Surname	Centre Number	Candidate Number
Other Names		0

New GCSE

4473/01

ADDITIONAL SCIENCE
FOUNDATION TIER
PHYSICS 2

A.M. THURSDAY, 24 May 2012

1 hour

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

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.

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 pages 2 and 3 of the examination paper. 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 **7**.

Equations and Units

Physics 1

energy transfer = power × time	$E = Pt$
units used (kWh) = power (kW) × time (h) cost = units used × cost per unit	
$\%\ \text{efficiency} = \dfrac{\text{useful energy [or power] transfer}}{\text{total energy [or power] input}} \times 100$	
$\text{density} = \dfrac{\text{mass}}{\text{volume}}$	$\rho = \dfrac{m}{V}$
wave speed = wavelength × frequency	$v = \lambda f$
$\text{speed} = \dfrac{\text{distance}}{\text{time}}$	

Physics 2

power = voltage × current	$P = VI$
$\text{current} = \dfrac{\text{voltage}}{\text{resistance}}$	$I = \dfrac{V}{R}$
$\text{acceleration [or deceleration]} = \dfrac{\text{change in velocity}}{\text{time}}$	$a = \dfrac{\Delta v}{t}$
acceleration = gradient of a velocity – time graph	
momentum = mass × velocity	$p = mv$
resultant force = mass × acceleration	$F = ma$
$\text{force} = \dfrac{\text{change in momentum}}{\text{time}}$	$F = \dfrac{\Delta p}{t}$
work = force × distance	$W = Fd$

Physics 3

pressure = $\frac{\text{force}}{\text{area}}$ $\qquad$ $p = \frac{F}{A}$

$v = u + at$ $\qquad$ where $\qquad$ u = initial velocity
$x = \frac{1}{2}(u + v)t$ $\qquad$ v = final velocity
a = acceleration
t = time
x = displacement

Units

1 kWh = 3.6 MJ
T / K = θ / °C + 273

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 in the spaces provided.*

1. The following equation shows a nuclear fusion reaction.

$$^{2}_{1}H + ^{3}_{1}H \longrightarrow ^{4}_{2}He + ^{1}_{0}n$$

deuterium + tritium ⟶ helium + neutron

(a) $^{2}_{1}H$, $^{3}_{1}H$ (and $^{1}_{1}H$) are all different forms of hydrogen.

Underline the correct word for "different forms" from the list below. [1]

element compound proton isotope

(b) Write down the nucleon number of the element He in the equation above. .... [1]

(c) Give **two** reasons why the process of nuclear fusion is very difficult to contain. [2]

1. ....

....

2. ....

....

4

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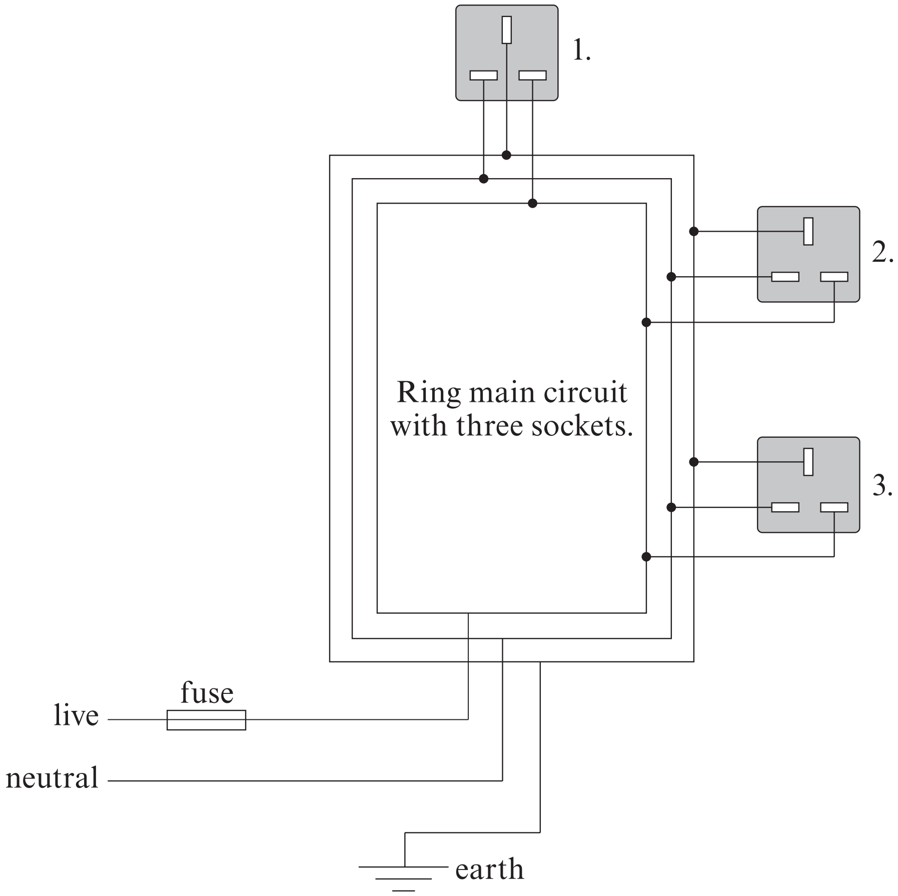
2. The diagram shows a ring main circuit. It contains 3 wall sockets.



The table gives information about appliances that are connected in each socket.

Socket	Appliance connected to the socket	Current (A)
1	toaster	8
2	washing machine	10
3	tumble dryer	6

(a) Use an equation from pages 2 and 3 to calculate the power of the washing machine, which operates on 230 V.
Give the correct unit. [3]

Power = ... Unit ....

(b) The ring main circuit is protected by a fuse. It breaks the circuit if too much current flows.
Draw a **circle** around the correct current rating for the fuse from the following list to allow all 3 appliances to operate at the same time. [1]

6 A 16 A 20 A 32 A

(c) Write down the size of the voltage that operates the tumble dryer. .... V [1]

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Turn over.

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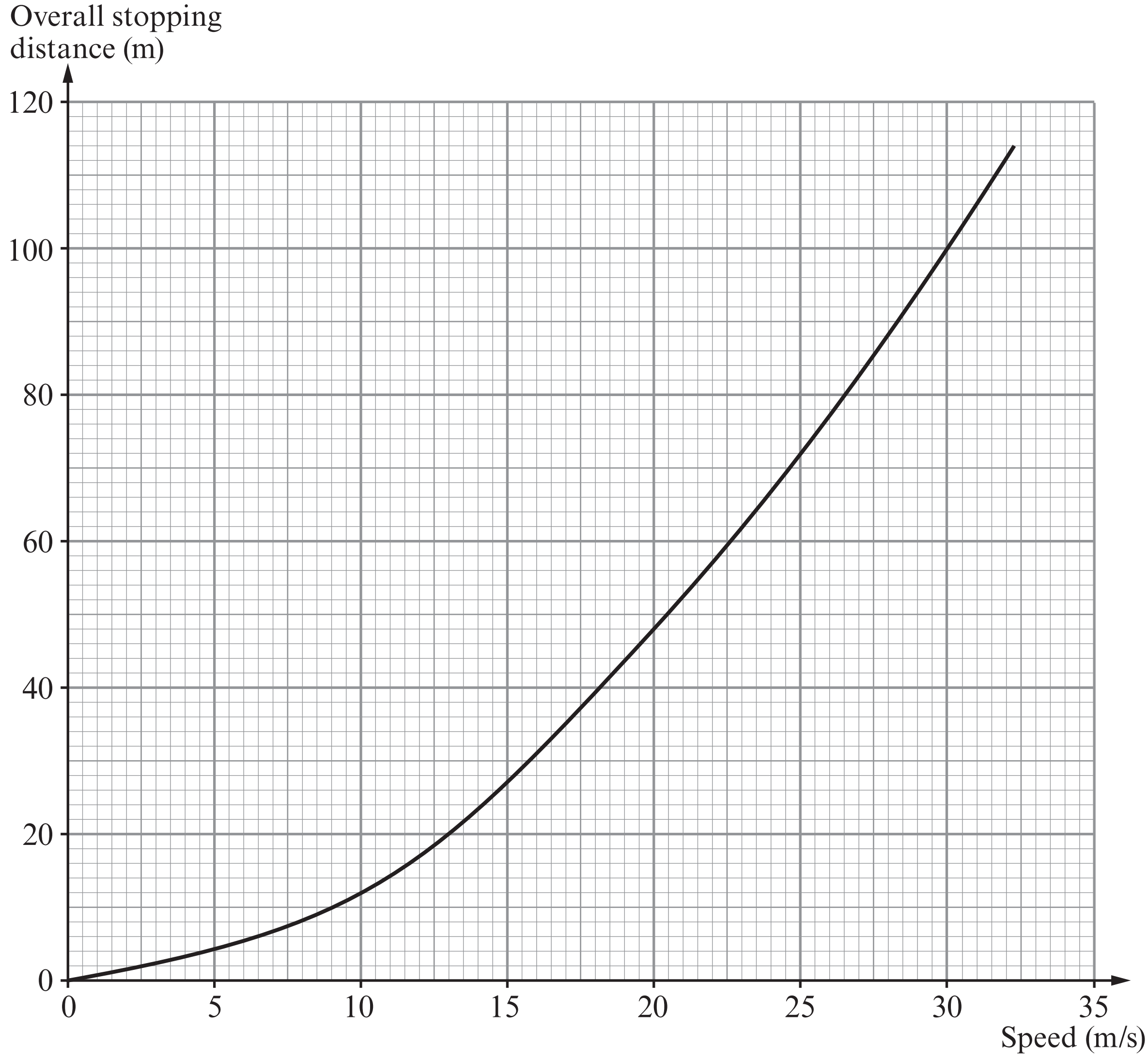
3. The graph below shows how the **overall stopping distance** for a car changes with its speed.



(a) State how the graph shows that the overall stopping distance is not proportional to the speed. [1]

....

....

(b) It is claimed that reducing the speed limit outside schools from 13 m/s (30 mph) down to 9 m/s (20 mph) will reduce the risk of a collision.

Use values from the graph to support this claim. [2]

....

....

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....

Examiner only

(c) At one particular speed, the thinking distance is 24 m and the braking distance is 76 m.

(i) Calculate the overall stopping distance and use the graph to find the speed at which this occurs. [2]

Overall stopping distance = ... m

Speed = ... m/s

(ii) Tick (✓) **two** factors in the list below that would increase the thinking distance. [2]

Worn tyres	☐
Icy road	☐
Using a mobile phone	☐
Wet road	☐
Drunk driver	☐

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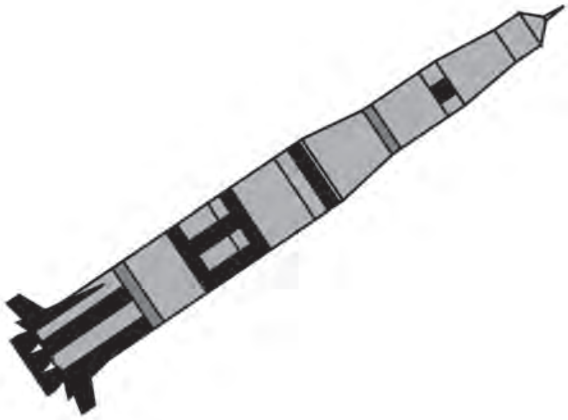
4. The picture shows a rocket out in space, well away from the pull of Earth's gravity.



(a) The rocket travels at constant speed in a straight line and it travels a distance of 50 000 m in 20 s. Use an equation from pages 2 and 3 to calculate its speed. [2]

Speed = ... m/s

(b) Explain why the rocket engines do not need to be used to keep the rocket moving at constant speed through space. [2]

....

....

....

....

(c) Firing the rocket engines increases the momentum of the rocket.
Explain why. [2]

....

....

....

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(d) The momentum of a small rocket increases from 200 000 kg m/s to 360 000 kg m/s in 8 seconds. Use the equation

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

to calculate the force on the rocket. [2]

Force = ... N

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5. *(a)* Some substances are radioactive because their atoms have nuclei that are unstable. Give a reason why they are unstable. [1]

....

....

(b) A particular radioactive substance, which emits gamma radiation, has a half life of 5 hours. A sample of this substance has an activity of 800 counts per minute.

(i) Write down the time taken for the activity to fall to 400 counts per minute. [1]

Time = ... hours

(ii) Calculate the activity after 20 hours. [1]

Activity = ... counts per minute

(iii) One medical use of radioactivity is to monitor the behaviour of internal organs from outside of the body. A radioactive tracer is injected into the patient's bloodstream. Explain whether or not the radioactive substance described above is suitable for use as a medical tracer. [3]

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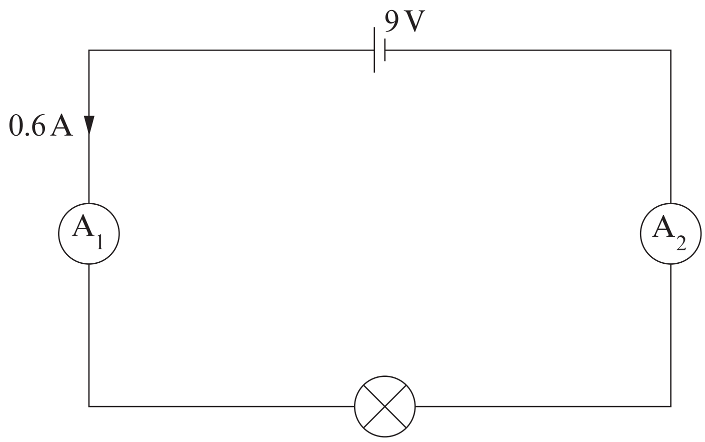
6. The circuit shows a battery and a lamp connected to two ammeters A_1 and A_2.
The current through A_1 is 0.6 A.



(a) Complete the following sentence by **underlining** the correct phrase in the brackets. [1]

Ammeter A_2 reads (less than 0.6 A / 0.6 A / more than 0.6 A).

(b) Using the correct circuit symbol, **add a voltmeter** to the circuit diagram above to measure the voltage across the lamp. [2]

(c) The voltmeter reads 9 V and the current through the lamp is 0.6 A. Use the equation

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

to calculate the resistance of the lamp. [1]

Resistance = ... Ω

(d) (i) State what happens to the current through A_1 when the 9 V battery is replaced by a 12 V battery. [1]

....

....

(ii) State what happens to the current through A_1 when another lamp is connected in series. [1]

....

....

6

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7. Describe how fission of $^{235}_{92}U$ is produced in a nuclear reactor **and explain** the role of moderators and control rods in the process. [6 QWC]

6

Examiner only

8. Iodine-131 [$^{131}_{53}I$] is present in fission products of uranium. It is a beta (β) emitter with a half-life of 8 days. When absorbed into the body it concentrates in the thyroid gland increasing the risk of thyroid cancer. After the nuclear disaster in Japan, people living in the area were given non-radioactive iodine-127 [$^{127}_{53}I$] supplement tablets to reduce their intake of iodine-131 that leaked from the reactor.

(a) What is a beta (β) particle? .... [1]

(b) Explain why iodine-131 increases the risk of thyroid cancer. [2]

....

....

....

(c) Compare the nuclear structure of $^{131}_{53}I$ and $^{127}_{53}I$. [3]

....

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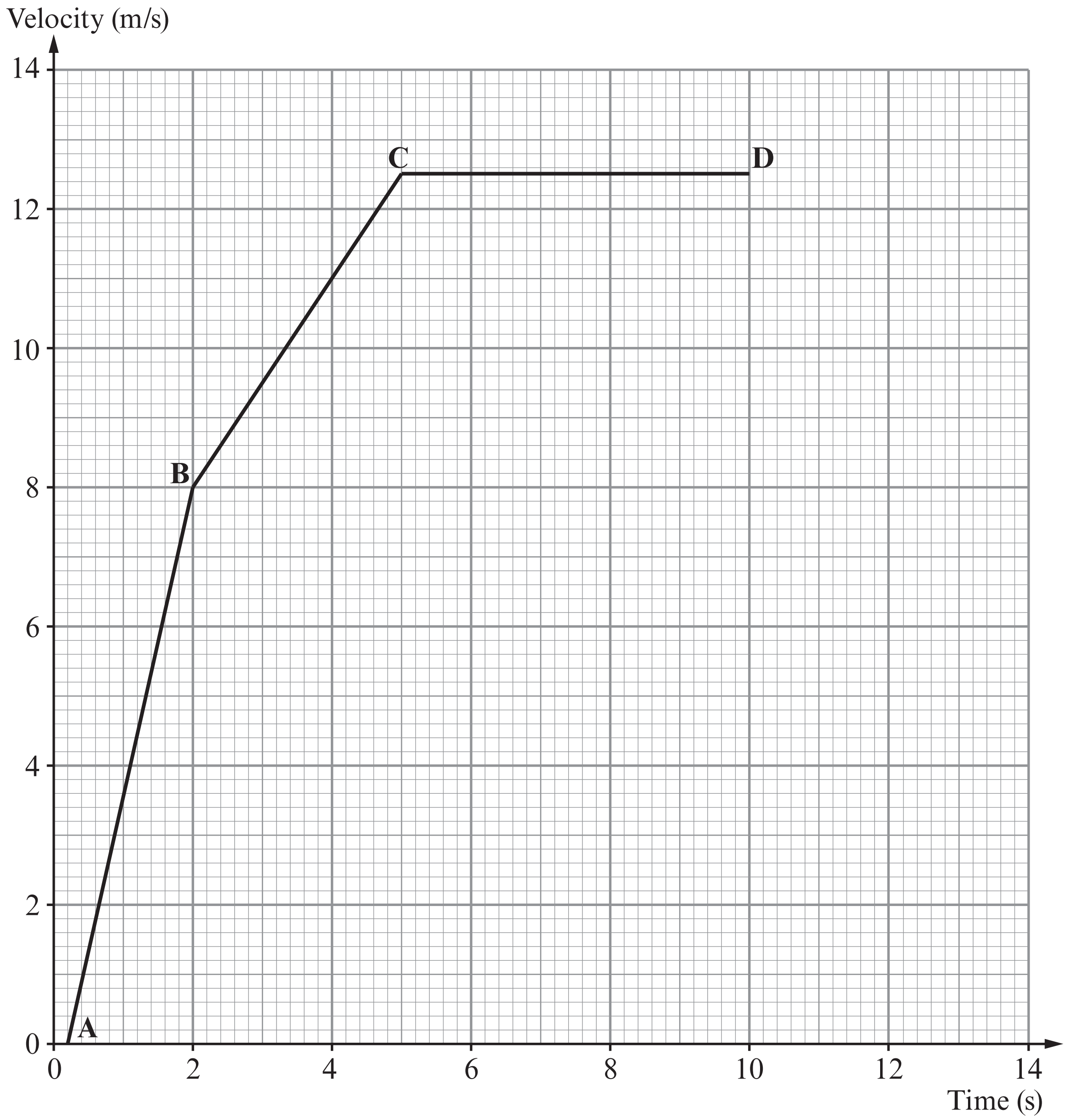
6

Examiner only

9. The simplified graph shows the velocity of a top athlete running a 100 m race. The gun is fired at 0 s to start the race.



(a) Use the graph to find the athlete's reaction time. .... s [1]

(b) (i) The acceleration of the athlete is greatest between **A** and **B**.
State how the graph shows this. [1]

....

....

Examiner only

(ii) Use the equation

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time}}$$

to calculate the athlete's acceleration between **A** and **B** and give its unit. [3]

Acceleration = ... Unit ....

(iii) Use your answer to *(b)* (ii) and an equation from pages 2 and 3 to calculate the resultant force on the athlete, given that his mass is 94 kg. [2]

Resultant force = ... N

(c) (i) Use the graph to identify the part of the race (**AB**, **BC** or **CD**) in which the athlete travels the furthest. [1]

....

(ii) Explain your answer. [2]

....

....

....

(d) At the end of the race the athlete takes 2.5 s to slow down uniformly to rest. **Complete the graph** to show this. [2]

THERE ARE NO MORE QUESTIONS IN THE EXAMINATION.

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