Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4473/02

W15-4473-02

ADDITIONAL SCIENCE/PHYSICS

PHYSICS 2
HIGHER TIER

P.M. THURSDAY, 15 January 2015

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**15**	
2.	**12**	
3.	**11**	
4.	**9**	
5.	**7**	
6.	**6**	
Total	**60**	

4473
020001

ADDITIONAL MATERIALS

In addition to this paper you may require a calculator.

INSTRUCTIONS TO CANDIDATES

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

You are reminded of the necessity for good English and orderly presentation in your answers.

A list of equations is printed on page 2. In calculations you should show all your working.

You are reminded that assessment will take into account the quality of written communication (QWC) used in your answers to questions **2***(b)*(i) and **6**.

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Equations

power = voltage × current	$P = VI$
resistance = $\frac{\text{voltage}}{\text{current}}$	$R = \frac{V}{I}$
power = current^2 × resistance	$P = I^2R$
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	
distance travelled = area under a velocity-time graph	
momentum = mass × velocity	$p = mv$
resultant force = mass × acceleration	$F = ma$
force = $\frac{\text{change in momentum}}{\text{time}}$	$F = \frac{\Delta p}{t}$
work = force × distance	$W = Fd$
kinetic energy = $\frac{\text{mass} \times \text{speed}^2}{2}$	$KE = \frac{1}{2}mv^2$
change in potential energy = mass × gravitational field strength × change in height	$PE = mgh$

SI multipliers

Prefix	Multiplier
p	10^{-12}
n	10^{-9}
μ	10^{-6}
m	10^{-3}

Prefix	Multiplier
k	10^{3}
M	10^{6}
G	10^{9}
T	10^{12}

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Answer **all** *questions.*

1. A class of students were using dice to model radioactive decay.

- There were 8 groups of students.
- Each group of students had 50 dice.
- The 50 dice were rolled.
- Any that landed with a 6 facing upwards were removed.
- The remaining dice were counted.
- The remaining dice were rolled again and again, taking away the 6's each time.
- The table shows the results from one group and from the whole class.

Roll number	Number of dice remaining	
	One group's results	Class results
0	50	400
1	42	330
2	37	280
3	28	230
4	26	190
5	22	160
6	18	130
7	13	110
8	5	90

(a) Each group's results were added together to give the class results. Give **one** reason why the bigger sample size makes the data more repeatable. [1]

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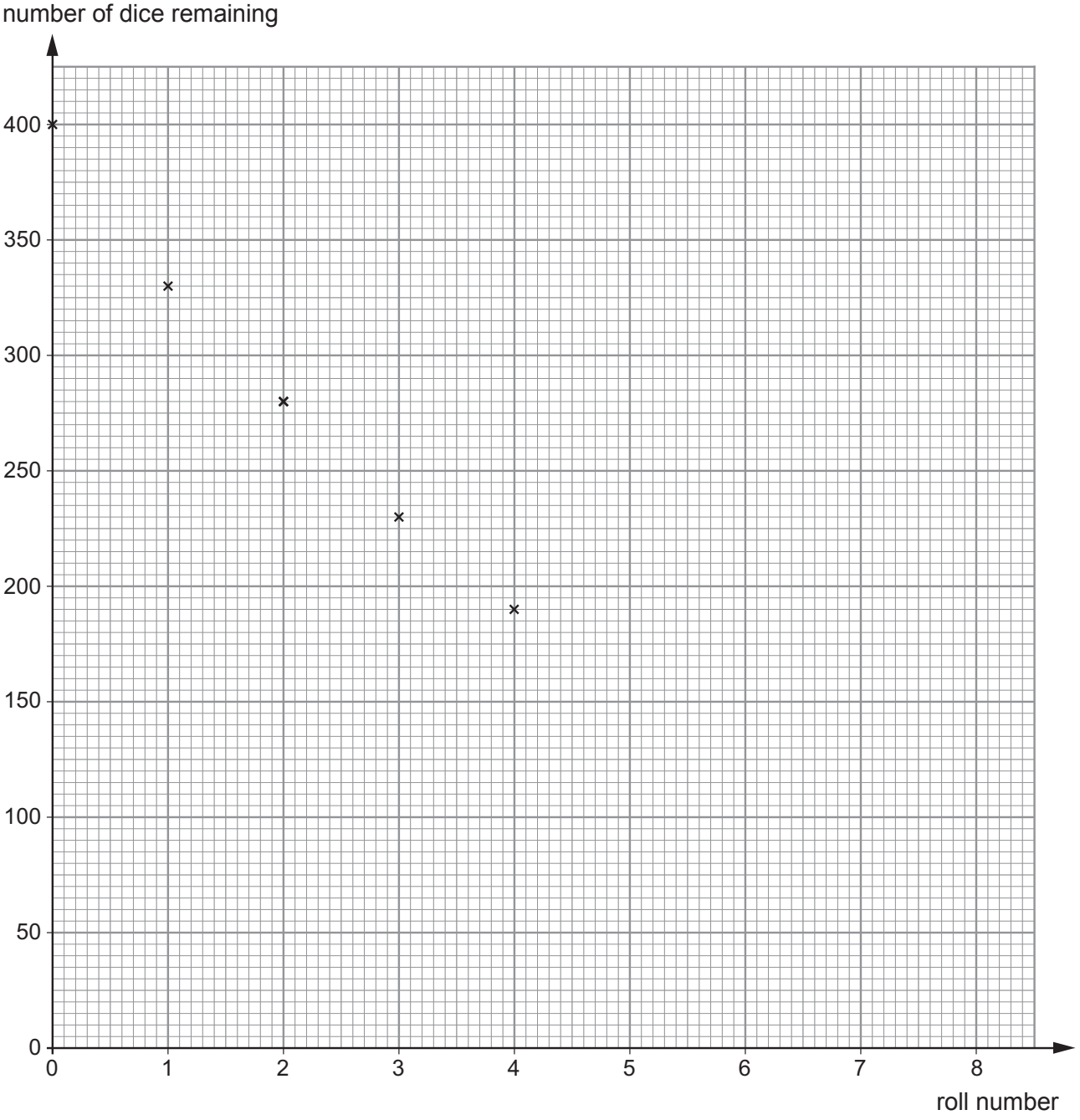
(b) The graph shows part of the data from the whole class.
Plot the remaining data and draw a suitable line. [3]



(c) The "half-life" for this modelled decay is the number of rolls needed for the number of dice to halve. *(The number of rolls will include fractions.)*

(i) Use the class results in the table on page 4 to estimate the half-life. [1]

half-life = ... rolls

(ii) Now use the graph to find the half-life. Show the method you use on the graph. [2]

half-life = ... rolls

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(iii) Suggest why it is better to use the graph than the table to estimate the half-life. [1]

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(iv) Use the graph to find how many rolls it took for the number of dice to fall to $\frac{1}{4}$ of the original value. Comment on your answer. [2]

number of rolls = ...

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(d) An experiment was carried out to obtain similar data using the radioactive isotope, protactinium 234, which is a beta emitter. The **initial count** rate was measured to be 80 counts per second. After 210 s the count rate had dropped to 10 counts per second.

(i) Find the half-life of protactinium 234. [2]

half-life = ... s

(ii) Calculate how long it would take for the count rate to drop from 80 to 2.5 counts per second. [2]

time taken = ... s

(iii) State the unit of activity of a radioactive source. [1]

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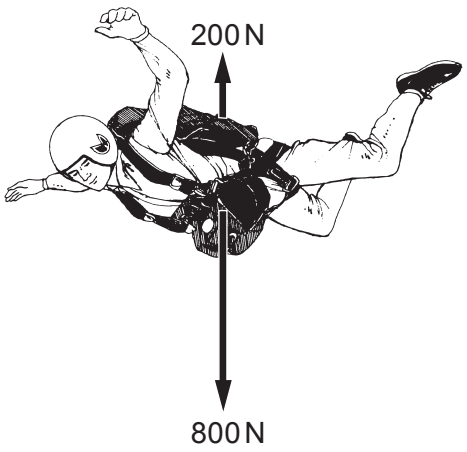
15

2. *(a)* A skydiver of mass 80 kg weighs 800 N.



Use the equation:

$$\text{acceleration} = \frac{\text{resultant force}}{\text{mass}}$$

to calculate the acceleration of a skydiver of mass 80 kg when the air resistance force is 200 N. [3]

acceleration = ... m/s^2

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(b) When a skydiver opens a parachute, he decelerates until he reaches a small terminal speed of about 3 m/s for landing.

(i) Discuss the above statement. Include in your answer the following points:

- An explanation in terms of forces – why a skydiver decelerates when the parachute is opened.
- An explanation of how a small terminal speed is achieved for landing. [6 QWC]

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(ii) The correct size of parachute is important to give a small terminal speed. A heavy person needs to have a different size parachute from a lighter person.

Explain why a heavier person needs a different area parachute from a lighter person to achieve the same small landing speed. [3]

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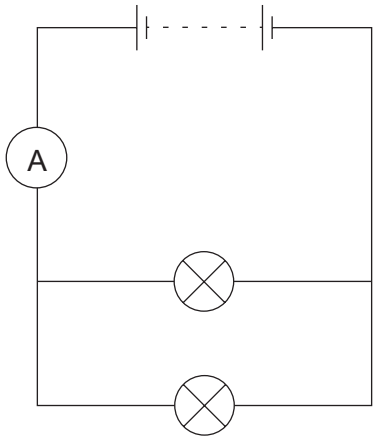
3. Two identical lamps, each having a constant resistance of 8 Ω are connected as shown. In this circuit the lamps each have a power output of 18 W.



(a) (i) Use an equation from page 2 to calculate the current through each lamp. [3]

current = ... A

(ii) Write down the reading on the ammeter. [1]

..... A

(iii) Use the equation $V = IR$ to calculate the voltage of the battery. [2]

voltage = ... V

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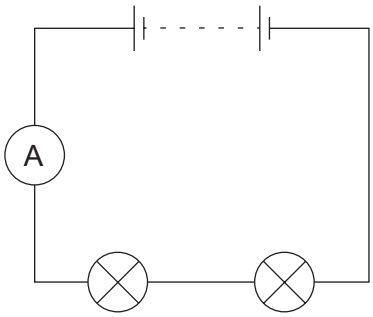
(b) The same two lamps are now connected in series with the same battery.



(i) Explain why the ammeter reading has decreased. [2]

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(ii) Calculate the power dissipated by each lamp in **this** circuit, given that the current is 0.75 A. [2]

power = ... W

(iii) Give a reason why lamps are connected in parallel rather than in series in domestic circuits. [1]

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4. *(a)* State Newton's third law of motion. [2]

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(b) A bean bag of mass 0.5 kg is dropped from rest and takes 0.8 s to fall to the floor, which it hits without rebounding. (g = 10 N/kg = 10 m/s^2)

(i) While the bean bag is falling, the Earth's gravity is pulling it towards the centre of the Earth. Write down the size of the force exerted **by the bean bag on the Earth** and give its direction. [2]

force = ... N

direction = ...

(ii) Use an equation from page 2 to calculate the velocity with which the bean bag hits the ground. (Ignore air resistance.) [2]

velocity = ... m/s

(iii) The bean bag is stopped in 0.2 s.
Use an equation from page 2 and your answer from part (ii) to calculate the resultant force exerted to stop the bean bag. [3]

resultant force = ... N

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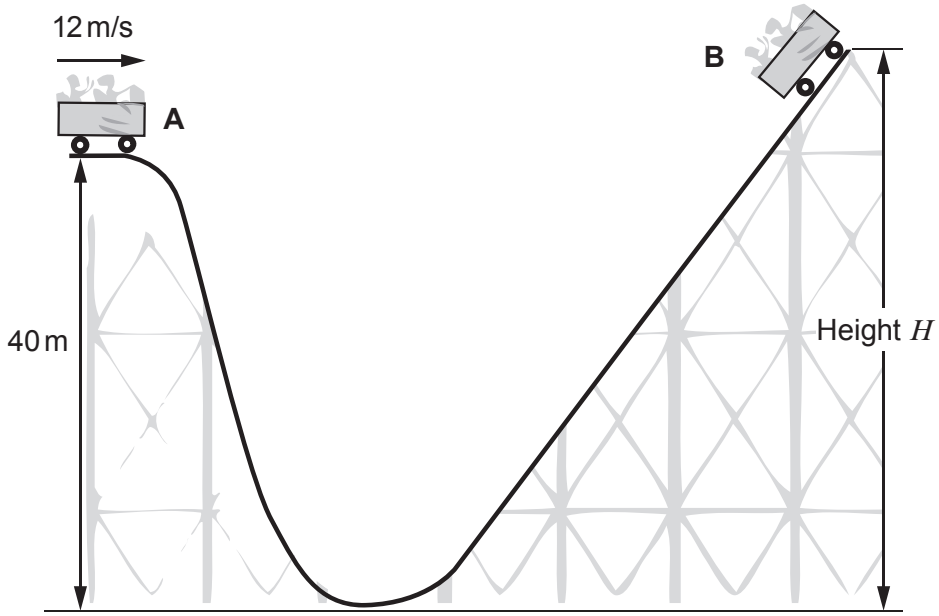
5. A roller coaster car has no engine. The car and its passengers have a total mass of 1 500 kg. The car is shown as it passes over a peak of the ride which is 40 m high at point **A**. It has a speed of 12 m/s at this point. It then rolls down the track to ground level before moving up to point **B** where it comes to rest before rolling backwards again.



(i) Calculate the **total** energy of the car at **A**. (g = 10 m/s^2 = 10 N/kg) [3]

energy = ... J

(ii) For the car moving at 12 m/s at **A**, calculate the maximum height H that the car reaches before stopping at point **B**. [2]

height = ... m

Examiner only

(iii) Explain why the car would not actually reach the height you have calculated in part (ii). [2]

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7

TURN OVER FOR QUESTION 6

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6. In nuclear reactors, uranium $^{235}_{92}\mathrm{U}$ undergoes fission when a neutron ($^{1}_{0}\mathrm{n}$) is absorbed. Products of this include krypton (Kr) and barium (Ba). The particles in the nuclei of these substances are shown below.

Element	Number of protons in the nucleus	Number of neutrons in the nucleus
Uranium	92	143
Krypton	36	54
Barium	56	88

Write a balanced **nuclear equation** for this reaction and explain how a controlled chain reaction is achieved inside the nuclear reactor. [6 QWC]

Equation:

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END OF PAPER

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