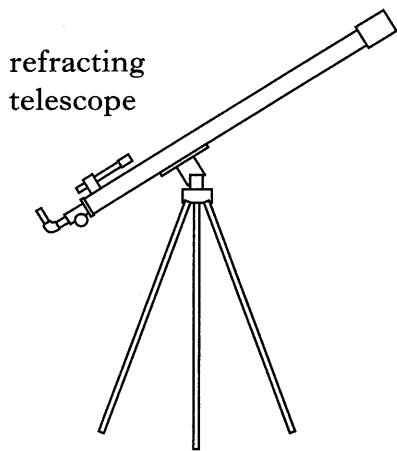
refracting
telescope
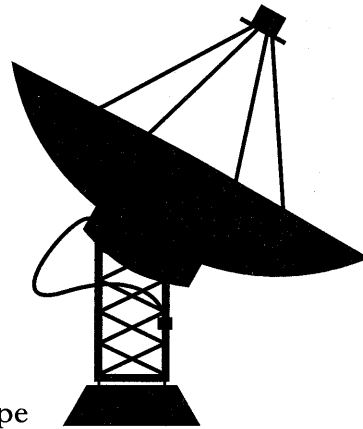
radio
telescope

(a) What type of radiation is detected by a refracting telescope?

.... **(1)**

(b) Which of the following is the same for the radiations detected by both telescopes?

frequency **speed** **wavelength**

.... **(1)**

10. A person walking in the countryside sees a farmer in the distance hammering in a fence post. The sound of the hammer hitting the post is heard by the person 1·5 seconds later.
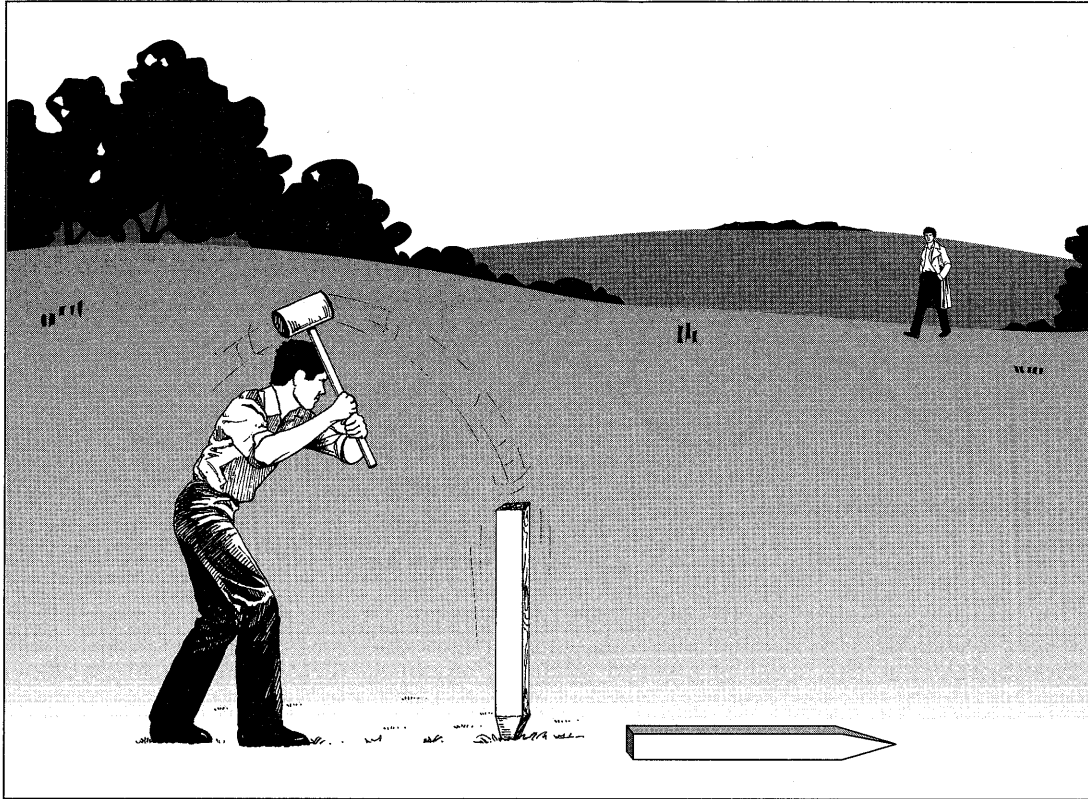
(*a*) Explain why there is a delay between seeing the post being hit and hearing the sound.

....

.... **(1)**

(*b*) Calculate the distance between the person and the farmer.

[speed of sound in air = 340 metres per second]

> *Space for working and answer*

(2)

[Turn over

11. A boy and a girl are watching the movement of water waves next to a pier. The pier has a gauge which measures the depth of the water as shown in the diagram.

Diagram not to scale

Depth
gauge
in metres
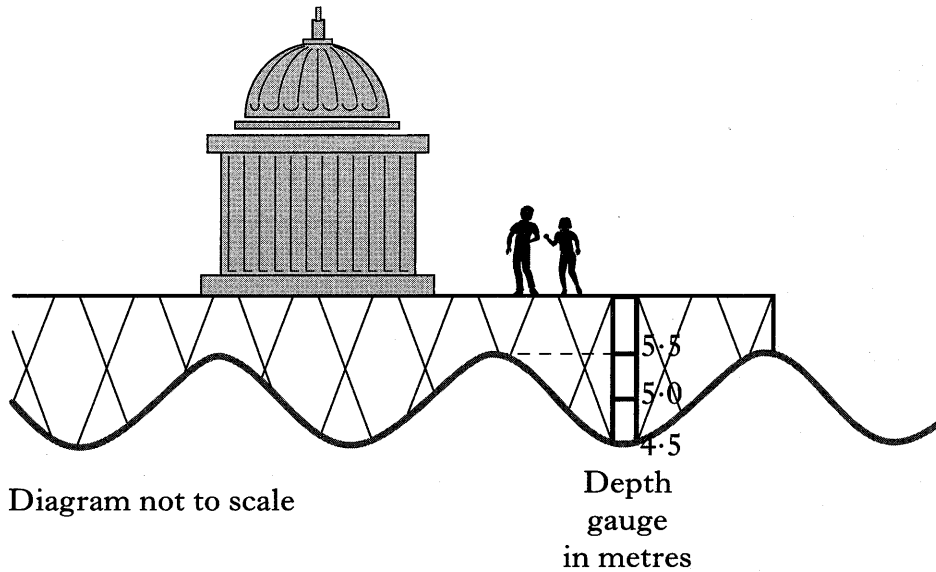
The boy notes that the crest of a wave takes 2·5 seconds to travel a distance of 30 metres along the side of the pier.

The girl notes that 24 wave crests pass her every minute.

(a) Show that the speed of the waves is 12 metres per second.

> *Space for working and answer*

(2)

(b) Show that the frequency of the waves is 0·4 hertz.

> *Space for working and answer*

(2)

11. (continued)

(c) Calculate the wavelength of the waves.

> *Space for working and answer*

(2)

(d) The boy and girl note that when a trough passes the gauge, the water depth is recorded at 4·5 metres. When a crest passes the gauge, it is recorded at 5·5 metres.

Calculate the amplitude of the waves.

> *Space for working and answer*

(1)

[Turn over

12. An electric fire is correctly wired to a 3-pin plug. The pins P, Q and R of the plug and the wires of the flex are shown below.

heating element

metal casing

electric fire

flex

plug

P

Q

R

fuse
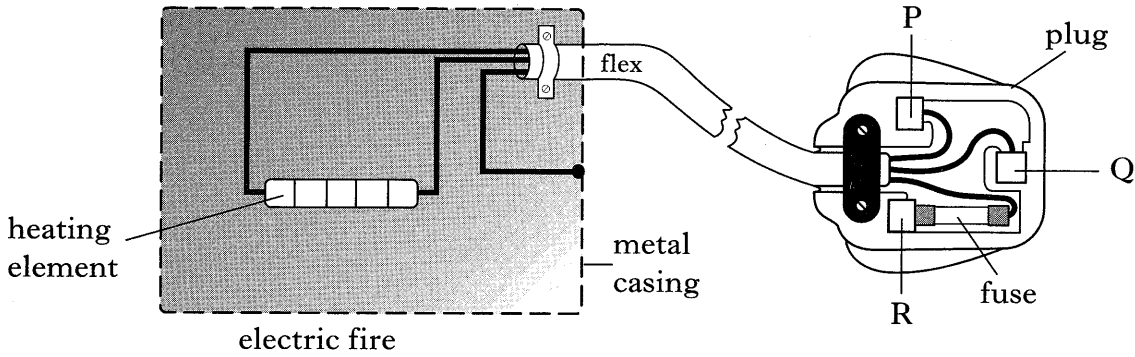
(a) Complete the table for the pins in the plug showing the names of the wires and the colour of insulation on each of the wires.

Pin	Name of wire	Colour of insulation
P		
Q		
R		

(3)

(b) It is suspected that there is a break in the wire connected to the metal casing. A continuity tester is used to detect if there is a break. The circuit diagram of the continuity tester is shown below.

1·5 volts

probes

lamp
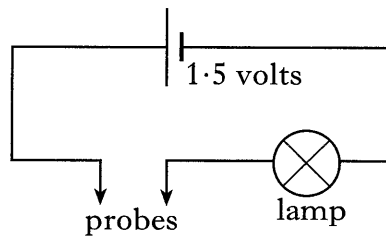
(i) Describe how you could check that the continuity tester is working properly.

....

....

.... **(2)**

(ii) To which pin, P, Q or R, should the wire from the metal casing of the fire be connected?

.... **(1)**

12. **(b) (continued)**

    (iii) Describe how the tester should be used to show that there is no break in this wire.

....

....

.... **(2)**

[Turn over

13. A caravan is fitted with two fluorescent lamps and a filament lamp.

A diagram of the lamp circuit is shown below.
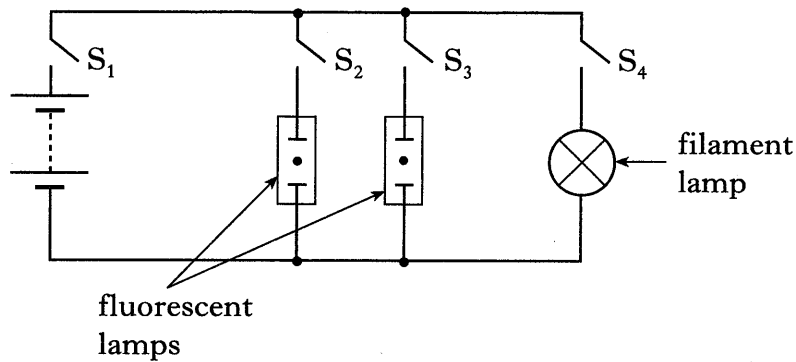
Each of the three lamps is marked 12 volts, 9 watts.

(a) Which switch or switches would have to be closed for the filament lamp **only** to be lit?

.... **(1)**

(b) (i) Calculate the current drawn from the battery when the filament lamp **only** is switched on.

> *Space for working and answer*

(2)

(ii) All three lamps are switched on.

Calculate the current drawn from the battery.

> *Space for working and answer*

(2)

(c) State why a fluorescent lamp is more efficient than a filament lamp.

....

.... **(2)**

14. The background noise level in a factory is measured at 110 decibels. Workers in this factory must wear ear protectors to reduce the noise level at their ears to below 80 decibels. Three different types of ear protectors X, Y and Z are tested for use in the factory. The ear protectors are tested over a range of frequencies. The noise levels detected when wearing the ear protectors are shown on the graph.
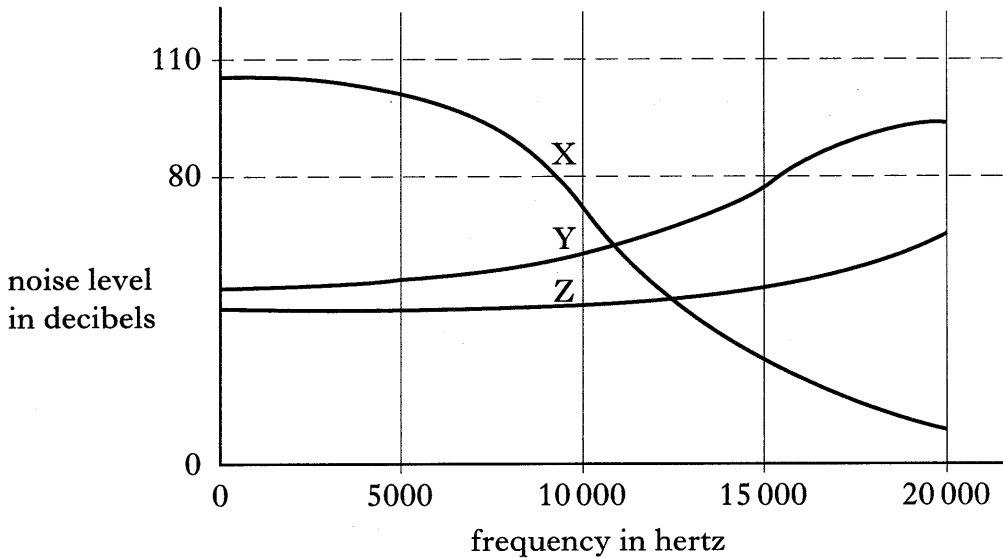
(a) Why must the workers in the factory wear ear protectors to reduce the noise level to below 80 decibels?

....

....

.... **(2)**

(b) Why are the ear protectors tested up to a frequency of 20 000 hertz?

....

.... **(1)**

(c) Using information from the graph, choose the best ear protector for use in the factory.

State and explain your choice.

....

....

.... **(2)**

[Turn over

15. A large gold cup in a museum is protected by an alarm system. The cup stands on a pressure sensor. If the cup is lifted, a buzzer sounds.

The diagram below shows part of the alarm system.
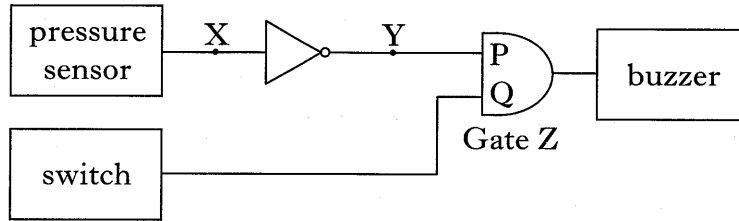
The logic states are as shown.

		Logic level
Pressure sensor output	cup present	1
	cup absent	0
Switch	on	1
	off	0
Buzzer input	buzzer sounds	1
	buzzer silent	0

(a) Complete the table for the logic levels at points X and Y in the diagram.

	Logic level at X	Logic level at Y
Cup present		
Cup absent		

(2)

(b) (i) What type of logic gate is Z?

.... **(1)**

(ii) P and Q are the inputs to gate Z.
Draw the truth table for gate Z.

Space for diagram

(2)

(c) What is the purpose of the switch in the alarm system?

....

.... **(1)**

16. A signal of 0·5 volt is applied to the input of an amplifier as shown. The voltage gain of the amplifier is 20.
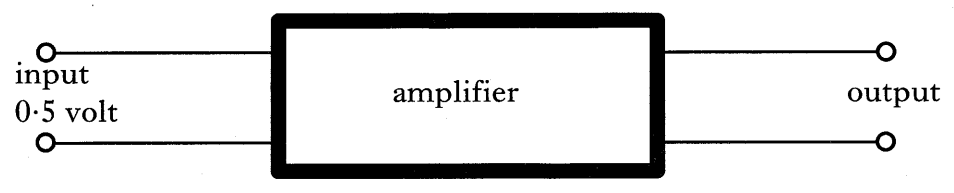
(a) Calculate the voltage at the output of the amplifier.

Space for working and answer

(2)

(b) The input signal has a frequency of 1000 hertz. What is the frequency of the signal at the ouput?

.... **(1)**

[Turn over

Marks

17. A helicopter of mass 12 000 kilograms travels to the scene of an accident to rescue an injured climber. The forces acting on the helicopter are as shown in the diagram.
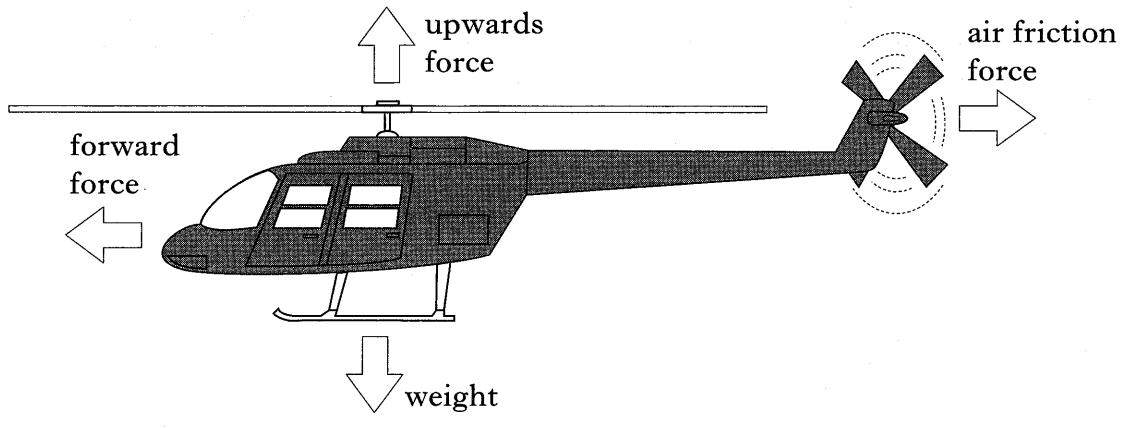
(a) The helicopter travels at a constant speed.

State how the forward force compares with the air friction force during the journey.

.... **(1)**

(b) Helicopter designers try to reduce the air friction force as much as possible. How can they do this?

.... **(1)**

(c) Calculate the weight of the helicopter.

> *Space for working and answer*

(2)

18. A class is doing an experiment to measure the power of a person running up stairs. The class is divided into two groups, X and Y, and a runner is chosen from each group. The results obtained by each group are shown below.

Group X

Mass of runner =	60 kilograms
Height of stairs =	8 metres
Time of run =	12·0 seconds

Group Y

Mass of runner =		45 kilograms
Height of stairs =		8 metres
Time: run 1	=	9·7 seconds
run 2	=	10·3 seconds
run 3	=	11·2 seconds
average	=	10·4 seconds

(*a*) (i) Calculate the potential energy gained by the runner in group X at the top of the stairs.

> *Space for working and answer*

(2)

(ii) Calculate the power developed by the runner in group X during the run.

> *Space for working and answer*

(2)

(*b*) (i) Suggest a reason why the times for the three runs made by the runner in group Y increase rather than remain about the same.

.... **(1)**

(ii) The pupils in group Y compared the average time of their runner with the time of the group X runner. They concluded that since the time for their runner was less, their runner developed more power.

By considering all the measurements that have been made, explain why this conclusion is wrong.

....

.... **(2)**

19. A wind farm on an island consists of 36 wind-powered generators. On a particular day, each generator has a power output of 600 kilowatts.

   (a)   (i)   Calculate the total power output of the wind farm on that day.

> *Space for working and answer*

(2)

         (ii)   On that day, 108 000 kilowatts of power are needed for the island. Calculate the percentage of this power that is supplied by the wind farm.

> *Space for working and answer*

(2)

   (b)   The wind farm was built to replace a coal-fired power station. Wind is a renewable source of energy; coal is a non-renewable source of energy.

         (i)   Name one other renewable source of energy.

.... **(1)**

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

.... **(1)**
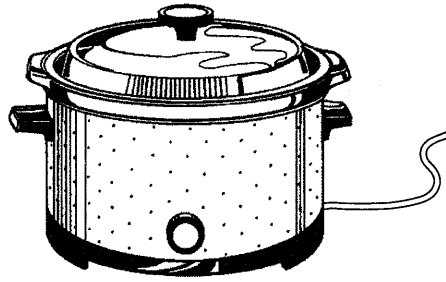
20. A deep fat fryer contains 1·2 kilograms of liquid cooking oil at a temperature of 20 degrees celsius. The oil has to be heated to a cooking temperature of 180 degrees celsius.

(*a*) Calculate the energy required to raise the temperature of the oil from 20 degrees celsius to cooking temperature.

[The specific heat capacity of the cooking oil is 2200 joules per kilogram per degree celsius.]

Space for working and answer

(2)

(*b*) The heater in the fryer is rated at 2400 watts.

(i) Calculate the minimum time needed for the oil to reach the cooking temperature.

Space for working and answer

(2)

(ii) In practice, the actual time is greater than the minimum time calculated.

Give one reason for this difference.

....

.... **(1)**

[Turn over

Marks

21. A spacecraft is sent on an unmanned mission to land on a distant planet.

The spacecraft is powered by rocket engines which can be turned on and off as necessary.

(*a*) State what happens to the motion of the spacecraft when its engines are turned on.

....

.... **(1)**
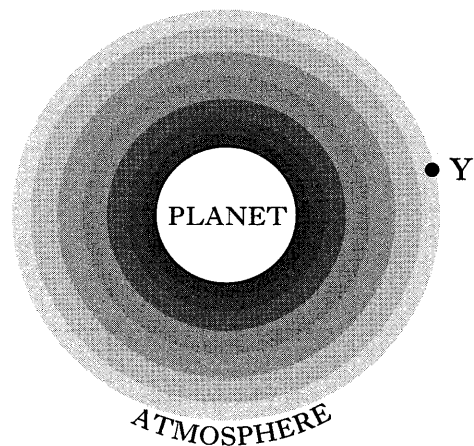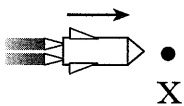
(*b*) At a point during the mission, where the spacecraft is far away from any planet, its engines are turned off.

Describe the motion of the spacecraft at this stage in the journey.

Explain your answer.

....

....

.... **(2)**

(*c*) The spacecraft now approaches the planet as shown, with its engines still switched off.

The spacecraft enters the planet's atmosphere at point Y.

•
X

PLANET

• Y

ATMOSPHERE

(i) On the diagram above, draw the path of the spacecraft as it travels from X to Y. **(1)**

(ii) The atmosphere exerts a frictional force on the spacecraft.

State **two** effects this has on the spacecraft.

....

.... **(2)**

22. Complete the passage below by choosing from the list of words given.
Use each word or phrase once only.

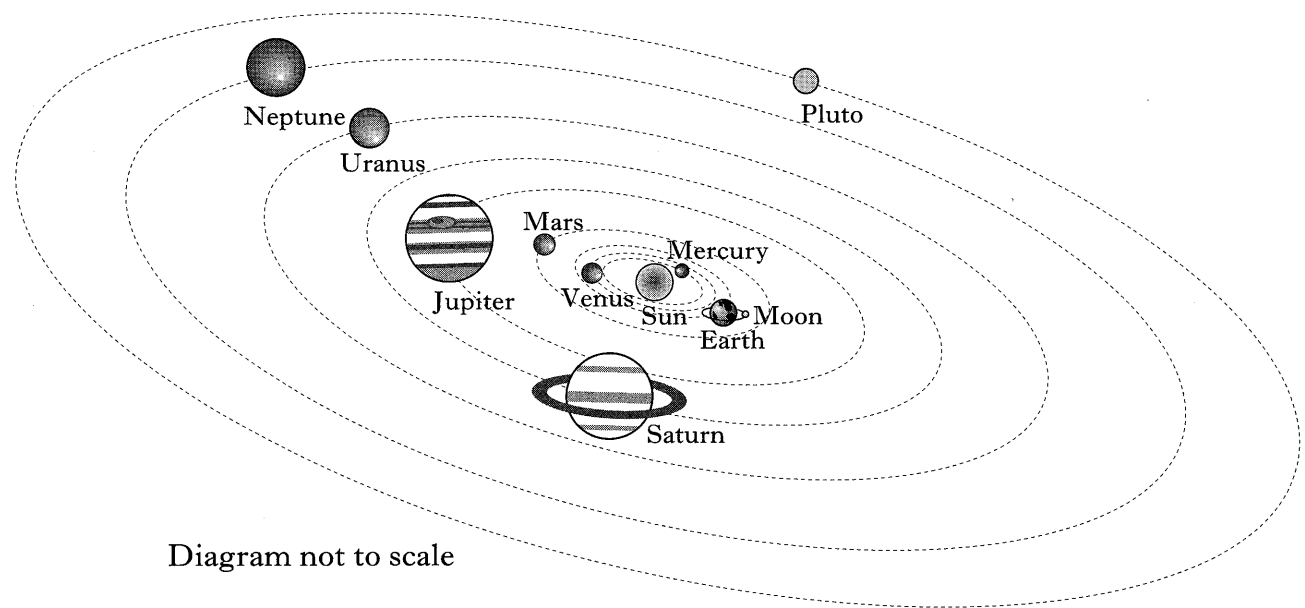**galaxy   Moon   planet   solar system   star   universe**

Diagram not to scale

The diagram shows our .... At the centre is the

Sun. The Sun is a gigantic ball of gas producing energy by nuclear

reactions.

The Earth is a .... which orbits the Sun.

The Earth has one natural satellite orbiting around it, called the

....

The Sun is an example of a ....

Millions of these bodies like our Sun are found in a ....

All of space is known as the ....   **(3)**

[END OF QUESTION PAPER]

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.