Paper Reference(s) 1SC0/1PH
Pearson Edexcel Level 1/Level 2 GCSE (9–1)

Total Marks

Combined Science
PAPER 3
Higher Tier

Wednesday 22 May 2024 – Morning

Time: 1 hour 10 minutes

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

Surname						
Other names						
Centre Number						
Candidate Number						

V74480A

Pearson

YOU MUST HAVE

Calculator, ruler, Equation Booklet (enclosed)

YOU WILL BE GIVEN

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.

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.

In questions marked with an ASTERISK (*), marks will be awarded for your ability to structure your answer logically, showing how the points you make are related or follow on from each other where appropriate.

There may be spare copies of some diagrams.

ADVICE

Read each question carefully before you start to answer it.

Try to answer every question.

Check your answers if you have time at the end.

Answer ALL questions. Write your answers in the spaces provided.

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 Figure 1 for Question 1 in the Diagram Booklet. It shows a person on a skateboard at the top of a ramp.

At **P**, the person is not moving.

(a) The person rides the skateboard down the ramp from **P** to **Q**.

The gravitational potential energy of the person decreases by **980 J**

The mass of the person is **35 kg**

Calculate **h**, the height of the ramp.
(2 marks)

Use **g = 10 N/kg**

Use the equation

change in gravitational potential energy = **m × g × h**

Answer space continues on the next page.

1(a) continued.

change in gravitational potential energy =
m × g × h

h = _____ m

(continued on the next page)

1 continued.

(b) The kinetic energy, **KE**, of the person at **Q** is **950 J**

The mass of the person is **35 kg**

Calculate the velocity of the person at **Q**.
(3 marks)

Use the equation

$$v^2 = \frac{2 \times KE}{m}$$

Answer space continues on the next page.

1(b) continued.

velocity = _____ m/s

(continued on the next page)

1 continued.

(c) Look at Figure 2 for Question 1(c) in the Diagram Booklet. It is a diagram that represents energy changes from **P** to **Q**.

(i) State what is represented by **X**. (1 mark)

(continued on the next page)

1(c) continued.

(ii) Calculate the value of **X**.
(1 mark)

value of **X** = _____ J

(continued on the next page)

1(c) continued.

(iii) Look again at Figure 2 for Question 1(c) in the Diagram Booklet. Calculate the efficiency of the system represented in Figure 2. (2 marks)

efficiency = _____

(Total for Question 1 = 9 marks)

2 (a) Two people, L and M, have a 100 m race.

L starts running before M.

Look at Figure 3 for Question 2(a) in the Diagram Booklet. It shows a distance/time graph of the race.

(i) State the DISTANCE that L has run when M overtakes. (1 mark)

distance = _____ m

(continued on the next page)

2(a) continued.

(ii) Look again at Figure 4 for Question 3(a) in the Diagram Booklet. Calculate the velocity of L when running the 100 m race. (2 marks)

velocity = _____ m/s

(continued on the next page)

2 continued.

(b) A motorcycle is travelling at a velocity of $6 \cdot 2\,m/s$

The motorcycle accelerates at $2 \cdot 5\,m/s^2$ until its velocity is $10\,m/s$

(i) Calculate the time taken for this acceleration.
(2 marks)

Use the equation

$$\text{time taken} = \frac{\text{change in velocity}}{\text{acceleration}}$$

Answer space continues on the next page.

2(b)(i) continued.

$$\text{time taken} = \frac{\text{change in velocity}}{\text{acceleration}}$$

time taken = _____ s

(continued on the next page)

2(b) continued.

(ii) The motorcycle now decelerates (slows down) from $10\,m/s$ to a stop.

The deceleration is at a constant rate of $4{\cdot}4\,m/s^2$

Calculate the distance the motorcycle travels as it slows down to a stop.
(2 marks)

Use the equation

$$v^2 - u^2 = 2 \times a \times x$$

Answer space continues on the next page.

2(b)(ii) continued.

$$v^2 - u^2 = 2 \times a \times x$$

distance = _____ m

(continued on the next page)

2 continued.

(c) A car collides with a barrier on a road.

The time of the collision is very short.

Explain ONE factor, other than the time of the collision, that would affect the force on the car in the collision.

Your explanation should refer to an equation in the Equation Booklet.
(2 marks)

(Total for Question 2 = 9 marks)

3 Ultraviolet (UV) waves from the Sun travel towards the Earth.

Ultraviolet waves can be grouped by wavelength.

The three groups of wavelengths are **UVA**, **UVB** and **UVC**.

Look at Figure 4 for Question 3 in the Diagram Booklet. It shows, for each group,

- the wavelength range
- the effect of the Earth's atmosphere on each type of **UV** wave.

(continued on the next page)

3 continued.

(a) (i) Explain why **UVC** is potentially the most dangerous ultraviolet radiation but does not cause harm to people.
(2 marks)

(continued on the next page)

3(a) continued.

(ii) The speed of electromagnetic radiation is $3{\cdot}00 \times 10^8$ m/s

Calculate the frequency of the shortest wavelength of **UVB** radiation.

(3 marks)

frequency = _____ Hz

(continued on the next page)

3 continued.

(b) UV radiation of wavelength 365 nm is used to detect forged banknotes.

In a genuine banknote there are marks that CANNOT be seen using visible light. These marks CAN be seen using UV radiation.

Explain why the marks can be seen when the UV radiation shines on the banknote.

Your answer should refer to the energy of electrons in atoms.

You may draw a diagram to help with your answer.
(4 marks)

Answer space continues on the next 2 pages.

3(b) continued.

3(b) continued.

(Total for Question 3 = 9 marks)

4 (a) Look at Figure 5 for Question 4(a) in the Diagram Booklet. A car starts from rest and then travels for 70 s as shown on the graph in Figure 5.

(i) Complete the sentence using data from Figure 5.
(1 mark)

The car is travelling at constant velocity

from _____ s

to _____ s.

(continued on the next page)

4(a) continued.

(ii) Look again at Figure 5 for Question 4(a) in the Diagram Booklet. Use data from the graph in Figure 5 to show that the car travels a total distance of about **710 m** in **70 s**.

(3 marks)

Answer space continues on the next page.

4(a)(ii) continued.

(continued on the next page)

4(a) continued.

(iii) Calculate the average speed of the car for the total distance travelled. (1 mark)

average speed = _____ m/s

(continued on the next page)

4 continued.

(b) The **INERTIAL** mass of an object is a measure of how difficult it is to change the velocity of the object.

A force of **450 N** acts on a car to give the car an acceleration of $0{\cdot}35\,m/s^2$

Calculate the INERTIAL mass of the car.
(2 marks)

Answer space continues on the next page.

4(b) continued.

inertial mass of car _____ kg

(continued on the next page)

4 continued.

(c) Look at Figure 6 for Question 4(c) in the Diagram Booklet. It shows a different velocity / time graph.

This straight line graph can be represented by the equation

$$y = mx + c$$

(i) Give the quantities that x and y represent in the equation.
(1 mark)

x represents _____

y represents _____

(continued on the next page)

4(c) continued.

(ii) Look again at Figure 6 for Question 4(c) in the Diagram Booklet. Calculate the value of m from the graph in Figure 6. (2 marks)

m = _____ m/s^2

(continued on the next page)

4(c) continued.

(iii) Look again at Figure 6 for Question 4(c) in the Diagram Booklet. State the value of **C** from the graph in Figure 6.
(1 mark)

value of **C** = _____

(Total for Question 4 = 11 marks)

5 (a) An electron has a charge of –1

The charge on an alpha particle is
(1 mark)

☐ A –2

☐ B 0

☐ C +1

☐ D +2

(b) Alpha, beta and gamma are all IONISING radiations.

Give the meaning of the term IONISING.
(1 mark)

(continued on the next page)

5 continued.

(c) A teacher determines the background radiation count rate in a laboratory.

Explain how to determine a value for the background radiation count rate. (3 marks)

(continued on the next page)

5 continued.

(d) The teacher now investigates the absorption of beta radiation by different thicknesses of aluminium.

The apparatus available is

- a source of beta radiation
- a Geiger–Müller (G-M) tube and counter
- 10 pieces of aluminium, each 0·5 mm thick
- a metre rule.

(continued on the next page)

5(d) continued.

(i) Sketch a labelled diagram showing the positions of the apparatus when the measurements are being taken. (2 marks)

(continued on the next page)

5(d) continued.

(ii) Give the independent variable in this investigation.
(1 mark)

(iii) Name a quantity that must be kept constant during the investigation.
(1 mark)

(continued on the next page)

5(d) continued.

(iv) Strontium-90 is the source of beta minus radiation in this investigation.

Look at the equation for Question 5(d)(iv) in the Diagram Booklet. Complete the nuclear equation for this emission of beta minus radiation.
(2 marks)

(Total for Question 5 = 11 marks)

6 (a) Look at Figure 7 for Question 6(a) in the Diagram Booklet. It shows a ball being rotated in a horizontal circle.

(i) Which arrow in Figure 7 shows the direction of the centripetal force on the ball?
(1 mark)

☐ A

☐ B

☐ C

☐ D

(continued on the next page)

6(a) continued.

(ii) Look again at Figure 7 for Question 6(a) in the Diagram Booklet. The ball is moving at constant speed. Give ONE reason why the velocity of the ball is continuously changing.

(1 mark)

(continued on the next page)

6 continued.

(b) Look at Figure 8 for Question 6(b) in the Diagram Booklet. It shows a gymnast landing on a mat and coming to rest.

The gymnast has a mass of 53 kg

The gymnast lands on the mat with a velocity of 4·0 m/s

The average force exerted by the mat on the gymnast is 3500 N

Calculate the time taken for the gymnast to come to rest.

Give your answer to an appropriate number of significant figures.
(3 marks)

Use the equation

$$\text{force} = \frac{\text{change in momentum}}{\text{time}}$$

Answer space continues on the next page.

6(b) continued.

$$\text{force} = \frac{\text{change in momentum}}{\text{time}}$$

time = _____ s

(continued on the next page)

6 continued.

*(c) Look at Figure 9 for Question 6(c) in the Diagram Booklet. It shows two trolleys, P and Q, moving at the same speed, v, directly towards each other.

The trolleys have the same mass.

When the trolleys collide, they stick together and stop.

Explain how momentum and energy are both conserved in this collision. (6 marks)

Answer space continues on the next 2 pages.

6(c) continued.

6(c) continued.

(Total for Question 6 = 11 marks)

TOTAL FOR PAPER = 60 MARKS

END OF PAPER