Surname	Centre Number	Candidate Number
Other Names		0

NEW GCSE

4463/02

SCIENCE A
HIGHER TIER
PHYSICS 1

A.M. FRIDAY, 20 January 2012

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**6**	
2.	**11**	
3.	**5**	
4.	**8**	
5.	**12**	
6.	**10**	
7.	**8**	
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. 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**(*b*)(ii) and **7**(ii).

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 $P = I^2R$

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

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

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

$\frac{pV}{T}$ = constant $\quad p$ = 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}

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Turn over.

*Answer **all** questions.*

1. Students measure the speed of sound using two different methods.

(i) **Method 1:** Two students stand in front of a wall. One starts a stopwatch as the other hits two wooden blocks together once.

(from esfscience.wordpress.com/category/physics/page/2/)

As soon as the students hear the echo from the wall they stop the stopwatch. The time measured is 0.56 s. They measure the distance to the wall as 98 m.
Use this information and an equation from pages 2 and 3 to calculate the speed of sound in air. [3]

Speed of sound = ... m/s

(ii) **Method 2:** In a laboratory they find that the wavelength of a sound wave of frequency 260 Hz is 1.3 m.
Use this information and an equation from pages 2 and 3 to calculate the speed of sound waves in air. [2]

Speed of sound waves = ... m/s

(iii) The true speed of sound in air is 330 m/s.
Method 1 is less accurate than **Method 2**. Suggest a reason for this. [1]

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6

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2. The National Grid is a system that supplies electrical energy to users all over the country.

(a) State **two** ways in which the National Grid system maintains a reliable energy supply to all users. [2]

1. ....

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2. ....

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(b) (i) A new gas fired power station is designed to produce a power output of 950 MW at a voltage of 25 kV. Using an equation from pages 2 and 3, calculate the output current **in amps** from the power station. [3]

Output current = ... A

(ii) Explain why step-up and step-down transformers are used in the National Grid. [6 QWC]

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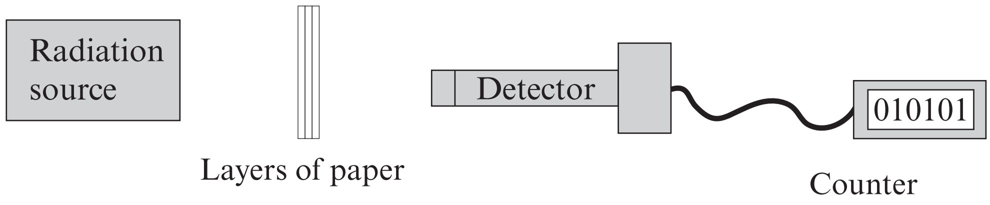
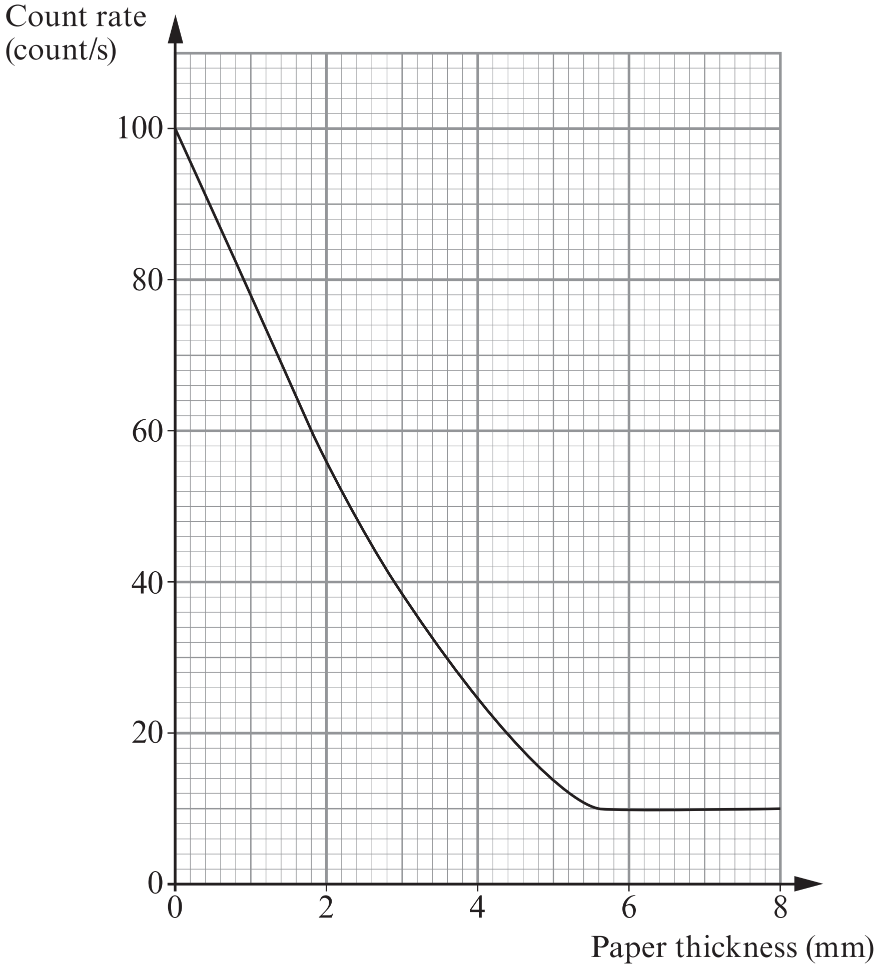
3. A student set up an experiment to see how much nuclear radiation could pass through different thicknesses of paper.



The following graph was plotted from the results obtained:



Examiner only

(a) Use the graph to complete the table of results that was obtained. [1]

Count rate (count/s)	Paper thickness (mm)
20	....
40	2.9
60	1.8
80	0.9
100	0.0

(b) Use the graph to estimate the value of the background radiation and show how you arrived at your answer. [2]

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Background radiation = ... count/s

(c) The radioactive source only emitted one type of nuclear radiation.

Name the type of radiation emitted by the source and state how you arrived at your answer. [2]

Type of radiation: ....

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Turn over.

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4. Compact fluorescent lamps (CFL), with a life of 10 000 hours, have replaced filament light bulbs. Light-emitting diodes (LED), with a life of 50 000 hours, are being developed. Information about both types of lights is given in the table below.

	LED	CFL
Power (W)	6	14
kWh of electricity used over 50 000 hours	300	**A** ....
Cost of using electricity	£36	**B** ....
Price per bulb	£23	£2.50
Bulbs needed for 50 000 hours of use	1	5
Cost of bulbs over 50 000 hours	£23	....
Total cost for 50 000 hours	£59	....

(i) The cost of electricity is 12 p / kWh.
Use the equations:
units used (kWh) = power (kW) × time (h)
cost = units used × cost per unit
to complete boxes **A** and **B** in the table. [3]

(ii) Complete the table to show that the total cost of buying and using **five** CFLs is more than buying and using **one** LED. [2]

Examiner only

(iii) Both types of light are equivalent to a 60 W filament light bulb. Use the information in the table to explain why the LED is **more than twice** as efficient as a CFL. [3]

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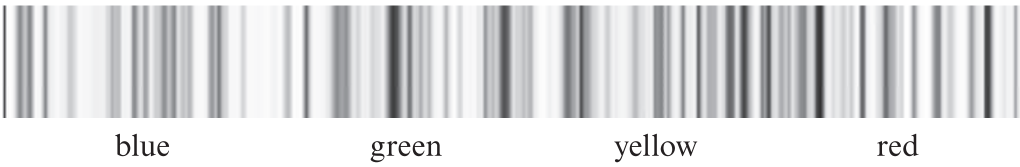
5. *(a)* In 1802, William Hyde Wollaston was the first person to discover that the spectrum from the Sun was crossed with dark lines.

Spectrum of our Sun



Later, Joseph von Fraunhofer measured the wavelengths of these lines.

(i) Explain why the spectra from stars are crossed with dark lines. [2]

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(ii) What information about the star do these dark lines reveal? [1]

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(b) **Describe** how the appearance of the spectra from a near and distant galaxy would be different, and **explain** why this difference occurs. [2]

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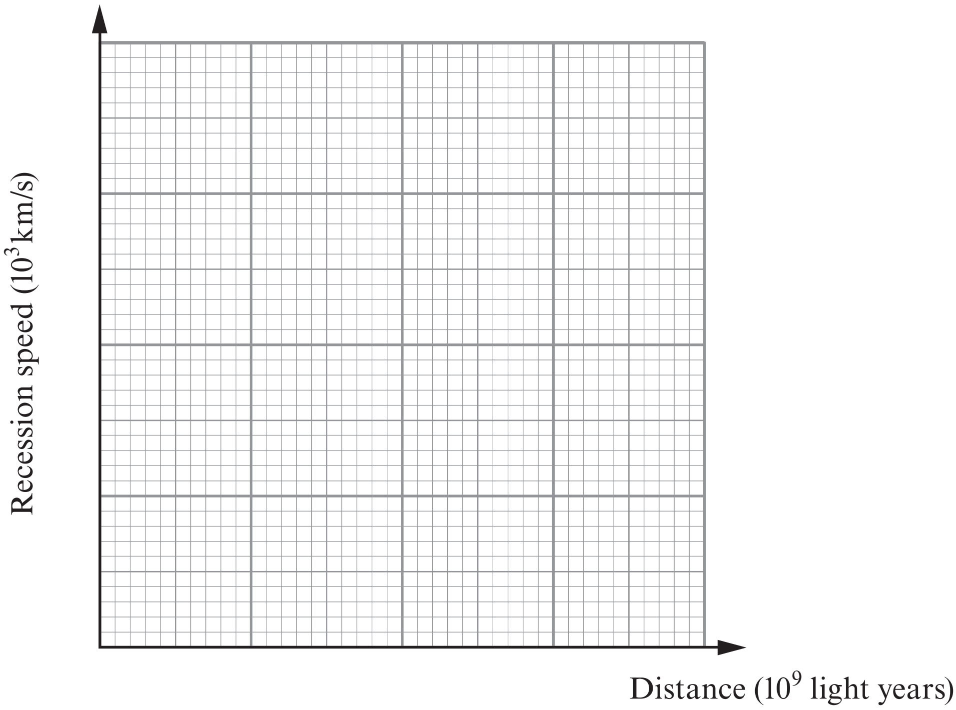
Examiner only

(c) Edwin Hubble's measurements on the spectra of galaxies allowed him to calculate their speed of recession (moving away). His results are shown in the table below.

Recession speed (10^3 km/s)	0	5.0	14.0	41.0	68.0
Distance (10^9 light years)	0	0.2	0.8	1.9	3.2

(i) Use the data to plot a graph on the grid below. [3]



(ii) Describe the relationship between recession speed and distance. [2]

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(iii) Explain how Hubble's measurements provided evidence for the origin of the universe. [2]

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6. Many homeowners, concerned by the rising costs of energy, are looking at different methods of home power generation.

Method	Set-up cost (£)	Power output (kW)
Photovoltaic cells	9 000	2
Small wind turbines	4 000	3
Biomass	5 000	15

(a) State **two** disadvantages for the homeowner of home power generation. [2]

1. ....

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2. ....

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(b) (i) Describe the advantages to the homeowner and the environment of installing photovoltaic cells rather than receiving all their electricity from the National Grid. [3]

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(ii) Home biomass power generators burn wood pellets or logs. Explain why, over time, they have a negligible effect on the carbon dioxide concentration in the atmosphere. [2]

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Examiner only

(c) Homeowners could also reduce their demand for energy by reducing heat losses from their homes. Explain how this could be achieved. [3]

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PLEASE TURN OVER FOR QUESTION 7

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7. (i) State **two** properties common to all types of electromagnetic radiation. [2]

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2. ....

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(ii) Describe how the greenhouse effect produces a heating effect on the Earth. [6 QWC]

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THERE ARE NO MORE QUESTIONS IN THE EXAMINATION.