

**Combined Science**  
**PAPER 3**  
**Foundation Tier**

Total Marks
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**Thursday 25 May 2023 – Morning**

**Time: 1 hour 10 minutes**

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

<b>Surname</b>					
<b>Other names</b>					
<b>Centre Number</b>					
<b>Candidate Number</b>					

## **YOU MUST HAVE**

**Calculator, ruler, Equation Booklet (enclosed)**

## **YOU WILL BE GIVEN**

**Diagram Booklet, Formulae 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 that you make are related or follow on from each other where appropriate.**

**A list of equations is provided as a separate booklet.**

**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.**

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**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 This question is about waves in the electromagnetic (e-m) spectrum.**

- (a) (i) Look at Figure 1 for Question 1(a) in the Diagram Booklet. It shows some types of radiation that form part of the e-m spectrum and some uses of e-m radiation.**

**Draw ONE straight line from each type of e-m radiation to its use.**

**ONE line has been drawn for you.  
(3 marks)**

**(continued on the next page)**

**1(a) continued.**

**(ii) Which of these waves has the highest frequency?  
(1 mark)**

- ☐ **A    infrared**
- ☐ **B    microwaves**
- ☐ **C    ultraviolet**
- ☐ **D    visible light**

**(continued on the next page)**

**1 continued.**

**(b) X-rays are also part of the e-m spectrum.**

**Look at Figure 2 for Question 1(b) in the Diagram Booklet. It shows an airport security scanner using X-rays to scan passengers' bags.**

**(i) Explain why X-rays are used to scan passengers' bags.  
(2 marks)**

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**(continued on the next page)**

**1(b) continued.**

- (ii) Explain why passengers are NOT scanned with X-rays.  
(2 marks)**

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**(Total for Question 1 = 8 marks)**

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- 2 (a) Look at Figure 3 for Question 2(a) in the Diagram Booklet. The graph shows how the velocity of a car changes with time.

The car starts from rest and travels along a level, straight road for 50 s.

- (i) Which part of the graph shows when the car has constant velocity?  
(1 mark)

☐ A PQ

☐ B QR

☐ C RS

☐ D ST

- (ii) Which part of the graph shows when the car has the greatest acceleration?  
(1 mark)

☐ A PQ

☐ B QR

☐ C RS

☐ D ST



**2(a) continued.**

- (iii) Calculate the acceleration of the car in the first 10 s shown on the graph.  
(2 marks)**

**Use the equation**

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

$$\text{acceleration} = \underline{\hspace{4cm}} \text{ m/s}^2$$

**(continued on the next page)**

**2(a) continued.**

- (iv) Calculate the distance the car travels in part QR shown on the velocity/time graph in Figure 3.  
(3 marks)**

**distance = \_\_\_\_\_ m**

**(continued on the next page)**

**2 continued.**

**(b) A different car has a mass of 1200 kg.**

**Calculate the force needed to give this car an  
acceleration of  $2.4 \text{ m/s}^2$   
(2 marks)**

**Use the equation**

$$F = m \times a$$

**force = \_\_\_\_\_ N**

**(Total for Question 2 = 9 marks)**

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- 3 An atom has a central nucleus containing neutrons and protons.**

**Electrons orbit the nucleus.**

- (a) (i) Which row of the table gives the relative mass and charge of a proton?  
(1 mark)**

	<b>relative mass</b>	<b>charge</b>
<input type="checkbox"/> <b>A</b>	<b>0</b>	<b>+1</b>
<input type="checkbox"/> <b>B</b>	<b>0</b>	<b>−1</b>
<input type="checkbox"/> <b>C</b>	<b>1</b>	<b>+1</b>
<input type="checkbox"/> <b>D</b>	<b>1</b>	<b>−1</b>

**(continued on the next page)**

**3(a) continued.**

**(ii) An atom has a radius of  $1.0 \times 10^{-10}$  m.**

**A nucleus has a radius of  $1.0 \times 10^{-15}$  m.**

**Calculate the ratio of the radius of the atom to the radius of the nucleus.**

**(2 marks)**

**ratio of radius of atom to radius of nucleus =**

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**(continued on the next page)**

**3(a) continued.**

**(iii) Explain why an atom has no charge overall.  
(2 marks)**

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**(continued on the next page)**

**3 continued.**

**(b) One isotope of carbon is carbon-14.**



- (i) State the number of protons in one atom of carbon-14.  
(1 mark)**

**number of protons = \_\_\_\_\_**

- (ii) State the number of neutrons in one atom of carbon-14.  
(1 mark)**

**number of neutrons = \_\_\_\_\_**

**(continued on the next page)**

**3(b) continued.**

**(iii) Look at Figure 4 for Question 3(b)(iii) in the Diagram Booklet. It shows a graph for the decay of the radioactive isotope carbon-14.**

**Use the graph to estimate the half-life of carbon-14.**

**(2 marks)**

**half-life = \_\_\_\_\_ years**

**(Total for Question 3 = 9 marks)**

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**4 (a) Look at Figure 5 for Question 4(a) in the Diagram Booklet. It shows a wave on the surface of water.**

**(i) Which of the arrowed lines shows the amplitude of the wave?  
(1 mark)**

☐ **A**

☐ **B**

☐ **C**

☐ **D**

**(ii) Explain why the wave shown in Figure 5 is a transverse wave.  
(2 marks)**

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**4 continued.**

- (b) Look at Figure 6 for Question 4(b) in the Diagram Booklet. It shows the top view of the wave pattern on screen and the side view of a ripple tank.**

**A screen is placed below the ripple tank.**

**The wave pattern produced by the ripples can be seen on the screen.**

**A student has a stop clock and a ruler.**

- (i) Describe how the student could measure the frequency of the ripples.  
(2 marks)**

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**(continued on the next page)**

**4(b) continued.**

- (ii) Describe how the student could measure the wavelength of the ripples.  
(2 marks)**

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**(continued on the next page)**

**4 continued.**

- (c) In a swimming pool, a wave is produced with a wavelength of 4.0 m and a velocity of 0.8 m/s.**

**Calculate the frequency of the wave.**

**State the unit of frequency.**

**(3 marks)**

**Use the equation**

$$v = f \times \lambda$$

**Answer space continues on the next page.**

**4(c) continued.**

**frequency of wave** \_\_\_\_\_

**unit** \_\_\_\_\_

**(Total for Question 4 = 10 marks)**

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- 5 (a) Which of these is a scalar quantity?**  
**(1 mark)**

☐ **A acceleration**

☐ **B distance**

☐ **C force**

☐ **D weight**

- (b) A student has some cupcake cases.**

**Look at the diagrams for Question 5(b) in the Diagram Booklet. One cupcake case is shown in Figure 7.**

**The student drops a stack of cupcake cases with the base facing downwards, as shown in Figure 8.**

**The speed of the falling stack of cupcake cases depends on the number of cupcake cases in the stack.**

**(continued on the next page)**

**5(b) continued.**

- (i) The student also has a stop clock and a metre rule.**

**Describe an investigation to show how the speed of the falling stack of cupcake cases depends on the number of cupcake cases in the stack.**

**(4 marks)**

**Answer lines continue on the next page.**

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**5(b)(i) continued.**

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**5(b) continued.**

- (ii) A stack of cupcake cases has a mass of 0.005 kg.**

**Calculate the weight, in newtons, of the stack of cupcake cases.**

**Gravitational field strength = 10 N/kg  
(2 marks)**

**Use the equation**

$$W = mg$$

**weight = \_\_\_\_\_ N**

**(continued on the next page)**

**Turn over**

**5(b) continued.**

**Look at Figure 9 for Question 5(b)(iii) in the Diagram Booklet. It shows a cupcake case that is falling at a constant velocity.**

**(iii) Draw an arrow on Figure 9 to show the force due to air resistance on the cupcake case.  
(1 mark)**

**(iv) State the value of the acceleration of the cupcake case when it is falling at a constant velocity.  
(1 mark)**

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**(continued on the next page)**

**5 continued.**

**(c) A car travels along a straight road.**

**The car accelerates at  $3 \text{ m/s}^2$  for a time of 7 s.**

**Calculate the change in velocity of the car.**

**(2 marks)**

**Use the equation**

**change in velocity = acceleration  $\times$  time taken**

**change in velocity = \_\_\_\_\_ m/s**

**(Total for Question 5 = 11 marks)**

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- 6 (a) Look at Figure 10 for Question 6(a) in the Diagram Booklet. It shows a football kicked against a wall.

The football has a mass of 0.42 kg.

- (i) The football gains 11 J of gravitational potential energy as it moves from the ground to the wall.

Calculate the height at which the ball hits the wall.

(3 marks)

Gravitational field strength = 10 N/kg

Use the equation

$$\Delta \text{GPE} = m \times g \times \Delta h$$

height = \_\_\_\_\_ m

**6(a) continued.**

- (ii) Calculate the kinetic energy of the football when it is moving at a velocity of 12m/s.  
(2 marks)**

**Use the equation**

$$\text{KE} = \frac{1}{2} \times m \times v^2$$

**kinetic energy = \_\_\_\_\_ J**

**(continued on the next page)**

**6(a) continued.**

- (iii) Describe the energy transfers that happen when the ball hits the wall.  
(2 marks)**

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**\*(b) In the UK, electricity is generated using non-renewable and renewable energy resources.**

**Look at Figure 11 for Question 6(b) in the Diagram Booklet. The graph shows how the amount of electricity generated by these resources changed from 2012 to 2020.**

**(continued on the next page)**

**6(b) continued.**

**Explain how and why the amount of electricity generated by renewable and non-renewable energy resources has changed from 2012 to 2020.**

**Your answer should include**

- **the trends shown in Figure 11**
- **the change in the amount of electricity generated by at least one renewable resource**
- **the change in the amount of electricity generated by at least one non-renewable resource.**

**(6 marks)**

**Answer lines continue on the next 2 pages.**

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**6(b) continued.**

[illegible]

**Turn over**



6(b) continued.

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(Total for Question 6 = 13 marks)

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**TOTAL FOR PAPER = 60 MARKS**

**END OF PAPER**