Surname	Centre Number	Candidate Number
First name(s)		0

GCSE

S24-3430U60-1

3430U60-1

FRIDAY, 24 MAY 2024 – MORNING

SCIENCE (Double Award)
Unit 6 – PHYSICS 2
FOUNDATION TIER

1 hour 15 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**9**	
2.	**3**	
3.	**10**	
4.	**12**	
5.	**11**	
6.	**6**	
7.	**9**	
Total	**60**	

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ADDITIONAL MATERIALS

In addition to this paper you will require a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

The assessment of the quality of extended response (QER) will take place in question **4**(a).

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Equations

$\text{speed} = \dfrac{\text{distance}}{\text{time}}$	
$\text{acceleration [or deceleration]} = \dfrac{\text{change in velocity}}{\text{time}}$	$a = \dfrac{\Delta v}{t}$
acceleration = gradient of a velocity-time graph	
resultant force = mass × acceleration	$F = ma$
weight = mass × gravitational field strength	$W = mg$
work = force × distance	$W = Fd$
force = spring constant × extension	$F = kx$

SI multipliers

Prefix	Symbol	Conversion factor	Multiplier
milli	m	divide by 1000	1×10^{-3}
centi	c	divide by 100	1×10^{-2}
kilo	k	multiply by 1000	1×10^{3}
mega	M	multiply by 1 000 000	1×10^{6}

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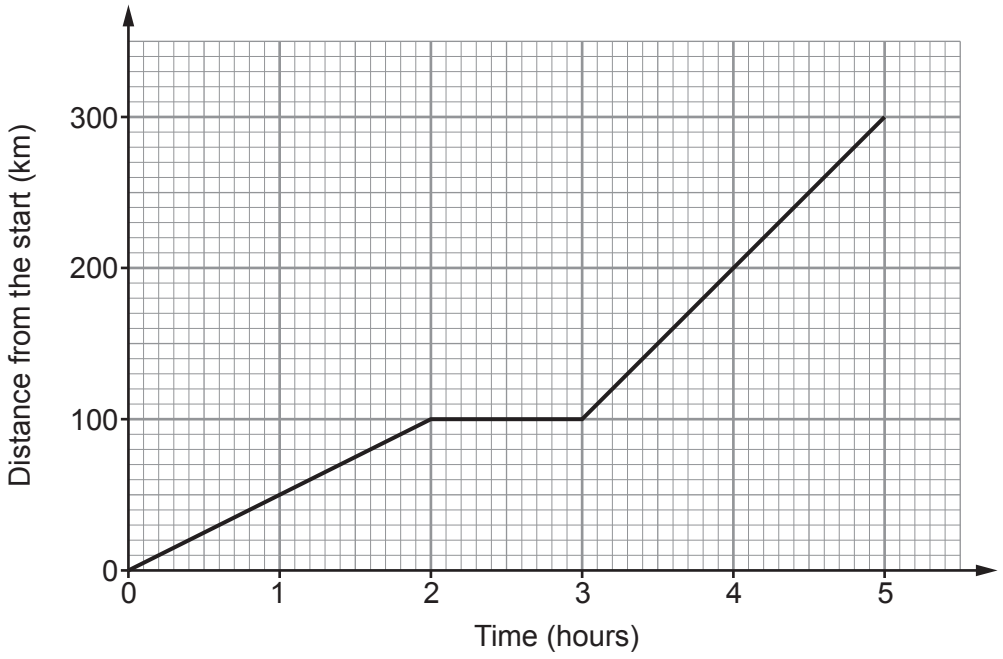
Answer **all** questions.

1. The graph below shows a journey by car.



Use the graph to answer the following questions.

(a) Use words from the box to complete the sentences below. [3]

has a constant speed	is not moving	is speeding up	is slowing down

Each phrase may be used once, more than once or not at all.

(i) In the first 2 hours, the car .....

(ii) Between 2 and 3 hours, the car .....

(iii) Between 3 and 5 hours, the car .....

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(b) (i) State the total distance travelled by the car. [1]

distance = ... km

(ii) Use your answer in (b)(i) and the equation:

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

to calculate the mean speed for the journey shown. [3]

mean speed = ... km/h

(c) Ian says the car's speed was greater in the first 2 hours than between 3 and 5 hours.
Robert disagrees and says the car was moving faster between 3 and 5 hours.

Complete the following sentences. [2]

During the first 2 hours, the car travelled ..... km.

Between 3 and 5 hours, the car travelled ..... km so I agree with

.....

3430U601
05

9

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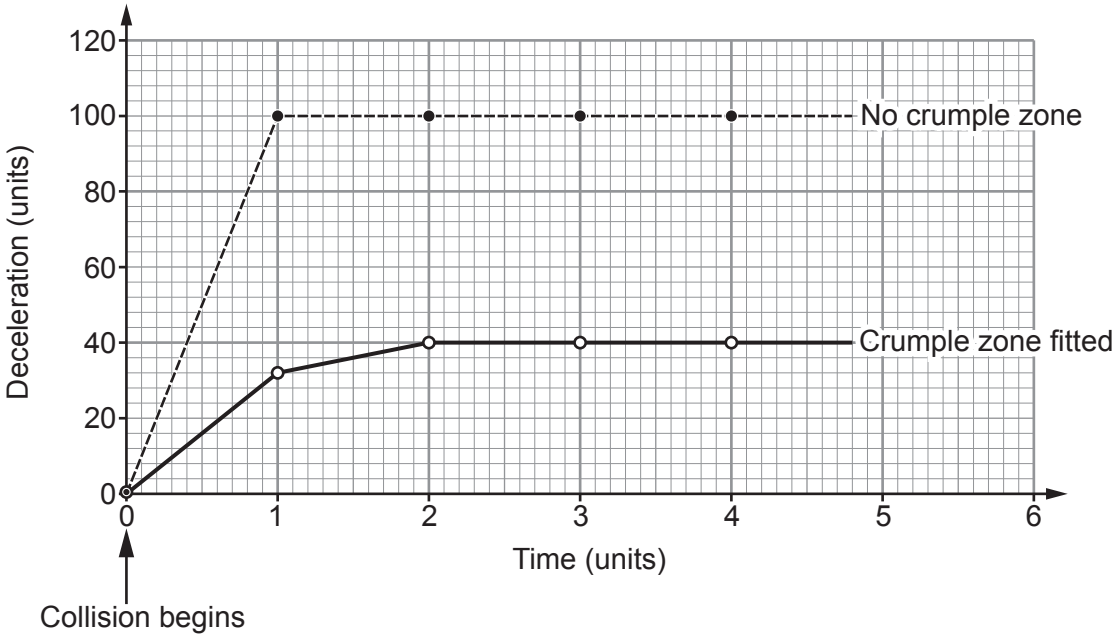
2. (a) Complete the sentence below by underlining the correct word in brackets. [1]

The (**acceleration** / **mass** / **speed**) of a car is a measure of its inertia.

(b) The graph below shows how the deceleration of car passengers compares during a collision with and without crumple zones fitted.



Use the information above to answer the following questions.

(i) When a crumple zone is fitted, state how long it takes to reach maximum deceleration after a collision begins. [1]

time = ... units

(ii) State the value of the maximum deceleration when the car has no crumple zone. [1]

maximum deceleration = ... units

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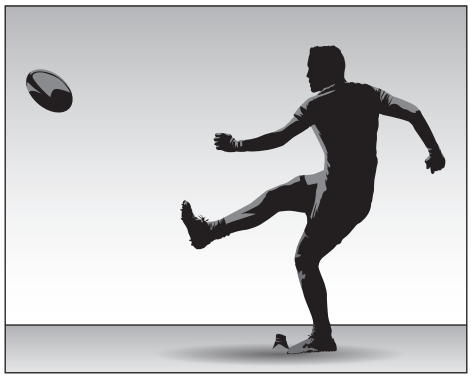
3. A rugby player kicks a ball up into the air.



Ignore the effects of air resistance when answering the following questions.

(a) Place **one** tick (✓) in each row to show what happens to each property as the ball **rises**. One row has been completed for you. [4]

Property of the ball	Stays constant	Gets smaller	Gets larger
acceleration	✓		
speed			
kinetic energy			
potential energy			
total energy			

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(b) (i) The rugby ball has a mass of 0.46 kg.
Use the equation:

resultant force = mass × acceleration

to calculate the force on the ball due to gravity as it moves through the air. [2]
(acceleration due to gravity, $g = 10\,m/s^2$)

resultant force = ... N

(ii) The rugby ball rises 15 m into the air.
Use your answer in (b)(i) and the equation:

work done = force × distance

to calculate the work done by gravity on the ball.
Give the correct unit. [3]

work done = ...

unit = ...

(iii) John says the resultant force calculated in (b)(i) is the same as the weight of the ball.
He thinks this because:

weight = mass × gravitational field strength

Explain whether you agree with John. [1]

.....

.....

10

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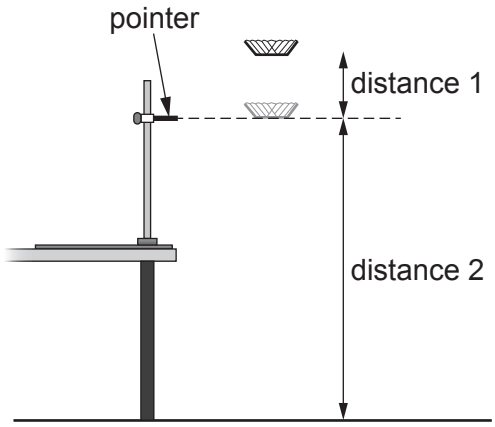
4. A group of students is investigating how the terminal speed of cake cases is affected by the number being dropped.
They set up the apparatus as shown in the diagram below.



(a) Describe a suitable method for this investigation. [6 QER]

You should include in your answer:

- how the apparatus is set up
- suitable values for distances 1 and 2
- the measurements taken.

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(b) The results from the investigation are shown in the table below.

Number of cake cases	Mass of cake cases (g)	Terminal speed (m/s)
0	0.0	0.0
2	1.0	2.5
3	.....	4.8
4	2.0	4.3
5	2.5	5.0
6	3.0	5.5

(i) **Complete** the table. [1]

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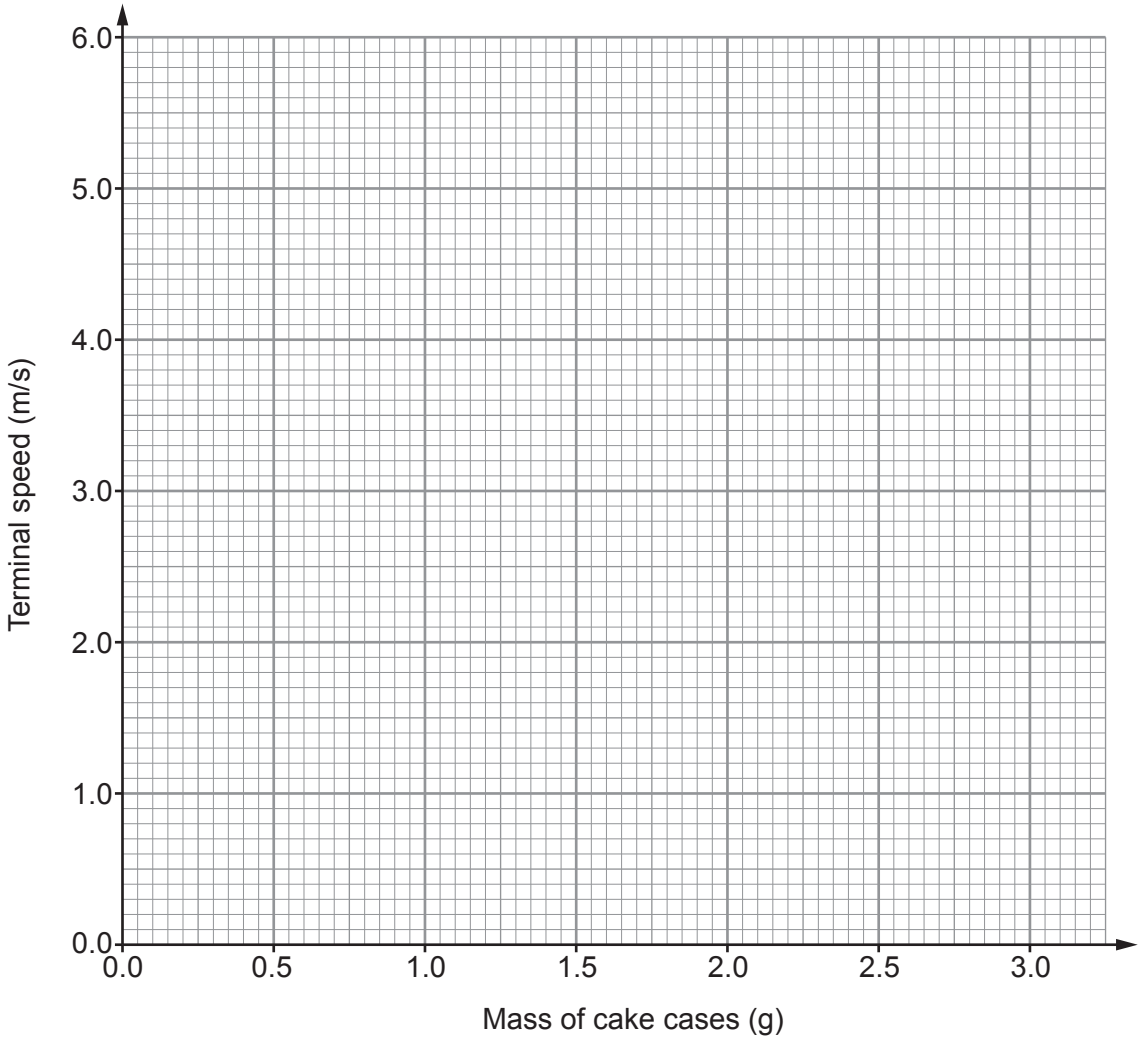
(ii) I. **Plot** the data on the grid below. [2]

II. Circle the anomalous result on the grid below. [1]

III. **Draw** a suitable curve of best fit. [1]



(iii) Use the graph to find the terminal speed for **1** cake case. [1]

terminal speed = ... m/s

12

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5. The table gives information about some radioactive isotopes.

Radioactive isotope	Radiation emitted	Half-life	Use
sodium-24	beta and gamma	15 hours	detecting leaks in underground pipes
technetium-99m	gamma	6 hours	radioactive tracer which is injected into blood
iridium-192	gamma	74 days	detecting cracks inside steel plates
francium-223	alpha or beta	22 minutes	no uses
palladium-103	beta	17 days	treating tumours by direct injection
radon-222	alpha	3.8 days	early warning for earthquakes

Use the information to answer the questions below.

(a) The time for radioactive isotopes to decay to a safe level is different for each one.

(i) State which radioactive isotope decays most quickly. ..... [1]

(ii) **Complete the table below**, which shows the time to decay to a fraction of $\frac{1}{32}$. [3]

Fraction remaining	Time		
	Palladium-103	Sodium-24	Technetium-99m
1	0	0	0
$\frac{1}{2}$	17 days	15 hours	.....
$\frac{1}{4}$	34 days	30 hours	.....
$\frac{1}{8}$	51 days	45 hours	.....
$\frac{1}{16}$	68 days	.....	.....
$\frac{1}{32}$	85 days	75 hours	.....

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(b) (i) Explain why iridium-192 is suitable for detecting cracks inside steel plates. [2]

.....

.....

.....

(ii) Explain why palladium-103 is suitable for treating cancer by directly injecting it into a tumour. [2]

.....

.....

.....

(iii) I. Radon-222 gas can be dangerous when breathed in.
Explain why. [2]

.....

.....

.....

II. State why radon-222 levels vary across the UK. [1]

.....

.....

11

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6. Our solar system formed about 4.5 billion years ago.

(a) Tick (✓) the boxes next to the **two** correct statements. [2]

Our solar system originated from a cloud of gas and dust. ☐

The heavy elements in our solar system originated from a supernova. ☐

The Sun formed when large asteroids clumped together. ☐

At the end of our Sun's life, heavy elements will be returned to space. ☐

(b) The table gives information about some planets in our solar system.

Planet	Mean distance from Sun (AU)	Diameter (1000 km)	Length of day (Earth days)	Length of year i.e. time to orbit the Sun (Earth years)
Venus	0.7	12	243	0.6
Earth	1.0	13	1	1
Mars	1.5	7	1	2
Saturn	9.5	120	0.4	29
Uranus	19.2	50	0.7	84
Neptune	30.0	50	0.7	165

Use the information in the table to answer the following questions.

(i) State which planet is closest in size to Earth. ..... [1]

(ii) State which planet has a day length longer than its year. ..... [1]

Examiner only

(iii) Natalie says the larger the gas giant planet the longer its days are.
Rhian says Natalie is wrong.
Explain whether you agree with Natalie or Rhian. [2]

.....

.....

.....

6

Examiner only

7. Three different radioactive isotopes, **X**, **Y** and **Z** are investigated.
The table below shows the count rate detected when different absorbers are placed between each radioactive isotope and a detector.
The distance between the detector and the radioactive isotopes is fixed.

The count rates have been corrected for background radiation.

Radioactive isotope	Count rate (units)			
	No absorber	Paper	Aluminium	Lead
X	20	20	20	6
Y	74	74	56	15
Z	44	32	32	12

(a) Explain how to correct count rates for background radiation. [2]

.....

.....

.....

(b) The radioactive isotopes used and the radiation they emit is shown in the table below.

Radioactive isotope	Radiation emitted
silver-110	beta and gamma
cobalt-60	gamma
radium-226	alpha and gamma

Use the information in both tables to identify the radiation(s) emitted by **X and Y** and identify these isotopes.

(i) Radioactive isotope **X** emits .....

Radioactive isotope **X** is ..... [2]

(ii) Radioactive isotope **Y** emits .....

Radioactive isotope **Y** is ..... [3]

Examiner only

(c) One isotope of silver has the symbol $^{110}_{47}\mathrm{Ag}$.

Complete the following sentences using numbers from the box.

47	63	110	157

(i) The number of protons in an atom of silver is ..... [1]

(ii) The number of neutrons in an atom of this isotope of silver is ..... [1]

9

END OF PAPER

Question number	Additional page, if required. Write the question number(s) in the left-hand margin.

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