Surname	Centre Number	Candidate Number
Other Names		0

New GCSE

4473/02

ADDITIONAL SCIENCE
HIGHER TIER
PHYSICS 2

A.M. THURSDAY, 24 May 2012

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**8**	
2.	**9**	
3.	**17**	
4.	**9**	
5.	**8**	
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.

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 answers to questions **1**(*a*) and **4**(*b*).

Equations and Units

Physics 1

power = voltage × current $P = VI$

energy transfer = power × time $E = Pt$

units used (kWh) = power (kW) × time (h)
cost = units used × cost per unit

$$\%\ \text{efficiency} = \frac{\text{useful energy [or power] transfer}}{\text{total energy [or power] input}} \times 100$$

$$\text{density} = \frac{\text{mass}}{\text{volume}} \qquad \rho = \frac{m}{V}$$

wave speed = wavelength × frequency $v = \lambda f$

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

Physics 2

$$\text{current} = \frac{\text{voltage}}{\text{resistance}} \qquad I = \frac{V}{R}$$

power = current^2 × resistance $P = I^2R$

$$\text{acceleration [or deceleration]} = \frac{\text{change in velocity}}{\text{time}} \qquad a = \frac{\Delta v}{t}$$

distance travelled = area under a velocity – time graph

acceleration = gradient of a velocity – time graph

momentum = mass × velocity $p = mv$

resultant force = mass × acceleration $F = ma$

$$\text{force} = \frac{\text{change in momentum}}{\text{time}} \qquad F = \frac{\Delta p}{t}$$

work = force × distance $W = Fd$

$$\text{kinetic energy} = \frac{\text{mass} \times \text{speed}^2}{2} \qquad \text{KE} = \frac{1}{2}mv^2$$

change in potential energy = mass × gravitational field strength × height PE = mgh

Physics 3

$$\frac{\text{primary coil voltage}}{\text{secondary coil voltage}} = \frac{\text{primary coil turns}}{\text{secondary coil turns}} \qquad \frac{V_1}{V_2} = \frac{N_1}{N_2}$$

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

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

$\frac{pV}{T} = \text{constant}$ p = pressure
V = volume
T = kelvin temperature

$E = mc^2$

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}

4473
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Examiner only

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

1. *(a)* 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]

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(b) Complete the equation for the fission reaction shown below.

$$^{235}_{92}U + ^{1}_{0}n \longrightarrow ^{137}_{\cdots\cdots}Ba + ^{\cdots\cdots}_{36}Kr + 2^{1}_{0}n$$

[2]

8

Examiner only

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

(ii) Write down the symbol for a beta particle in the form $^{A}_{Z}X$. .... [1]

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

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

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(c) Calculate for how long people had to take the iodine supplement tablets until the activity of iodine-131 reduced to approximately 3% of its original value just after a leak. [2]

Time = ... days

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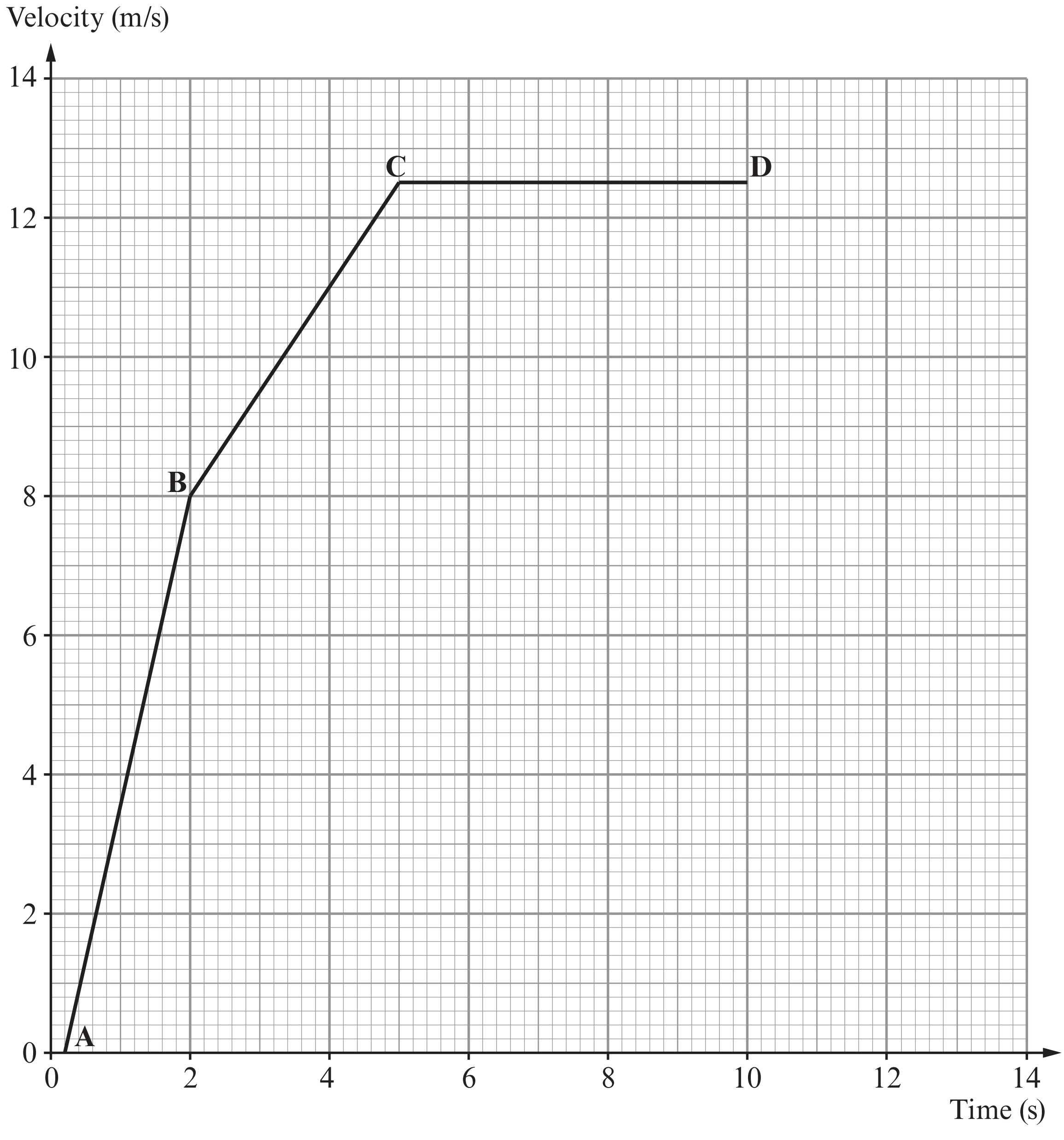
3. The simplified graph shows the velocity of a top athlete running a 100 m race. The gun is fired at 0 s to start the race.



(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]

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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]

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(ii) Explain your answer. [2]

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(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]

(e) (i) Use information from pages 2 and 3 to calculate the distance travelled by the athlete between points **B** and **D**. [3]

Distance travelled = ... m

(ii) Use an equation from pages 2 and 3 to calculate the mean velocity of the athlete between points **B** and **D**. [2]

Mean velocity = ... m/s

17

Examiner only

4. *(a)* A skydiver has a mass of 75 kg.

(i) Calculate the weight of the skydiver. [g = 10 N/kg] [1]

Weight = ... N

(ii) After jumping from a plane, at one point in the fall the air resistance is 300 N. Use the equation

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

to calculate the acceleration of the skydiver at this point. [2]

Acceleration = ...

Examiner only

(b) Explain in terms of forces, why, after jumping from a plane, a skydiver reaches a terminal speed. [6 QWC]

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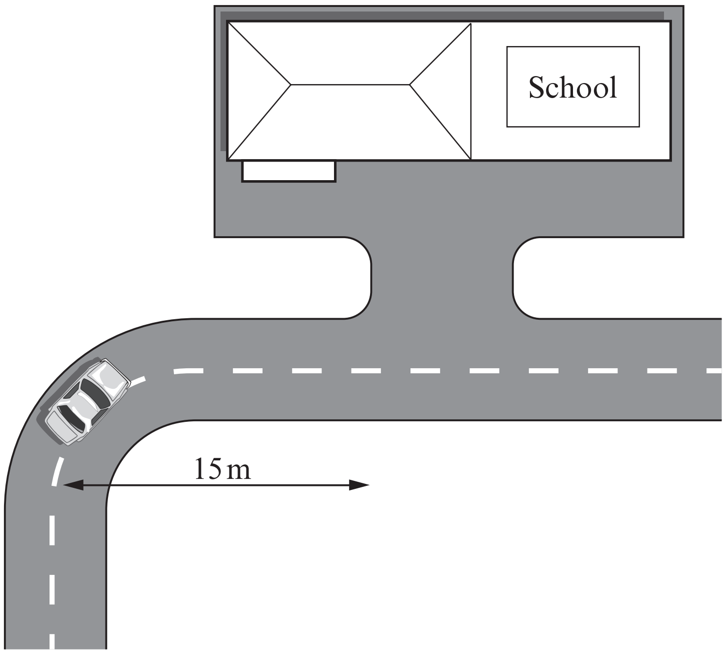
5. The speed limit outside a school is currently 18 m/s (40 mph). The thinking distance at **this speed** is 12 m.

(a) Using equations from pages 2 and 3, calculate the braking distance **and hence**, the overall stopping distance for a car of mass 1000 kg travelling at 18 m/s if the braking force is 6750 N. [Hint: consider kinetic energy and work done.] [5]

Overall stopping distance = ... m

(b) The entrance to the school is situated 15 m past a bend in the road.



Campaigners argue that the speed limit should be halved to 9 m/s (20 mph). **Explain how** this would decrease the chance of children getting knocked down as they crossed the road. [A numerical answer is required for full marks.] [3]

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Examiner only

6. A lighting scheme is being planned for a new restaurant.
Information about the lights to be used is shown in the table below.

Position of lights	Number of lights	Description of lights
over tables	20	11 W compact fluorescent
toilets	6	18 W compact fluorescent
kitchen	6	50 W fluorescent

All the lights will be connected in parallel to one another and to the 230 V mains.

(a) Give a reason for connecting the lights in parallel. [1]

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(b) (i) Use an equation from pages 2 and 3 to calculate the mains current flowing to the lighting circuit when all the lights are switched on. [3]

Total current = ... A

(ii) Regulations for this circuit mean that the power loss in the main supply cable should not exceed 19 W. Use an equation from pages 2 and 3 to calculate the maximum resistance of the cable that should be used in the circuit. [3]

Maximum resistance = ... Ω

(c) Calculate the resistance of each fluorescent light used in the kitchen. [2]

Resistance = ... Ω

THERE ARE NO MORE QUESTIONS IN THE EXAMINATION.

9