Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4473/01

W15-4473-01

ADDITIONAL SCIENCE/PHYSICS

PHYSICS 2
FOUNDATION TIER

P.M. THURSDAY, 15 January 2015

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**9**	
2.	**11**	
3.	**8**	
4.	**8**	
5.	**15**	
6.	**9**	
Total	**60**	

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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 answer to question **6***(b)*.

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Equations

power = voltage × current	$P = VI$
resistance = $\frac{\text{voltage}}{\text{current}}$	$R = \frac{V}{I}$
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	
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	$W = Fd$

SI multipliers

Prefix	Multiplier	
m	10^{-3}	$\frac{1}{1\,000}$
k	10^{3}	1 000
M	10^{6}	1 000 000

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Answer **all** *questions.*

1. The **overall stopping distance** of a car is made up of two parts, thinking distance and braking distance.

(a) The table below shows how the thinking distance, braking distance and overall stopping distance change if the driving conditions change. Complete the following table using the words **increases, decreases** or **no change**. [3]

Condition	Effect on thinking distance	Effect on braking distance	Effect on overall stopping distance
Poor brakes	no change	increases	increases
Driver under the influence of alcohol	.....	no change	increases
Driver drives at a lower speed	decreases	decreases	.....
Wet road	.....	increases	increases

(b) The table shows the thinking distance and braking distance for a car travelling at **30 m/s**. The questions that follow are about this car.

Speed (m/s)	Thinking distance (m)	Braking distance (m)
30	18	75

(i) Use the equation:

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

to calculate the driver's thinking time. [2]

thinking time = ... s

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(ii) The brakes produce a stopping force of 1 200 N. Use the equation:

$$\text{work} = \text{force} \times \text{distance}$$

to calculate the work done by the brakes in stopping the car. [2]

work done = ... J

(iii) When the brakes are applied, the car stops in 5 s. Use the equation:

$$\text{deceleration} = \frac{\text{change in speed}}{\text{time}}$$

to calculate its deceleration. [2]

deceleration = ... m/s^2

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2. *(a)* Complete the sentences below using words from the box. [3]
Each word may be used **once, more than once, or not at all**.

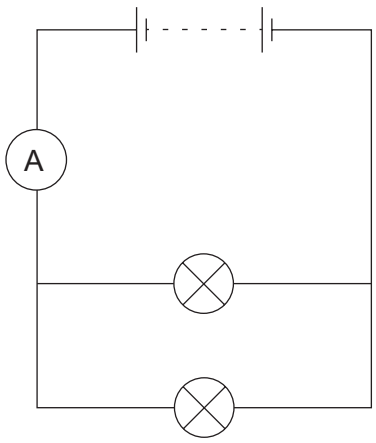
voltage	power	current

(i) An ammeter measures the ..... through a circuit.

(ii) When lamps are connected in series they all have the same ..... through them.

(iii) When lamps are connected in parallel they all have the same ..... across them.

(b) Two identical lamps, each of resistance 8 Ω are connected in parallel. They are connected to a 12 V battery.



(i) Use the equation:

$$\text{current} = \frac{\text{voltage}}{\text{resistance}}$$

to calculate the current through one lamp. [2]

current = ... A

(ii) What is the reading on the ammeter? [1]

..... A

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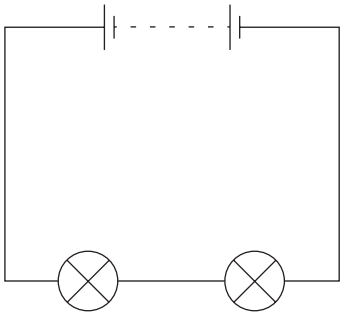
(iii) Use an equation from page 2 to calculate the power of one lamp. [3]

power = ... W

(c) The same two lamps are now connected in series with the same battery.
The resistance of the circuit has now increased so it is **four times bigger** than when the lamps were in parallel.



Describe fully the effect this has on the current through the battery. [2]

.....

.....

.....

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3. *(a)* A car is travelling at 20 m/s before slowing down to a velocity of 5 m/s.

(i) Calculate the change in velocity of the car. [1]

change in velocity = ... m/s

(ii) The driver of the car has a mass of 60 kg. Use the equation:

momentum = mass × velocity

to calculate the change in momentum of the driver. [1]

change in momentum = ... kg m/s

(iii) The car slowed down for 6 s. Use the equation:

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

to calculate the size of the force acting on the driver during braking. State the unit. [2]

force = ...

unit .....

(b) In another situation, the car slowed down from 20 m/s to 5 m/s in less time. Explain what effect this has on the force acting on the driver. [2]

.....

.....

.....

(c) Seat belts help to keep drivers and passengers safer when the car stops suddenly during an accident.
Name **two** *other* safety features that help to do this. [2]

1. .....

2. .....

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4. The table below gives information about some elements.

Element	Symbol	Nucleon number (A)	Proton number (Z)	Number of neutrons in a nucleus
Hydrogen	H	1	1	0
Helium	He	4	2	.....
Iron	Fe	.....	26	30
Lead	Pb	207	82	125
Krypton	Kr	90	36	54
Barium	Ba	144	56	88
Uranium	U	235	92	143

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

(b) Tritium has a proton number of 1 and a nucleon number of 3.
Tritium is an isotope of one of the elements in the table above. Which one? [1]

.....

(c) The **nuclear** symbol for uranium is written as $^{235}_{92}\mathrm{U}$.
Use information in the table above to answer the following questions.

(i) Complete the nuclear symbol for lead. $^{\cdots\cdots}_{\cdots\cdots}\mathrm{Pb}$ [1]

(ii) In a nuclear reactor, uranium undergoes fission by absorbing a neutron ($^{1}_{0}\mathrm{n}$).
The products of this reaction are **krypton**, **barium** and **two neutrons**.

Complete the equation below for this reaction. [2]

$$^{235}_{92}\mathrm{U} + {}^{1}_{0}\mathrm{n} \longrightarrow \cdots\cdots + \cdots\cdots + \cdots\cdots\, {}^{1}_{0}\mathrm{n}$$

(d) Complete the sentences below by **underlining** the correct word(s) in the brackets. [2]

(i) In a nuclear reactor the moderator (**slows down / speeds up / absorbs**) neutrons.

(ii) In a nuclear reactor the control rods (**slow down / speed up / absorb**) neutrons.

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5. 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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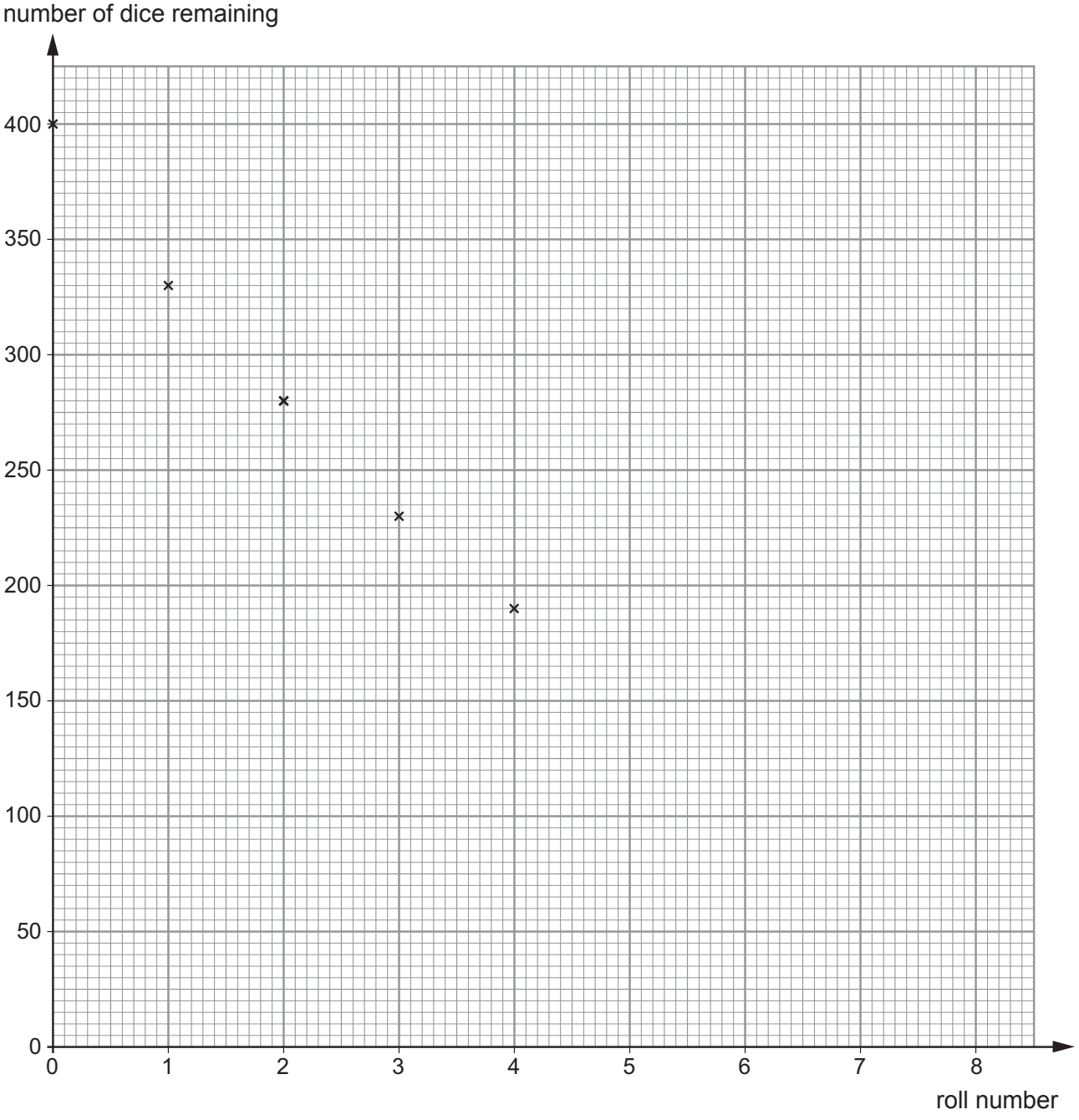
(b) The graph shows part of the data from the whole class.
Plot the remaining data and draw a suitable line. [3]



(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 10 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

Turn over.

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

.....

.....

(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 = ...

.....

.....

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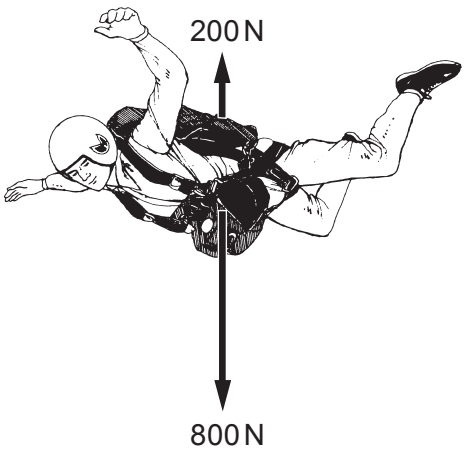
6. *(a)* A skydiver of mass 80 kg weighs 800 N.



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.

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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