Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4473/02

ADDITIONAL SCIENCE/PHYSICS

PHYSICS 2
HIGHER TIER

A.M. THURSDAY, 23 May 2013

1 hour

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	12	
2.	12	
3.	6	
4.	7	
5.	8	
6.	15	
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 answers to questions **2**(i) and **6***(a)*.

M A Y 1 3 4 4 7 3 0 2 0 1

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Equations

power = voltage × current	$P = VI$
current = $\frac{\text{voltage}}{\text{resistance}}$	$I = \frac{V}{R}$
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. All living material takes in carbon-14 (C-14) which is radioactive and decays by beta emission. It has a half-life of 6000 years and is used in carbon dating which tells us the age of some old fossils. The age of things that died more than **10 half-lives** in the past cannot be accurately measured as the amount of C-14 present is too small.

(a) (i) State what you understand by the statement "the half-life of carbon-14 is 6000 years". [1]

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(ii) Explain how carbon-14 decays by beta emission. [2]

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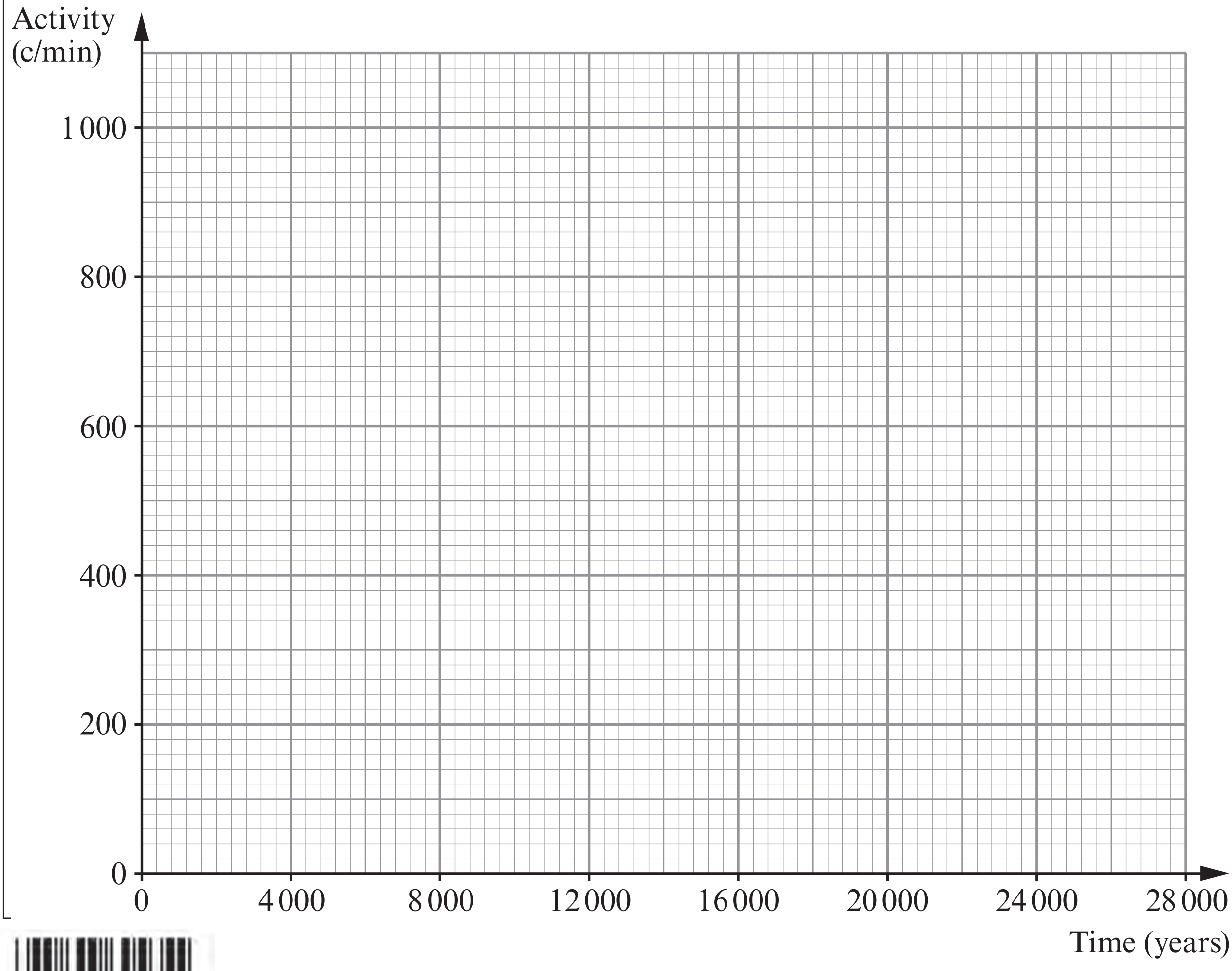
(b) The activity of an amount of carbon-14 reduces with time in the way shown in the table below. (All values have been adjusted for background radiation.)

Time (years)	0	6000	12000	18000	24000
Activity (c/min)	800	400	200	100	50

(i) Use the information in the table to **plot a graph** on the grid below. [3]



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(ii) Use the graph to give the activity from the carbon at 16 000 years. [1]

Activity = ... c/min

(iii) Calculate the number of years after which carbon dating proves to be impossible. [2]

Number of years = ...

(c) (i) A sample of bone taken from a skeleton at an archaeological site gave a reading of 32 c/min. An identical mass of bone in a living animal gives a reading of 80 c/min. Use the graph to find the age of the skeleton. [1]

Age = ... years

(ii) State the method you used to arrive at your answer and show it on the graph. [2]

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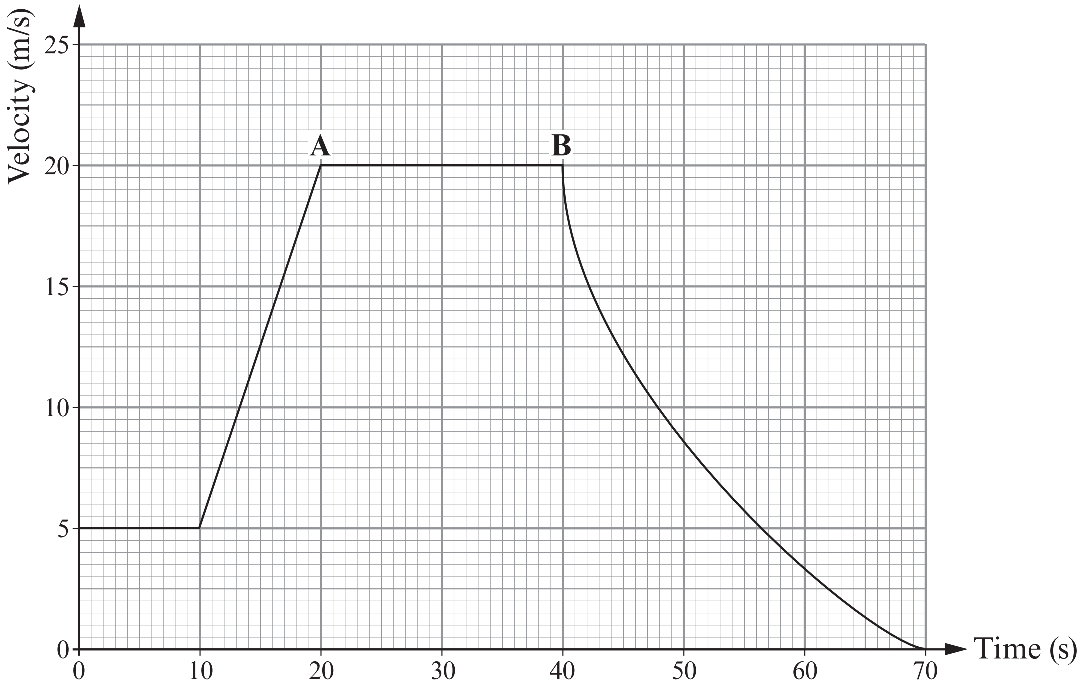
2. The velocity-time graph for part of a journey of a bus is shown below.



(i) Using data from the graph, describe the motion of the bus during the 70 s shown. [6 QWC]

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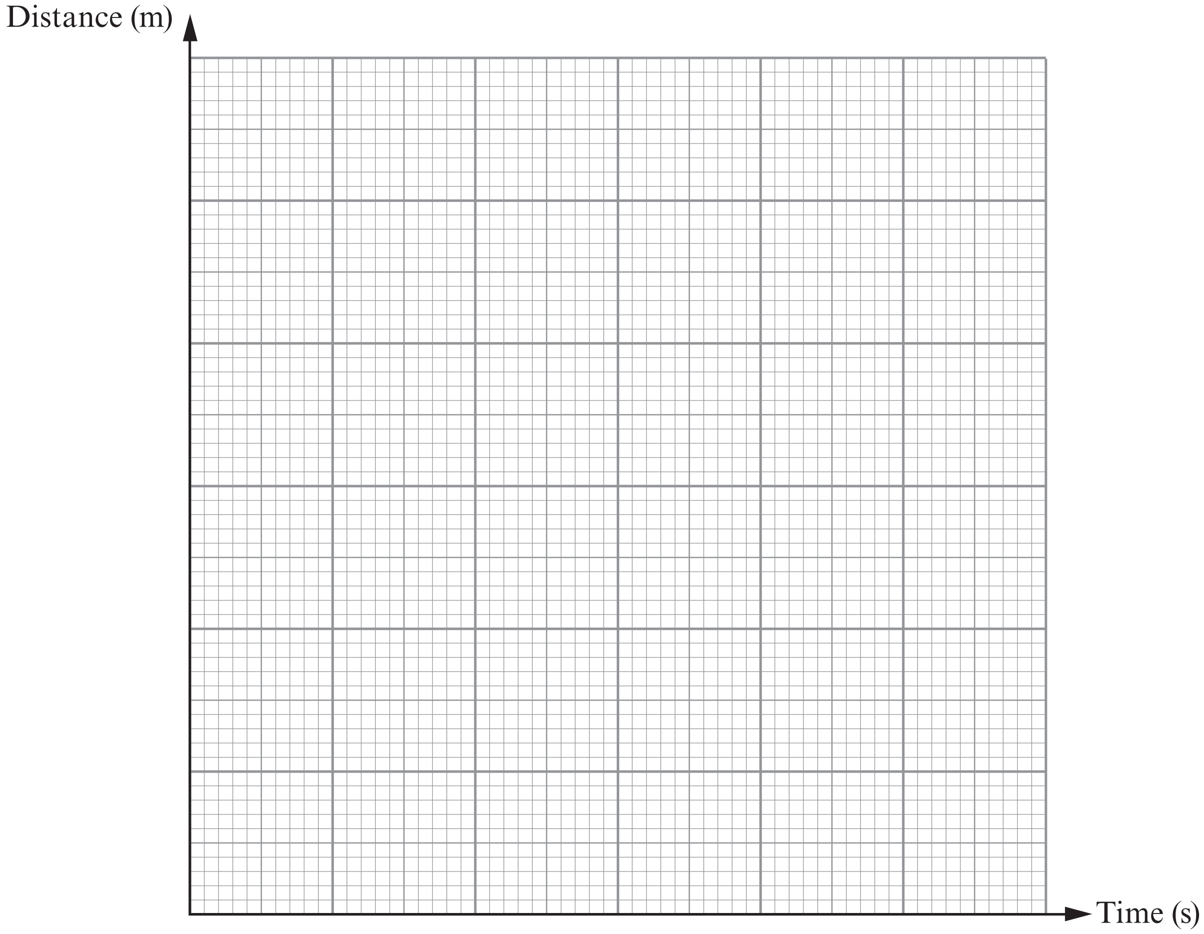
(ii) During the first 10 s, the bus travels 50 m. Use this information to construct a distance-time graph for the **first 10 s only** on the grid below. [3]



(iii) Use the equation:

distance = speed × time

to calculate the distance travelled by the bus between **A** and **B** on the graph opposite. [3]

Distance travelled = ... m

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3. *(a)* State Newton's first law of motion. [2]

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(b) (i) A car experiences an accelerating force of 2 250 N for 8 seconds. Use an equation from page 2 to calculate its change in momentum. [2]

Change in momentum = ... kg m/s

(ii) If the car was initially travelling at 5 m/s and has a mass of 900 kg, use an equation from page 2 to calculate its final velocity. [2]

Final velocity = ... m/s

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4. The table below shows information about different nuclei involved in the process of nuclear fission.

Nucleus	Symbol	Number of protons	Number of neutrons
Plutonium	Pu	94	145
Yttrium	Y	39	50
Caesium	Cs	55	93

(a) A nucleus of plutonium undergoes fission when bombarded with a **slow moving** neutron (n) splitting into the daughter nuclei yttrium and caesium.

(i) How are slow moving neutrons achieved in a nuclear reactor? [1]

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(ii) Produce the balanced nuclear equation for this fission reaction. [4]

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(b) Caesium has 40 known isotopes. Describe how these isotopes are similar to and different from each other. [2]

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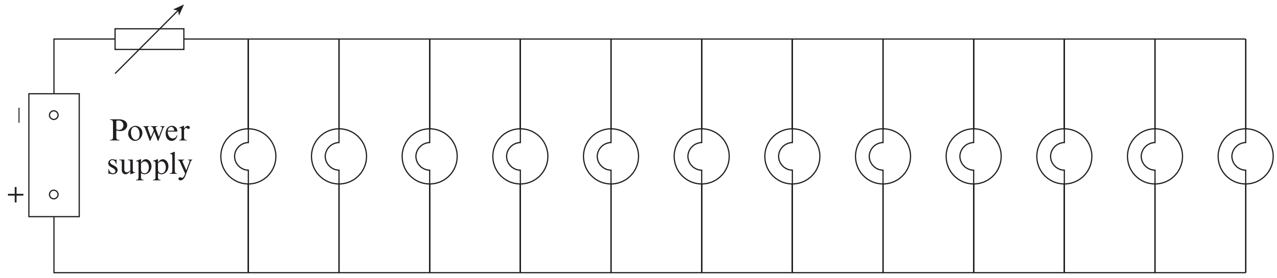
5. A light fitting consists of twelve 40 W lamps connected in parallel. They are connected to the 230 V mains in a circuit in series with a single dimmer switch.



(a) Use an equation from page 2 to calculate the current through each lamp, when all the lamps are operating at normal brightness. [2]

Current = ... A

(b) The lamps are dimmed. At one dimmer switch setting, the resistance of the dimmer switch is 82 Ω and the power loss in the dimmer switch is 118 W.

(i) Use an equation from page 2 to calculate the current through the dimmer switch. [3]

Current = ... A

(ii) Calculate the power produced by each lamp at this dimmer switch setting. [3]

Power = ... W

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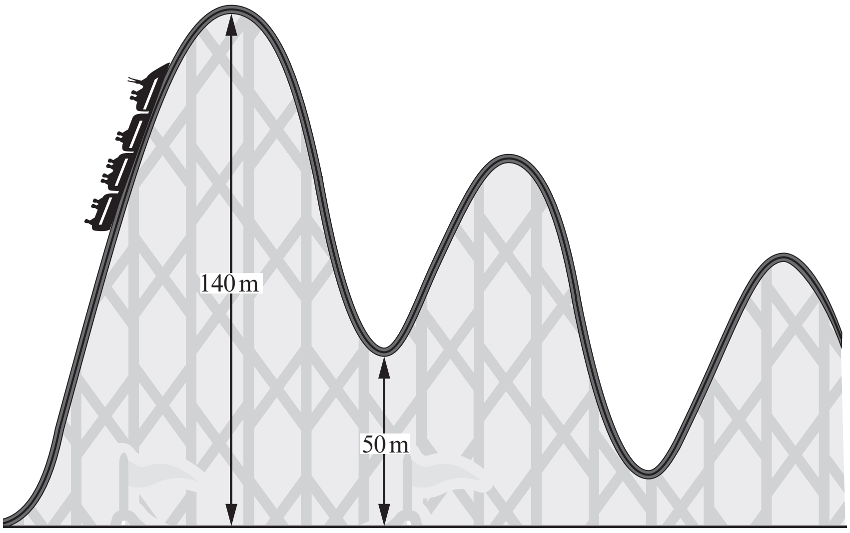
6. A rollercoaster car has no engine. The car is pulled to the top of the first peak at the beginning of the ride, but after that the car must complete the ride on its own. Every peak on a rollercoaster must be lower than the one before it.



(a) Explain in terms of energy transfers how the car is able to complete the ride after being pulled to the top of the first peak and why each peak must be lower than the one before it. [6 QWC]

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(b) One of the world's tallest rollercoasters has an initial peak of height 140 m. After reaching the top, the car first falls to a height 50 m above the ground before it continues on its journey.

The mass of the car and passengers is 1 200 kg.

(i) Use equations from page 2 to calculate the theoretical maximum velocity of the car after this first fall. (g = 10 m/s^2) [4]

Maximum velocity = ... m/s

(ii) Discuss whether or not this theoretical maximum velocity depends on the mass of the passengers. [2]

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(iii) In practice, the car reaches a velocity of 37 m/s after this first fall. The length of track on the fall is 100 m. Use equations from page 2 to calculate the mean resistive force on the car. [3]

Mean resistive force = ... N

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END OF PAPER

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

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