Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4473/01

ADDITIONAL SCIENCE/PHYSICS

PHYSICS 2
FOUNDATION TIER

P.M. THURSDAY, 16 January 2014

1 hour

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

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 **8**.

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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}	$\frac{1}{1000}$
k	10^{3}	1000
M	10^{6}	1000000

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PLEASE DO NOT WRITE ON THIS PAGE

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Answer **all** *questions in the spaces provided.*

1. Newton's laws of motion are important in the way rockets move.

(a) **Tick (✓)** the box next to the statement that correctly completes each sentence. [1]

(i) Newton's **3rd** Law can be written as:

Unbalanced forces change the motion of an object. ☐

The forces of two objects on each other (action and reaction) are always equal and act in opposite directions. ☐

Resultant force is equal to mass times acceleration. ☐

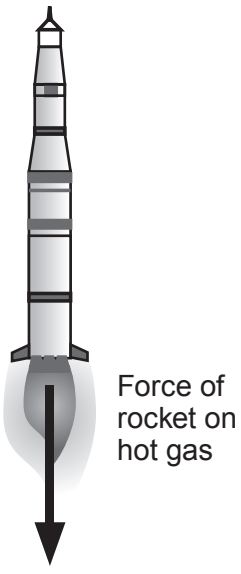
(ii) A rocket exerts a force of 15 000 000 N on hot gases which exert a force of … [1]

less than 15 000 000 N on the rocket ☐

15 000 000 N on the rocket ☐

more than 15 000 000 N on the rocket ☐

(b) The diagram shows the direction of the force produced by a rocket on the hot gases.



Add an arrow to the diagram to show the direction of the force of the hot gases on the rocket. [1]

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(c) (i) A model rocket has a weight of 5 N. The upward thrust on the rocket is 20 N. Calculate the resultant force on the rocket. [1]

resultant force = ... N

(ii) The mass of this rocket is 0·5 kg. Use your answer to *(c)*(i) and the equation:

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

to calculate the acceleration of the model rocket. [2]

acceleration = ... m/s^2

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6

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2. Complete the following paragraph about a nuclear reactor by **underlining** the correct word or words in each of the brackets. [5]

The absorption of **(slow protons / slow neutrons / slow electrons)** can cause a **(fusion / fission / chemical)** reaction in uranium nuclei. The particles are slowed down by **(a moderator / control rods / concrete shielding)**. The emission of **(protons / neutrons / electrons)** in this reaction can cause a chain reaction. An uncontrolled chain reaction is prevented by using **(a moderator / control rods / concrete shielding)**.

5

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3. A sky diver jumps from an aeroplane.

(a) The statements below describe the different parts of the fall.

A The sky diver just leaves the aeroplane.

B The sky diver speeds up.

C The sky diver reaches a constant speed.

D The sky diver opens the parachute.

Circle the correct part of the fall, **A**, **B**, **C** or **D**, to answer each question. [4]

(i) In which part of the fall does the air resistance **suddenly** increase? **A** **B** **C** **D**

(ii) In which part of the fall are the weight and air resistance equal? **A** **B** **C** **D**

(iii) In which part of the fall does the kinetic energy of the sky diver stay constant? **A** **B** **C** **D**

(iv) In which part of the fall is the air resistance greater than the weight? **A** **B** **C** **D**

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(b) The sky diver has a mass of 70 kg and when the parachute opens he decelerates from 55 m/s to a velocity of 5 m/s. Use the equation:

momentum = mass × velocity

to calculate the **change in momentum** of the sky diver. [2]

change in momentum = ... kg m/s

6

Turn over.

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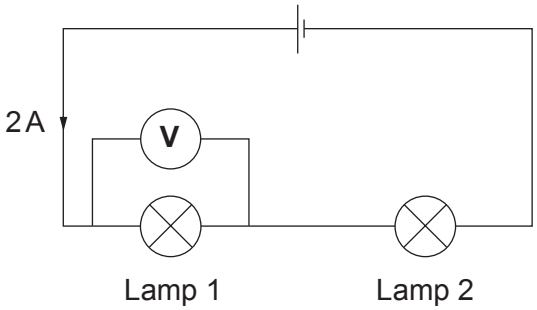
4. A student sets up the following circuit:



The current through lamp 1 is 2 A and the voltmeter reading is 4 V.

(a) (i) Use the information above and the equation:

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

to calculate the resistance of lamp 1. [2]

Resistance = ... Ω

(ii) Use the information above and the equation:

$$\text{power} = \text{voltage} \times \text{current}$$

to calculate the power of lamp 1. [2]

Power = ... W

(iii) State the current through lamp 2. [1]

Current = ... A

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(b) The student adds another lamp in series with lamps 1 and 2. Choose words from the box to complete the following sentences. Each word or phrase may be used **once, more than once or not at all**.

increase	decrease	stay the same

(i) When the extra lamp is added, it causes the current through lamp 1 to

..... and the battery voltage to ..... . [2]

(ii) The extra lamp causes the circuit resistance to ..... . [1]

(c) In houses the lamps are connected in parallel instead of series as in the circuit opposite. Give **two** reasons why. [2]

1. .....

2. .....

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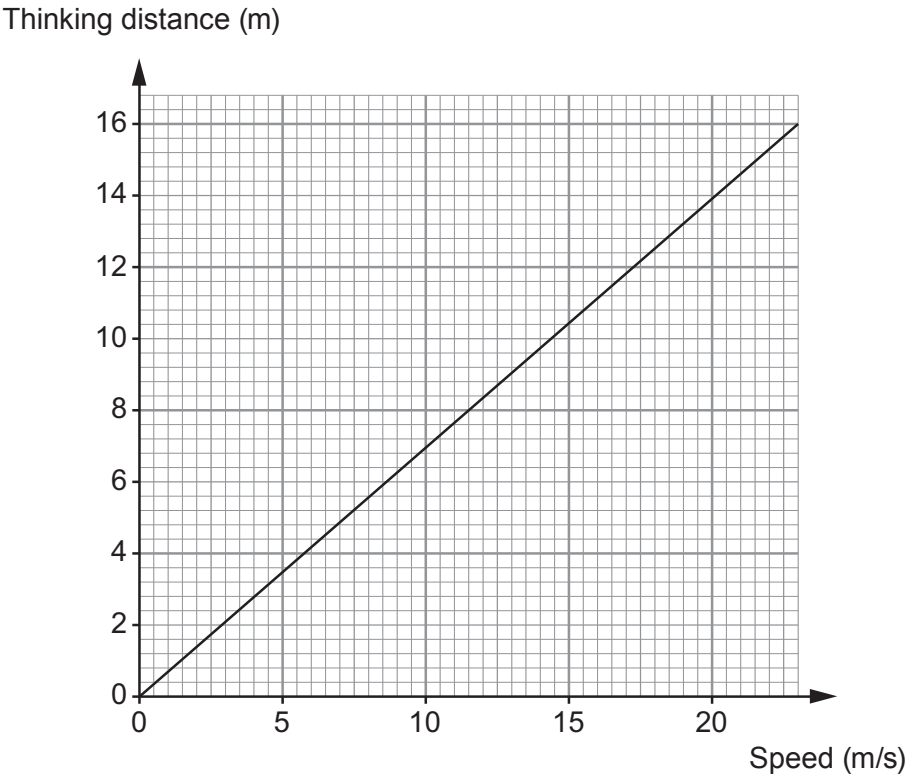
5. *(a)* **Two** things happen when a car driver does an emergency stop.

- The driver sees a hazard and thinks what to do. The distance travelled by the car in this time is called the **thinking distance**.
- The driver's foot presses the brake to stop the car.

What distance is added to the **thinking distance** to give the total stopping distance? [1]

.....

(b) The graph shows how thinking distance changes with speed for an alert driver.



(i) Describe how thinking distance changes as the speed changes. [2]

.....

.....

(ii) How is feeling tired likely to affect the thinking distance? [1]

.....

(iii) **Add a line** to the graph above for a tired driver. [1]

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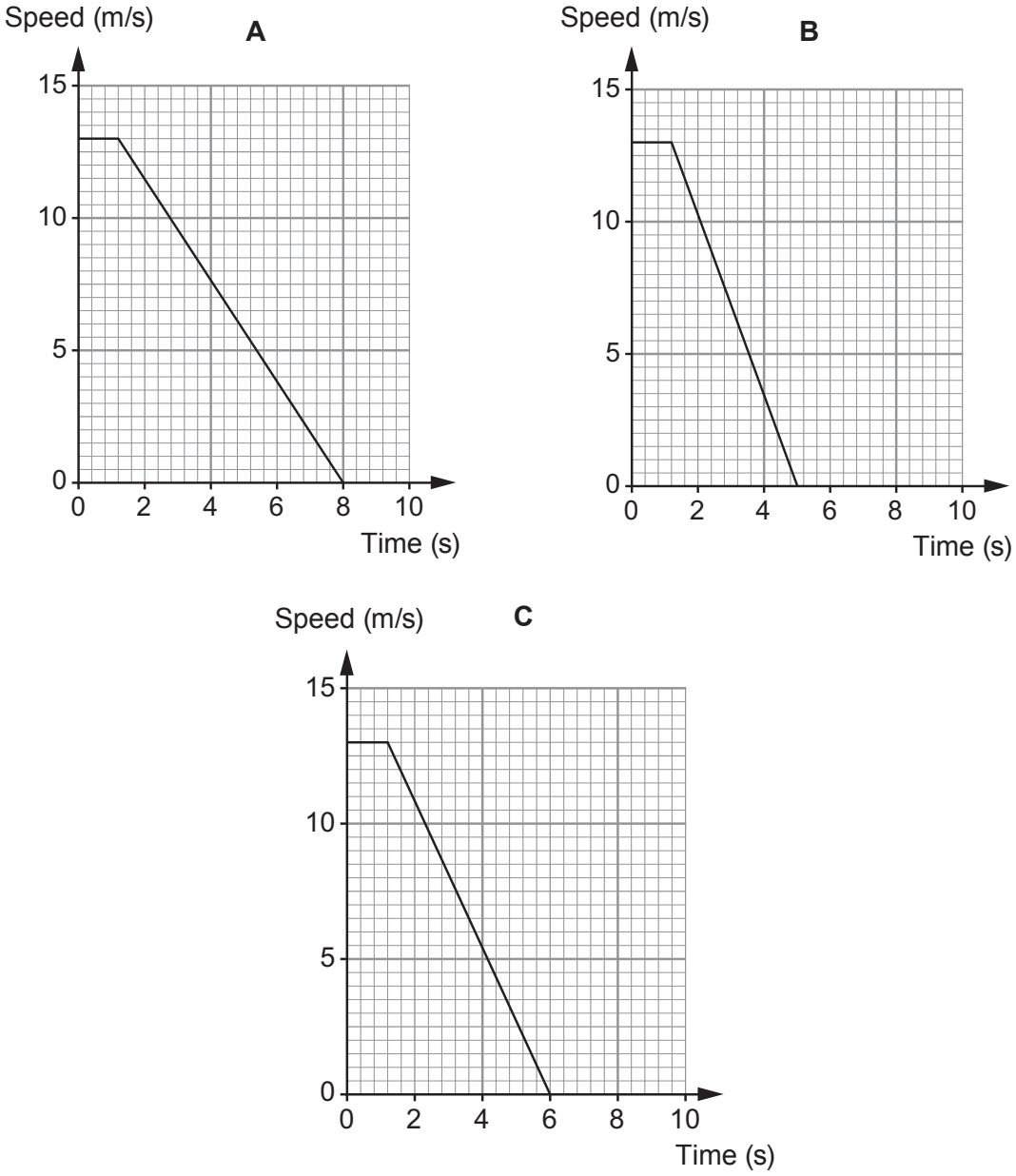
(c) Three cars, **A**, **B** and **C**, are travelling towards traffic lights. The graphs below show how the speed of each car changes **after** the drivers see the lights turn to red.



Use information in the graphs to answer the following questions.

(i) How fast were the cars travelling when the lights changed to red?

..... m/s [1]

(ii) After how many seconds does car **A** stop? ..... s [1]

(iii) Which **one** of the cars, **A**, **B** or **C** stops in the shortest distance? ..... [2]

How does the graph show this?

.....

9

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6. A car is travelling at 15 m/s and decelerates to 0 m/s in 5 s on a dry road.

(i) Use an equation from page 2 to calculate the deceleration of the car. [2]

deceleration = ... m/s^2

(ii) (I) Use the equation:

$$\text{mean speed} = \frac{(\text{initial speed} + \text{final speed})}{2}$$

to calculate the mean speed of the car as it decelerates. [2]

mean speed = ... m/s

(II) Explain how the mean speed of the decelerating car travelling at 15 m/s would have changed (if at all) if the road had been icy instead of dry. [2]

.....

.....

.....

6

Examiner only

7. Isotopes of iodine can be used to study the thyroid gland in the body.

A small amount of the radioactive isotope is injected into a patient and the radiation is detected outside the body. Two isotopes that could be used are $^{123}_{53}\mathrm{I}$ and $^{131}_{53}\mathrm{I}$.

(a) Answer the following questions in terms of the numbers of particles.

(i) State **one** similarity between the nuclei of $^{123}_{53}\mathrm{I}$ and $^{131}_{53}\mathrm{I}$. [1]

.....

.....

(ii) State **one** difference between the nuclei of $^{123}_{53}\mathrm{I}$ and $^{131}_{53}\mathrm{I}$. [1]

.....

.....

(b) The nucleus of $^{131}_{53}\mathrm{I}$ decays into xenon (Xe) by giving out beta (β) and gamma (γ) radiation.

(i) What is beta radiation? [1]

.....

(ii) Complete the equation below to show the decay of Iodine-131 (I-131). [2]

$$^{131}_{53}\mathrm{I} \longrightarrow {}^{\ldots\ldots}_{54}\mathrm{Xe} + {}^{0}_{\ldots\ldots}\beta + \gamma$$

(c) The isotope $^{123}_{53}\mathrm{I}$ decays by gamma emission. Explain why it is better to use $^{123}_{53}\mathrm{I}$ than $^{131}_{53}\mathrm{I}$ as a medical tracer. [2]

.....

.....

.....

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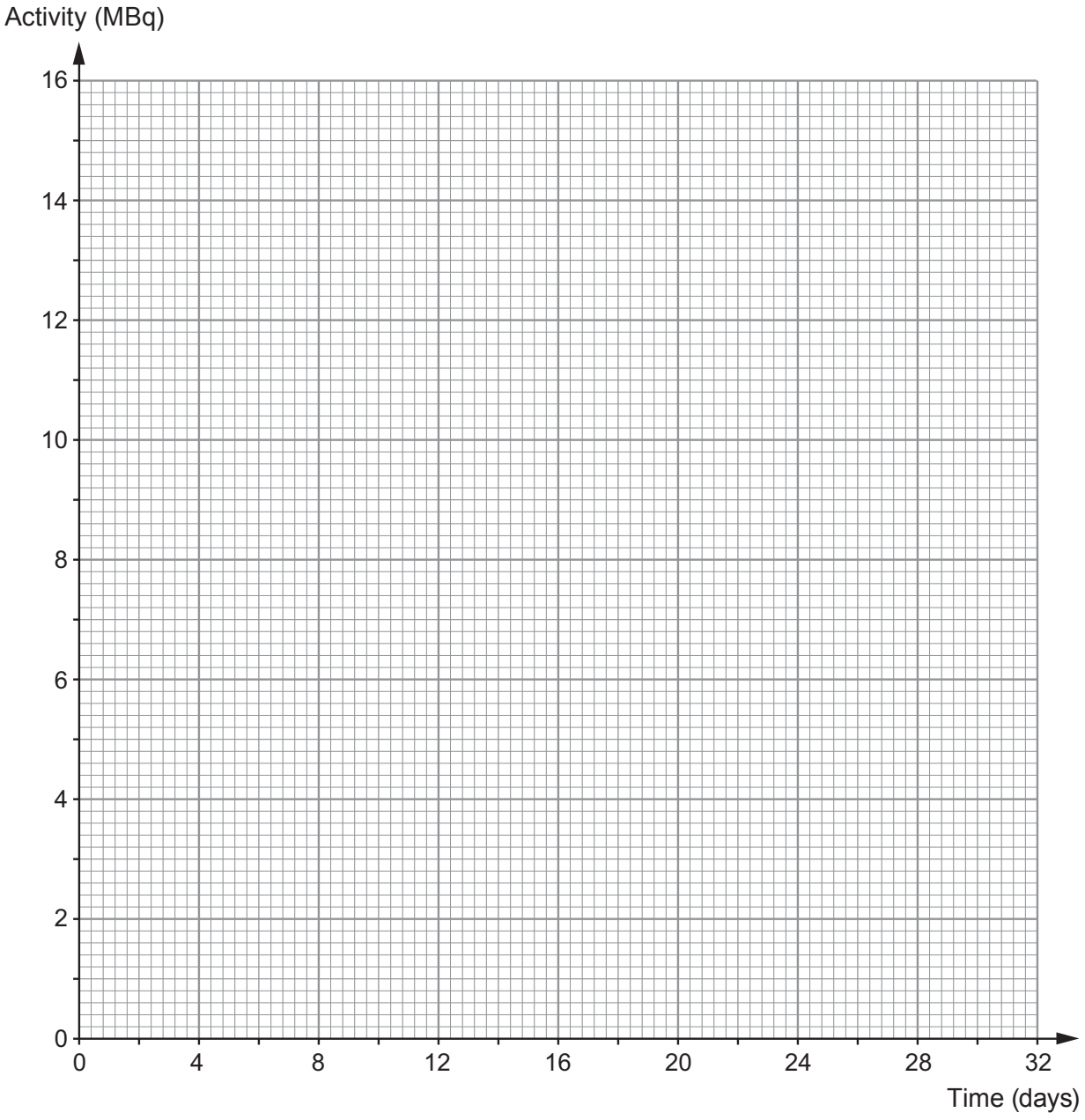
(d) (i) Iodine-131 has a half-life of 8 days. A sample has an initial activity of 16 MBq. Plot the data on the grid and draw a suitable line to show how the activity changes over 32 days. [3]

Time (days)	0	8	16	24	32
Activity (MBq)	16	8	4	2	1



(ii) **Draw lines** on the graph to find the time it takes for the activity to fall from 12 MBq to 3 MBq. Comment on your answer. [2]

.....

.....

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8. A number of safety features appear in modern cars to protect the people in the car in a head-on collision. A passenger safety cage and a collapsible steering column are two safety features. Name **one** *other* safety feature and explain the physics behind its design.

Your answer should include:

- the name of **one** *other* safety feature;
- a description of what it does in a collision;
- an explanation of how it works in terms of either forces or energy. [6 QWC]

END OF PAPER

6

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

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