Surname	Centre Number	Candidate Number
Other Names		0

GCSE – NEW

3430U60-1

S18-3430U60-1

SCIENCE (Double Award)

Unit 6 – PHYSICS 2
FOUNDATION TIER

WEDNESDAY, 23 MAY 2018 – AFTERNOON

1 hour 15 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**6**	
2.	**8**	
3.	**8**	
4.	**8**	
5.	**15**	
6.	**15**	
Total	**60**	

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ADDITIONAL MATERIALS

In addition to this examination paper, you may require a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

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

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 continuation page 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 ***5(a)*(ii)**.

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Equations

speed = $\frac{\text{distance}}{\text{time}}$	
acceleration [or deceleration] = $\frac{\text{change in velocity}}{\text{time}}$	$a = \frac{\Delta v}{t}$
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	Multiplier
m	1×10^{-3}
k	1×10^{3}
M	1×10^{6}

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Answer **all** *questions.*

1. Road traffic accidents occur when a vehicle is unable to stop safely. The overall stopping distance can be worked out using the following equation:

overall stopping distance = thinking distance + braking distance

The table shows stopping distances from the Highway Code.

Speed (mph)	20	30	40	50	60	70
Thinking distance (m)	6	9	12	15	.....	21
Braking distance (m)	6	14	24	38	56	75
Overall stopping distance (m)	12	23	36	53	.....	96

(a) **Complete the table.** [2]

(b) (i) Describe how worn tyres affect the following distances. [2]

Thinking distance .....

Braking distance .....

(ii) Describe how a driver using a mobile phone affects the following distances. [2]

Thinking distance .....

Braking distance .....

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Turn over.

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2. This question is about the Solar System.

(a) **Complete** the following sentence. [2]

The Solar System was formed by the collapse of a cloud of ..... and ..... .

(b) The table shows some information about planets in our Solar System.

	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune
mean distance from Sun (AU)	0.4	0.7	1	1.5	5.2	9.5	19.2	30
mass compared with Earth	0.055	0.815	1	0.107	318	95	15	17
orbital time (years)	0.24	0.60	1	2	12	30	84	160
mean temperature at surface on sunny side (°C)	430	465	20	–20	–150	–170	–200	–210
number of moons	0	0	1	2	63	60	27	13

Use the information in the table to answer the questions that follow.

(i) Describe how the temperature on a planet depends on the distance from the Sun. [1]

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(ii) Identify the planet that does not follow this trend. [1]

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(iii) Pallas is an asteroid found in the asteroid belt.

I. Estimate its temperature ..... °C [1]

II. Estimate its orbital time ..... years [1]

(iv) It is suggested that the greater the mass of a planet, the more moons that will orbit around it. Explain whether the data agrees with this suggestion. [2]

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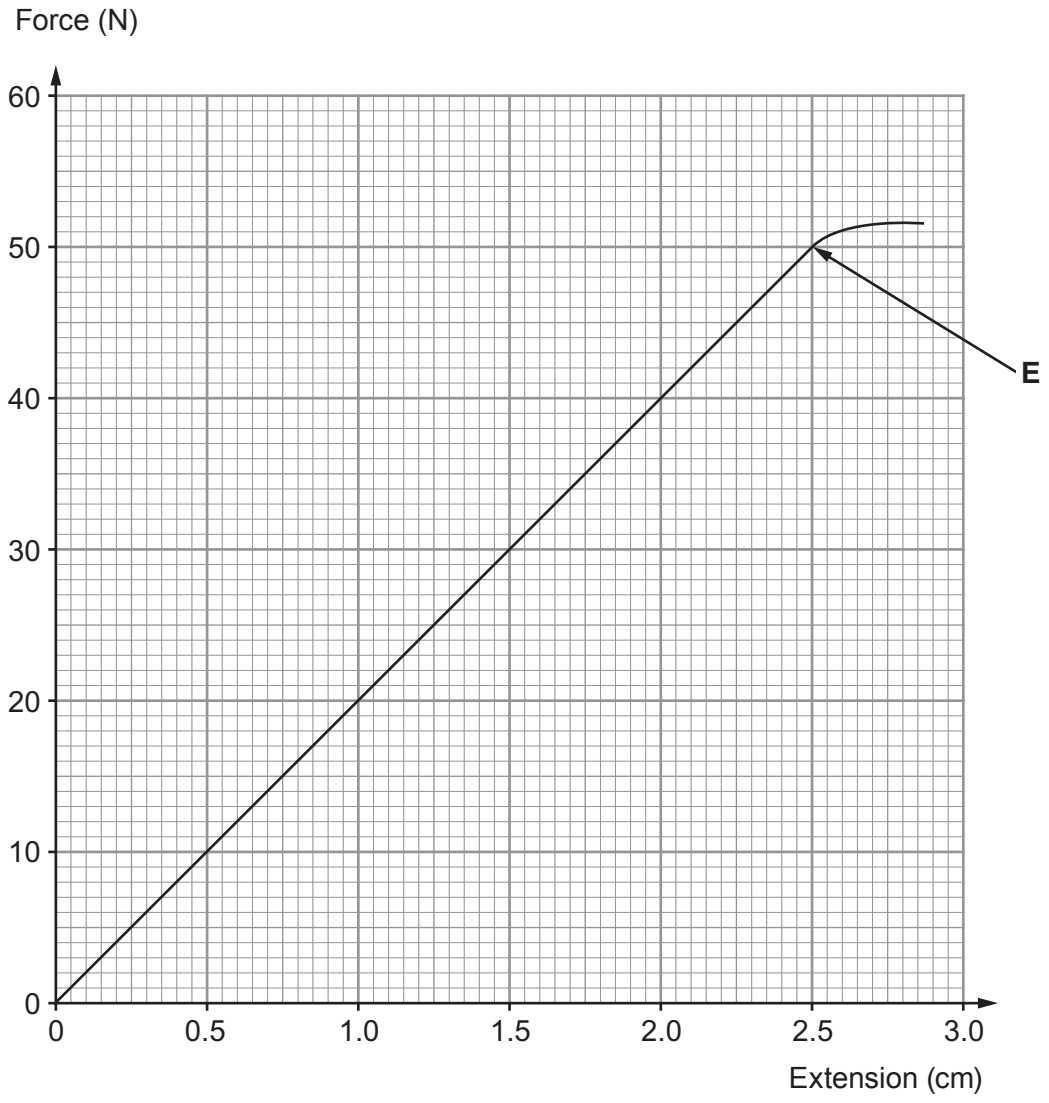
3. An engineering firm in South Wales makes springs for trampolines.

A trampoline is an elastic disc that is connected to a frame by many springs connected in parallel. As you land on a trampoline the springs stretch. The springs work to return to their normal length. The springs pull back against your weight as you land. The heavier the person on the trampoline, the longer the springs extend. Springs are tested to see if they return to their normal length after being stretched. The spring will be permanently stretched if it extends beyond the elastic limit (point **E**) where Hooke's Law is no longer obeyed.

The graph shows how far a particular spring extends when forces are applied.



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(a) (i) Use the graph to find the largest force at which Hooke's Law is still obeyed. [1]

Force = ... N

(ii) Each spring in one trampoline will experience a maximum force of 58 N.
Explain whether this particular spring is suitable for use in the trampoline. [2]

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(b) (i) Calculate the spring constant for this spring up to point **E** using the equation: [3]

$$\text{spring constant} = \frac{\text{force}}{\text{extension}}$$

Spring constant = ... N/cm

(ii) **Add a line** to the graph for a spring with a smaller spring constant. [2]

8

Turn over.

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4. One type of car which is very efficient is a hybrid electric vehicle, which has both a conventional fuel engine and an electric motor which runs from batteries.

Data about a hybrid electric / petrol car is given below.

Minimum time taken to accelerate from 0 - 30 m/s	12 s
Mass of car	1 100 kg
Mean CO_2 emissions	90 g/km
Mean fuel economy	32 km/litre

(a) The car travels 160 km per week.

(i) Calculate the mean mass of CO_2 emitted by the car in a week. [1]

CO_2 = ... g

(ii) Calculate how many litres of fuel are used every week. [1]

Fuel used = ... litres

(b) (i) Use data from the table and an equation from page 2 to calculate the maximum acceleration of the car. [3]

Acceleration = ... m/s^2

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(ii) Use an equation from page 2 to calculate the size of the resultant force required to produce this acceleration. [2]

Resultant force = ... N

(c) State **one** other way cars are made more energy efficient. [1]

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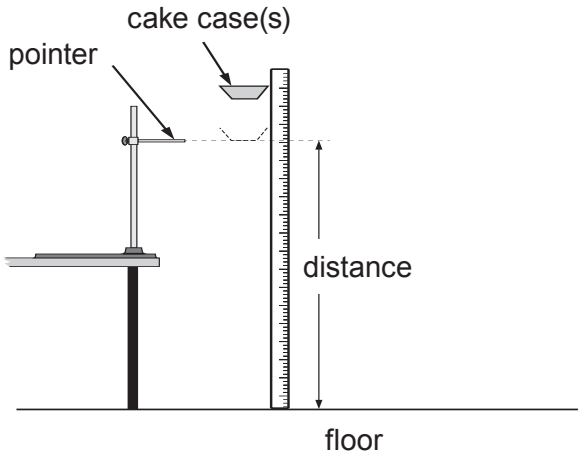
5. Students investigate the terminal speed of falling paper cake cases.



(a) (i) State what is meant by terminal speed. [1]

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(ii) Describe how you would carry out the investigation to find out how the mass of falling paper cake cases affects their terminal speed. [6 QER]

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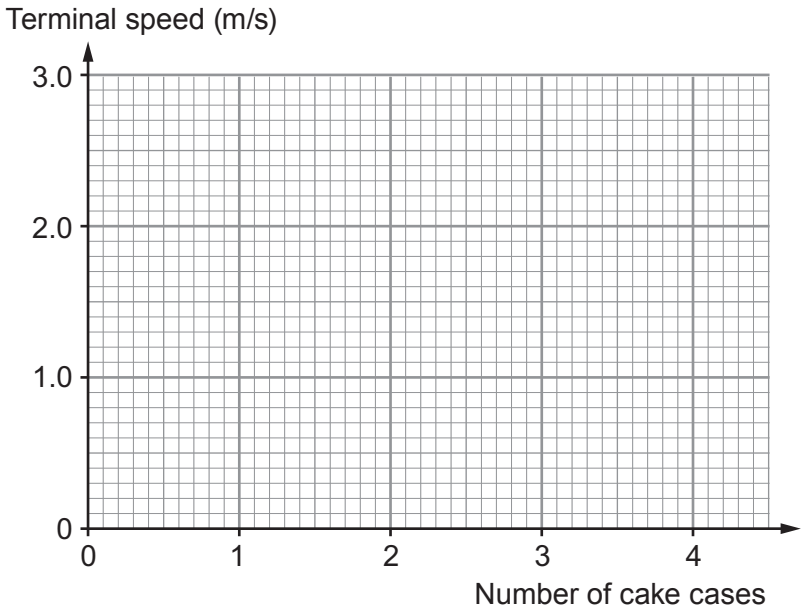
(b) The table shows results from the investigation.

Number of cake cases	Distance (m)	Mean time taken for cake cases to fall 1.50 m (s)	Terminal speed (m/s)
0			0
1	1.50	0.90	1.7
2	1.50	0.68	2.2
3	1.50	0.60	.....
4	1.50	0.56	2.7

(i) **Complete the table** using an equation from page 2 to find the value of the missing terminal speed. *Space for workings.* [2]

(ii) Plot the data in the table on the grid below and draw a suitable line. [3]



(iii) One student suggests that doubling the number of cake cases reduces the **time** to fall by a half. Explain whether the results support this suggestion. [3]

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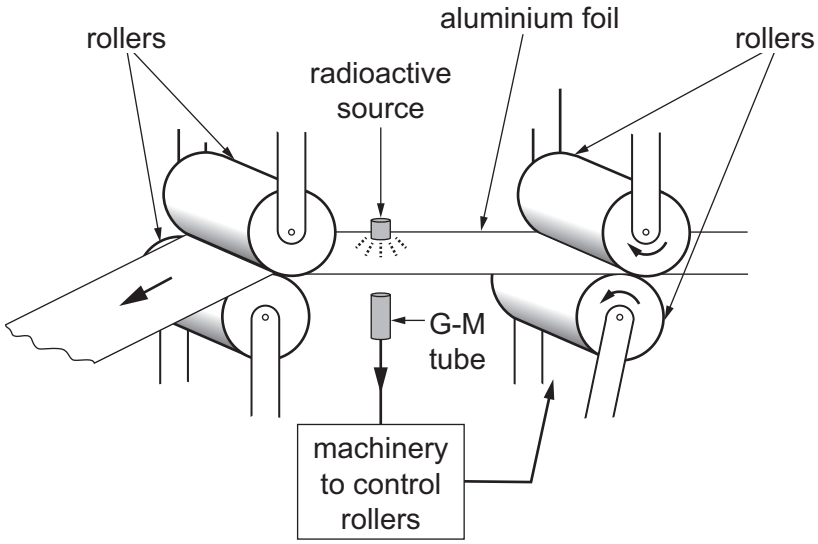
6. A group of students study the uses of radioactivity. They find that radioactive isotopes are widely used in a variety of applications. For example, alpha emitters are used in smoke detectors. Medical diagnosis and cancer treatments use a range of radioisotopes emitting alpha, beta and gamma radiation.

One use they study in detail is monitoring the thickness of aluminium foil when it is manufactured. Radiation passes through the aluminium foil and is detected by a G-M tube. Changes to the thickness cause a difference in the count rate detected and adjustments can then be made to the pressure applied by the rollers.



Different radioisotopes have different half-lives and decay in different ways. The properties of some radioisotopes are given in the table below.

Isotope	Symbol	Half-life	Decay mode
strontium-90	$^{90}_{38}\mathrm{Sr}$	29 years	beta
americium-241	$^{241}_{95}\mathrm{Am}$	432 years	alpha
caesium-137	$^{137}_{55}\mathrm{Cs}$	30 years	gamma
phosphorous-32	$^{32}_{15}\mathrm{P}$	14 days	beta
actinium-225	$^{225}_{89}\mathrm{Ac}$	10 days	alpha

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(a) Tick (✓) the boxes alongside the **three** correct statements below. [3]

Alpha radiation consists of helium nuclei	☐
Alpha radiation is more ionising than gamma	☐
Strontium-90 has 90 nucleons	☐
Gamma radiation consists of low energy waves	☐
Gamma radiation only travels a short range in air	☐
Beta radiation consists of slow moving electrons	☐

(b) One of the students suggests that strontium-90 is the most suitable isotope from the table for monitoring the thickness of aluminium foil. Explain whether or not you agree with this suggestion. [3]

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(c) (i) Explain what is meant by the statement: 'The half-life of strontium-90 is 29 years.' [2]

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(ii) Calculate the time taken for the activity of strontium-90 to fall to $\frac{1}{8}$th of its initial value. [3]

Time = ... years

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(d) The students' teacher demonstrates experiments with radioactive sources. First she measures the radiation in the laboratory, recording 150 counts in 5 minutes. This allows her to work out the count rate of the background radiation.

(i) Calculate the background radiation count rate in counts per **second** (cps). [2]

Background count rate = ... cps

(ii) Suggest **two** ways in which the teacher could improve the accuracy of her result. [2]

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END OF PAPER

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

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