Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4473/02

W16-4473-02

ADDITIONAL SCIENCE/PHYSICS

PHYSICS 2
HIGHER TIER

A.M. THURSDAY, 14 January 2016

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**12**	
2.	**14**	
3.	**5**	
4.	**12**	
5.	**11**	
6.	**6**	
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 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.

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 questions **2***(b)* 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 student does an experiment with **dice** to investigate **radioactive decay**. The dice, which represent radioactive atoms, are thrown together onto the floor. Those that show a **six** are removed. These represent the atoms whose nuclei have decayed. The remaining dice (undecayed atoms) are thrown again and the process is repeated several times.

The student starts with **600** dice.

(a) (i) Predict how many of the dice would show a "six" on the first throw. [1]

.....

(ii) State why the student cannot predict **which** dice will show a "six". [1]

.....

.....

(b) The results of the experiment are shown in the table below.

Throw	Number of sixes	Number of dice remaining
0	0	600
1	95	505
2	85	420
3	.....	350
4	60	290
5	50	240
6	40	200
7	30	170
8	25	145

(i) **Fill in the gap** in the table above. [1]

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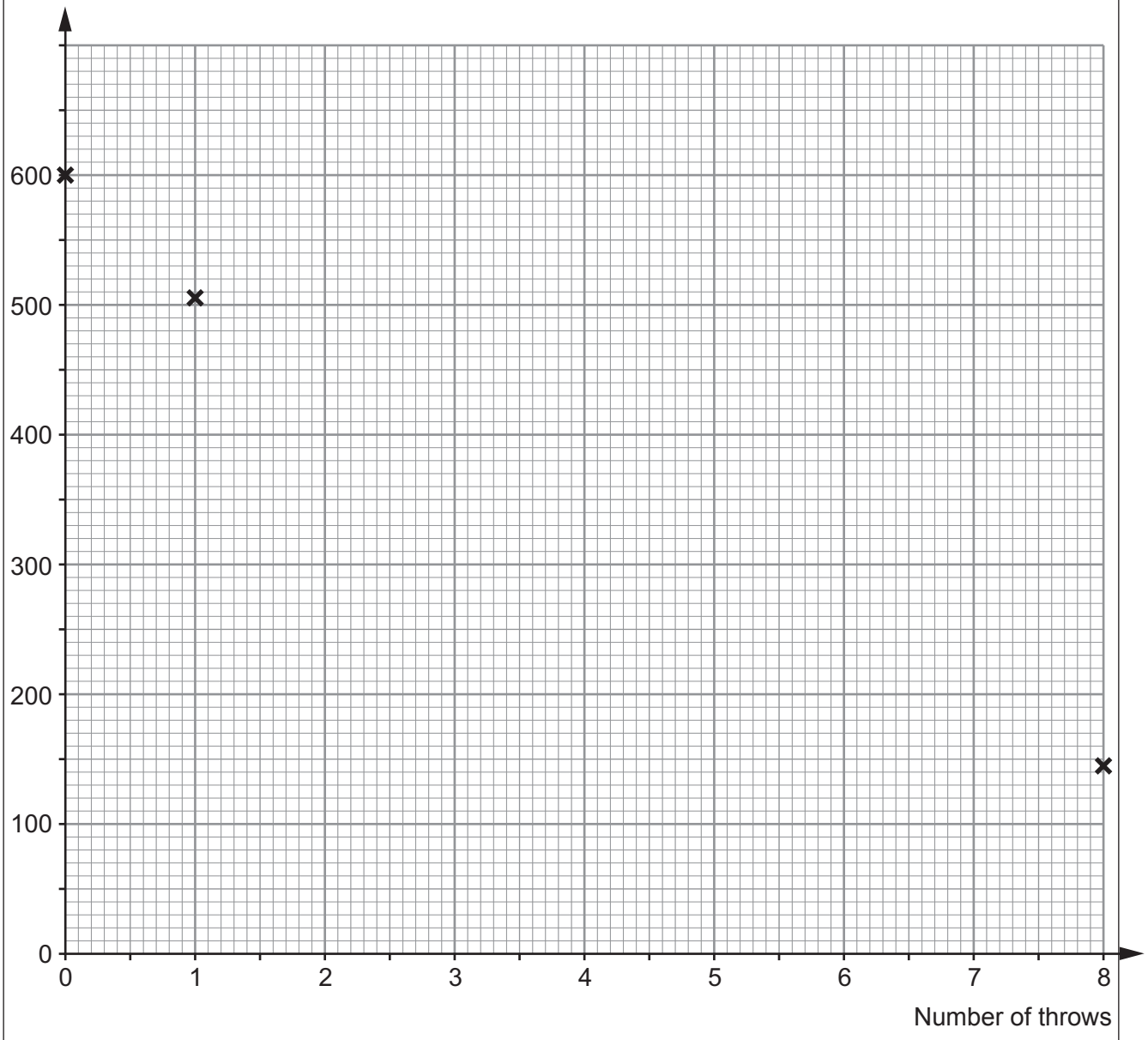
(ii) Plot the results on the grid below and draw a suitable line. [3]
Three points have been plotted for you.



(iii) **Draw lines on to your graph** to enable you to find the **half-life** of the dice. [2]

half-life of dice = ... throws

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(c) Americium-241 is a radioactive substance which is used in smoke alarms in houses. It decays by emitting alpha particles.

(i) State why Americium-241 is radioactive. [1]

.....

.....

(ii) What is an alpha particle? [1]

.....

(iii) Explain why the use of Americium-241 in house smoke alarms when in normal use, does not present a significant health risk to people living in the houses. [2]

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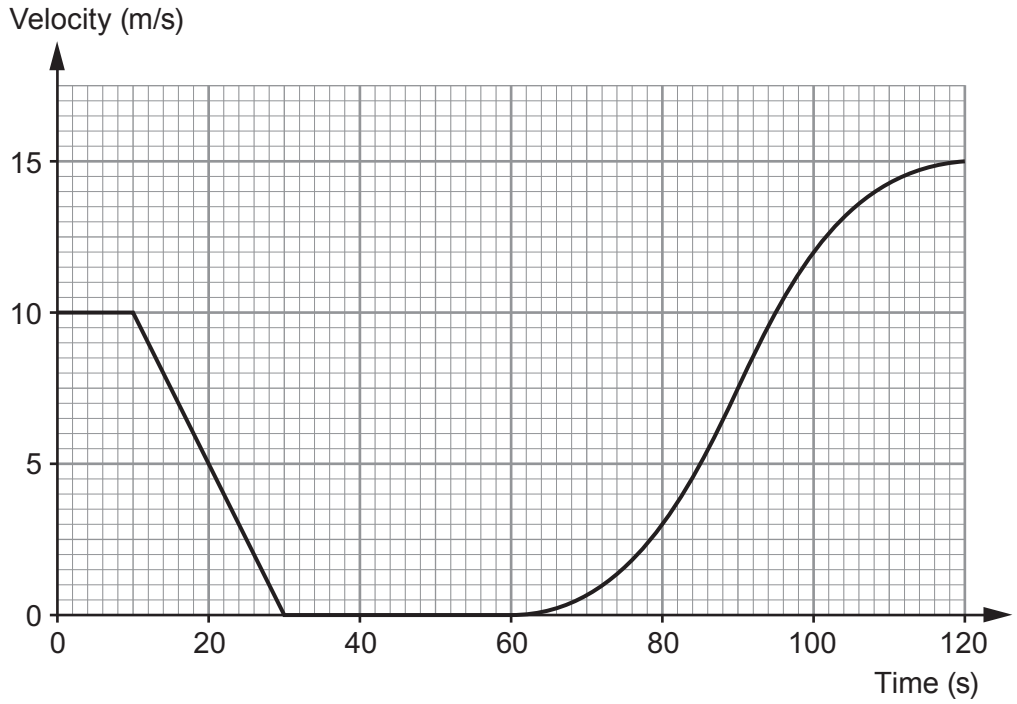
2. The velocity-time graph below shows part of the journey of an underground train.



(a) Use the graph to find the total time that the train was travelling faster than 5 m/s. (Show your workings.) [2]

total time = ... s

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(b) Describe **fully** the motion of the train for the time shown. [6 QWC]

Your answer should include:

- data from the graph;
- appropriate calculations.

(Calculations of distance should not be given in your answer.)

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(c) (i) Use the equation: distance = speed × time

to calculate the distance travelled by the train in the **first 10 s** of the journey. [1]

distance = ... m

(ii) Between 10 s and 30 s, the train travels 100 m. Use an equation from page 2 to calculate the mean speed of the train between 0 s and 60 s. [3]

mean speed = ... m/s

(d) Use the graph to estimate (with a calculation) the distance travelled between 60 s and 120 s. [2]

distance = ... m

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3. *(a)* **Complete** the equation for the fission reaction shown below. [2]

$$^{235}_{92}\mathrm{U} \quad + \quad ^{1}_{0}\mathrm{n} \longrightarrow \quad ^{90}_{36}\mathrm{X} \quad + \quad ^{143}_{\ldots\ldots}\mathrm{Y} \quad + \quad \ldots\ldots\ ^{1}_{0}\mathrm{n}$$

(b) What do the numbers 235 and 92 tell us about the particles inside the uranium nucleus? [2]

.....

.....

.....

(c) State how a fission reactor can be quickly shut down in the event of an accident. [1]

.....

.....

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4. Use equations from page 2 to answer the following questions about a swimmer.

(a) A swimmer of mass 60 kg steps off a diving board, and enters the water with a kinetic energy of 2 940 J.

(i) Assuming that no air resistance acts on the swimmer, calculate a value for the height of the diving board. [3]
(gravitational field strength, g = 10 N/kg)

height = ... m

(ii) In practise, air resistance acts on the swimmer as he falls. State how and explain why the actual height of the diving board is different from your calculated value. [3]

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(b) (i) When swimming at constant speed, the kinetic energy of the swimmer is 7.5 J. Calculate the speed of the swimmer. [3]

speed = ... m/s

(ii) The swimmer then glides to a stop in 2 m. Calculate the mean drag force acting on the swimmer. [3]

drag force = ... N

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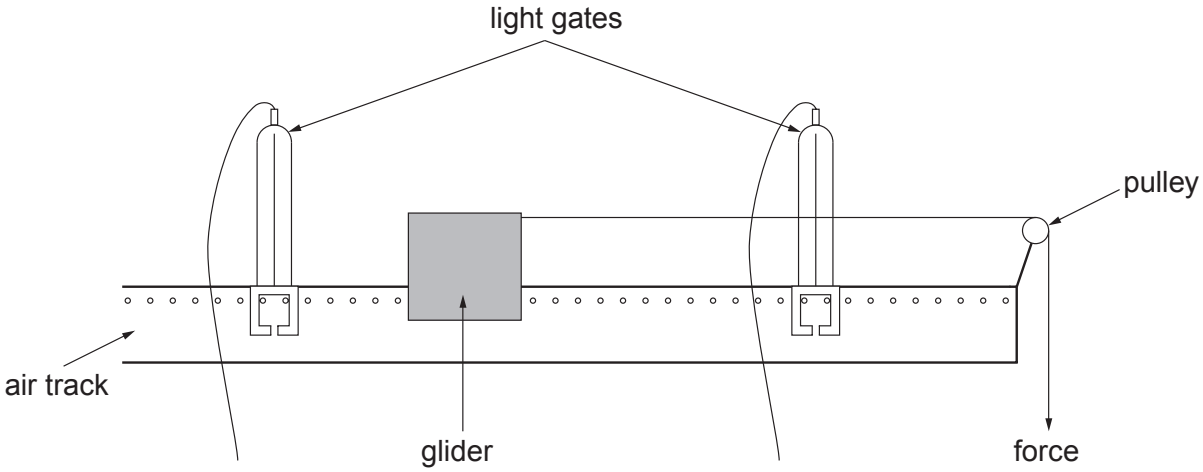
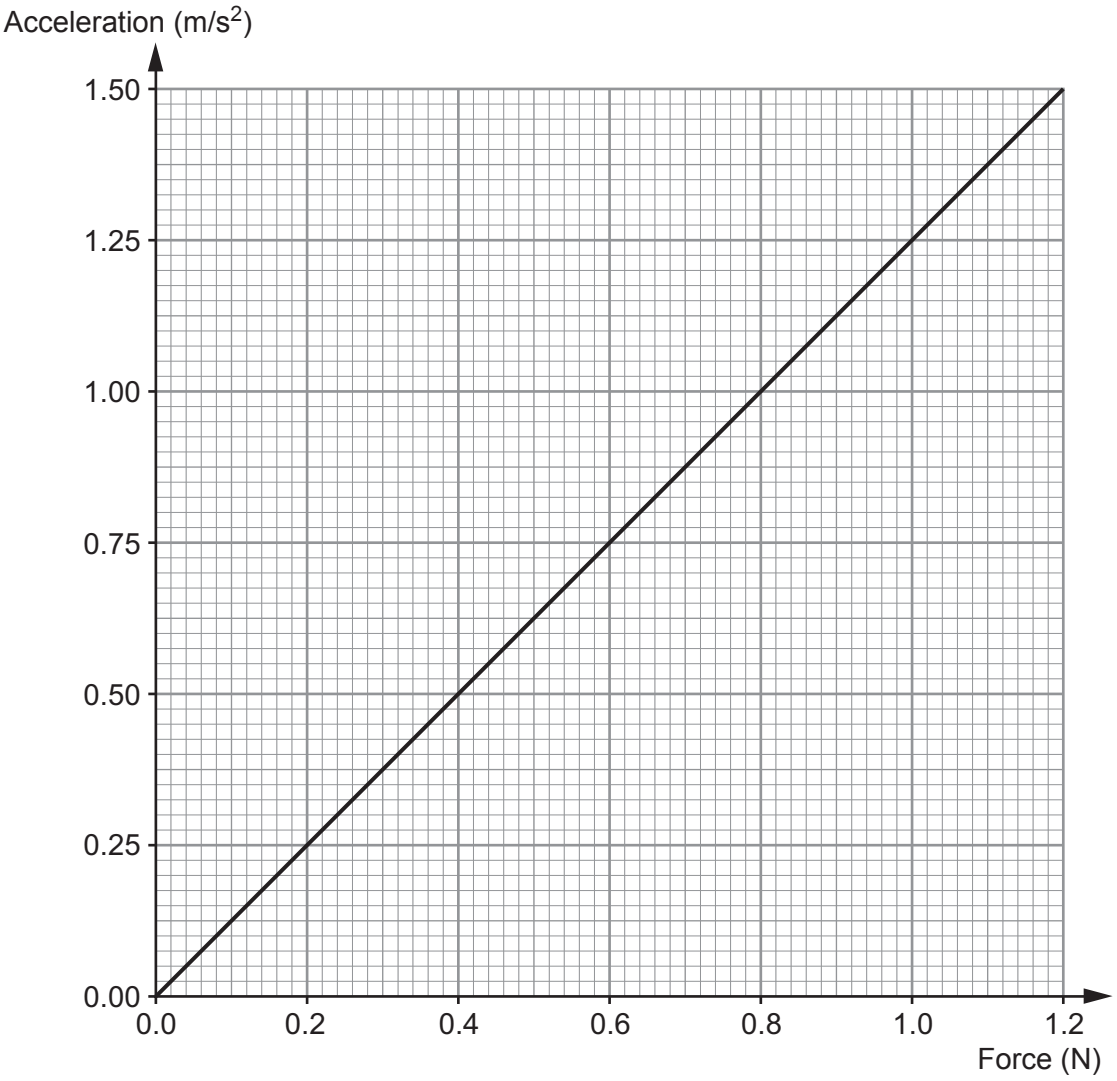
5. A student sets up a glider on a frictionless air track. Light gates are set up to measure its acceleration. A frictionless pulley is attached to the end of the air track as shown, allowing a force to be applied to the glider.



From the results taken, a graph is plotted showing the relationship between the force and the acceleration of the glider.



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(a) (i) Use an equation from page 2 to calculate the mass of the glider. [2]

mass = ... kg

(ii) A force of 2.0 N is used to pull the glider from rest.

I. Determine the value of the acceleration. [1]

acceleration = ... m/s^2

II. The string snaps at 0.6 s. Use your value of acceleration and equations from page 2 to calculate the momentum of the glider at this time. [4]

momentum = ... kg m/s

III. Explain whether or not this momentum changes as the glider continues along the track, before reaching the end. [2]

.....

.....

.....

(b) The experiment is repeated with a glider of **3 times** the original mass. **Draw a line on** the original graph to show the results that you would expect. [2]

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6. A student investigated the changes in resistance of a 12 V filament lamp and wrote the following report of her experiment.

> A 12 V power supply was connected in series with an ammeter, the lamp and a variable resistor. A voltmeter was connected in parallel with the lamp.
>
> Initially the variable resistor was set on its highest setting and readings were taken from the ammeter and voltmeter. The setting on the variable resistor was changed 6 times and the readings were taken from the meters each time.

The student did not write anything more.

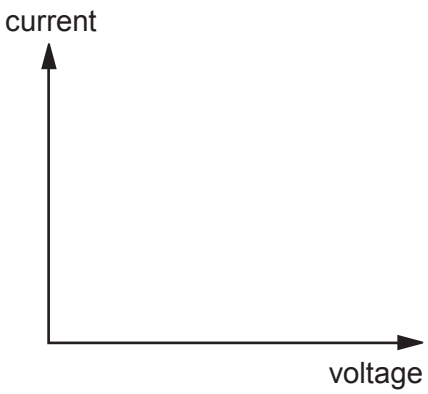
Your task is to complete the report. [6 QWC]

You should include the following points in your answer:

- a circuit diagram from the description given by the student;
- an explanation of how the results should be used to obtain resistance values;
- a sketch graph of how the current through the lamp would change with increasing voltage;
- a brief description of **how** the resistance of the lamp would change with increasing voltage (not **why** it changes).

Draw your circuit diagram below

Draw your graph below



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

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