

Science (Single Award)
Physics
PAPER: 1P

Total Marks

Friday 14 June 2024 – Afternoon

Time: 1 hour 10 minutes

In the boxes below, write your name, centre number and candidate number.

Surname					
Other names					
Centre Number					
Candidate Number					

YOU MUST HAVE

Calculator, ruler, protractor, Equation Booklet (enclosed)

YOU WILL BE GIVEN

Formulae Booklet

Diagram Booklet

INSTRUCTIONS

Answer ALL questions.

Answer the questions in the spaces provided in this Question Paper or in the separate Diagram Booklet – there may be more space than you need.

Calculators may be used.

INFORMATION

The total mark for this paper is 60.

The marks for EACH question are shown in brackets – use this as a guide as to how much time to spend on each question.

There may be spare copies of some diagrams.

ADVICE

Read each question carefully before you start to answer it.

Write your answers neatly and in good English.

Try to answer every question.

Check your answers if you have time at the end.

Answer ALL questions.

Some questions must be answered with a cross in a box ☐. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☐.

- 1 Look at the image for Question 1 in the Diagram Booklet. It shows an electric lawnmower used to cut grass.**

The lawnmower is powered by a battery and has an electric motor and two switches.

A sharp blade is attached to the motor. The blade cuts the grass when the motor spins.

Look at the Diagram 1 for Question 1 in the Diagram Booklet. It shows how the electrical components are connected in a circuit.

(a) The lawnmower has two switches in its circuit.

- (i) Explain why the motor will not turn when only one switch is closed.
(2 marks)**

1(a) continued.

- (ii) Suggest why the lawnmower has two switches instead of only one switch.
(1 mark)**

(continued on the next page)

1 continued.

- (b) The lawnmower's motor has a voltage of 18 V across it.**

When the motor is turning, there is a current of 8.6 A in the motor.

- (i) State the formula linking voltage, current and resistance.
(1 mark)**

(continued on the next page)

1(b) continued.

(ii) Calculate the resistance of the motor.

**Give the unit.
(4 marks)**

resistance = _____

unit _____

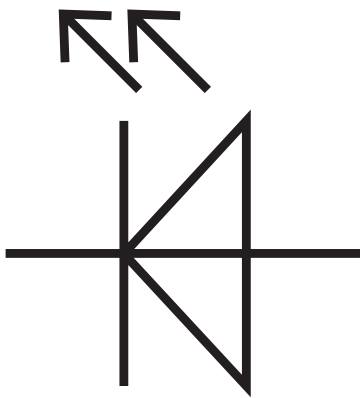
(continued on the next page)

Turn over

1 continued.

- (c) The manufacturer of the lawnmower wants to include a light emitting diode (**LED**) in the circuit that will emit light when the motor is turning.

The circuit symbol for an **LED** is



Look at Diagram **2** for Question 1(c) in the Diagram Booklet. Draw the **LED** on diagram **2** so that it will emit light when the motor is turning.
(2 marks)

(Total for Question 1 = 10 marks)

2 In 1976, a spacecraft called Viking 2 began orbiting the planet Mars.

(a) The orbit of Viking 2 was the same as the orbit of a moon.

**(i) Using the blank page for Question 2(a) in the Diagram Booklet, draw a labelled diagram to show how Viking 2 orbited Mars.
(2 marks)**

**(ii) Add a labelled arrow to the diagram you have created for Question 2(a)(i) in the Diagram Booklet to show the force that causes the spacecraft to orbit Mars.
(2 marks)**

(continued on the next page)

2 continued.

- (b) A landing vehicle was launched from Viking 2 when the spacecraft was in orbit.**

On the surface of Mars, the landing vehicle had a weight of 2.1 kN

- (i) State the formula linking weight, mass and gravitational field strength, g
(1 mark)**

(continued on the next page)

2(b) continued.

- (ii) The gravitational field strength on the surface of Mars is 3.7 N/kg**

**Calculate the mass of the landing vehicle.
(3 marks)**

mass = _____ kg

(continued on the next page)

2(b) continued.

- (iii) Suggest why the gravitational field strength on the surface of Mars is less than the gravitational field strength on the surface of Earth.
(1 mark)**

(Total for Question 2 = 9 marks)

- 3 A student investigates how the mass of sugar dissolved in water affects the refraction of light.**

This is the student's method.

Step 1 fill a semicircular dish with 100 cm^3 of pure water

Step 2 direct a ray of red light at the flat side of the dish at an angle of incidence of 45°

Step 3 measure the angle of refraction of the light at the flat surface of the dish

Step 4 make a solution of 25 g of sugar dissolved in 100 cm^3 of water

Step 5 refill the dish with the sugar solution and repeat steps 2 and 3

The student repeats this method with solutions made from different masses of sugar dissolved in 100 cm^3 of water.

(continued on the next page)

3 continued.

- (a) Look at the table for Question 3(a) in the Diagram Booklet. It gives some of the variables in the student's investigation.**

Place ticks (✓) in the table to show whether each variable is an independent, dependent or control variable.

(4 marks)

- (b) Look at the diagram for Question 3(b) in the Diagram Booklet. It shows the student's experiment when the semicircular dish contains pure water.**

- (i) Draw the normal line where the ray of light hits the flat side of the dish.**

(1 mark)

- (ii) The ray of light has an angle of refraction of 32.0° for pure water.**

Draw the refracted ray of light.

(2 marks)

(continued on the next page)

3 continued.

(c) Look at the grid for Question 3(c) in the Diagram Booklet. The table shows the student's results.

Mass of sugar in g	Angle of refraction in °
0	32·0
25	31·2
50	30·4
75	29·7
100	28·9
125	28·3
150	26·5
175	27·0

**(i) Plot a graph of the results on the grid.
(1 mark)**

(ii) One of the results is anomalous.

**Draw a circle around the anomalous result.
(1 mark)**

**(iii) Draw the curve of best fit.
(1 mark)**

(continued on the next page)

Turn over

3(c) continued.

- (iv) Describe the relationship between the mass of sugar and the angle of refraction.
(2 marks)**

(Total for Question 3 = 12 marks)

4 This question is about nuclear fission.

- (a) Look at the diagram for Question 4(a) in the Diagram Booklet. It shows a uranium-**235** nucleus undergoing nuclear fission when it absorbs a neutron.**

The uranium-235** nucleus splits into two daughter nuclei and three smaller particles.**

- (i) Give the name of the smaller particles released in nuclear fission.
(1 mark)**
-
-

- (ii) State what happens to the amount of energy in the NUCLEAR store of the nuclei during nuclear fission.
(1 mark)**
-
-

(continued on the next page)

4(a) continued.

- (iii) State what happens to the amount of energy in the KINETIC store of the daughter nuclei during nuclear fission.
(1 mark)**
-
-

- (b) In a power station, nuclear fission can be used to generate electricity.**

Some of the daughter nuclei produced in fission are highly radioactive and emit gamma radiation.

- (i) In a power station, nuclear fission takes place inside a nuclear reactor.**

**Explain why nuclear reactors are surrounded with thick layers of concrete.
(3 marks)**

Answer space continues on the next page.

4(b)(i) continued.

(continued on the next page)

4(b) continued.

- (ii) Look at the graph for Question 4(b)(ii) in the Diagram Booklet. It shows the energy of gamma radiation that passes through different thicknesses of concrete shielding.**

Determine the thickness of concrete needed to reduce the energy of gamma radiation by **90% (3 marks)**

thickness = _____ cm

(Total for Question 4 = 9 marks)

Turn over

5 This question is about the stopping distance of a car.

- (a) Look at the diagram for Question 5(a) in the Diagram Booklet. It shows the forces acting on a car when it is travelling forwards at a constant speed.**

The engine of the car applies a constant driving force in the forwards direction.

Force *X* acts on the car in the opposite direction to its motion.

**Give the name of the force *X*.
(1 mark)**

(continued on the next page)

5 continued.

(b) The road the car is travelling on is dry.

The driver of the car sees an obstacle in the road and needs to bring the car to a stop.

Look at the graph for Question 5(b) in the Diagram Booklet. The velocity-time graph shows how the velocity of the car changes from when the driver sees the obstacle until the car comes to a stop.

**(i) Determine the reaction time of the driver.
(1 mark)**

reaction time = _____ s

(continued on the next page)

5(b) continued.

- (ii) Calculate the total stopping distance of the car.
(4 marks)**

stopping distance = _____ m

(continued on the next page)

5(b) continued.

- (iii) Explain the effect of a wet road on the thinking distance and braking distance.
(4 marks)**

Answer space continues on the next page.

thinking distance

braking distance

Turn over

5(b)(iii) continued.

(Total for Question 5 = 10 marks)

6 This question is about gases.

(a) Look at the diagram for Question 6(a) in the Diagram Booklet. It shows some gas particles inside a closed container.

(i) The arrows in the diagram represent the velocities of the gas particles.

Explain what the diagram shows about the motion of the gas particles.

(2 marks)

(continued on the next page)

6(a) continued.

- (ii) Explain how the gas particles exert a pressure on the walls of the container.
(2 marks)**

(continued on the next page)

6 continued.

(b) Look at the table for Question 6(b) in the Diagram Booklet. It gives information about particles in a different sample of gas.

**(i) Calculate the mean speed of the particles in this gas sample.
(3 marks)**

$$\text{[kinetic energy} = \frac{1}{2} \times \text{mass} \times \text{speed}^2\text{]}$$

mean speed = _____ m/s

(continued on the next page)

6(b) continued.

- (ii) Calculate the total mass of gas in the sample.
(2 marks)**

total mass = _____ kg

(continued on the next page)

6(b) continued.

(iii) A student quickly compresses the gas.

They do **100 J** of work on the gas in a time of **0.5** seconds.

Which of these statements is **CORRECT**?

(1 mark)

☐ A **50 J** of energy is transferred to the gas

☐ B the rate of energy transferred to the gas is **200 W**

☐ C the gas particles move more slowly

☐ D the volume of the gas increases

(Total for Question 6 = 10 marks)

TOTAL FOR PAPER = 60 MARKS

END OF PAPER