Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4463/02

S16-4463-02

SCIENCE A/PHYSICS

PHYSICS 1
HIGHER TIER

A.M. MONDAY, 20 June 2016

1 hour

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	10	
2.	14	
3.	14	
4.	8	
5.	6	
6.	8	
Total	60	

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ADDITIONAL MATERIALS

In addition to this paper you may require a calculator and a ruler.

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 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 **2**(*d*) and **6**(iii).

Equations

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

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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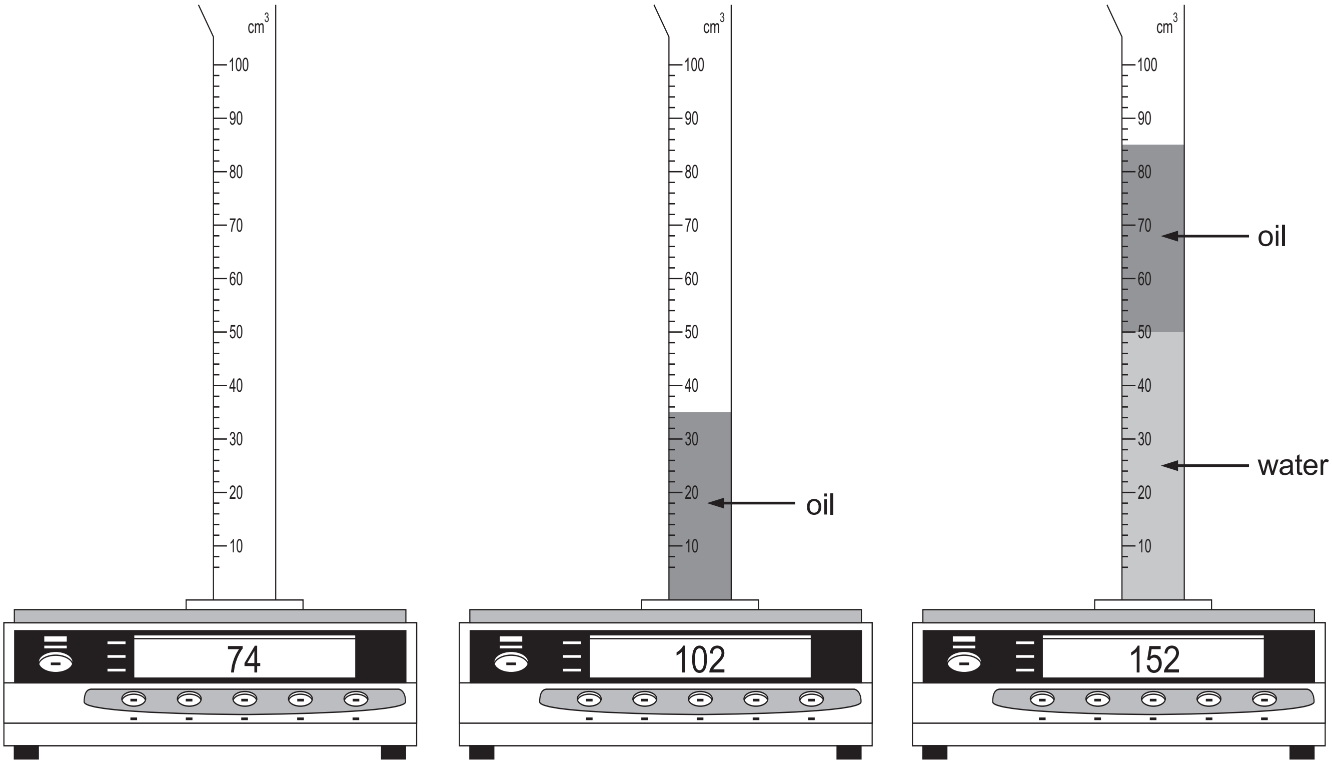
Answer **all** *questions.*

1. A pupil wants to compare the densities of oil and water. Oil floats on water.
She uses a **measuring cylinder that has a mass of 74 g** and an electronic balance that measures to the nearest gram (g).

She places the empty measuring cylinder on to the balance.

She places the measuring cylinder containing some oil on to the balance.

Some water was then added to the cylinder.



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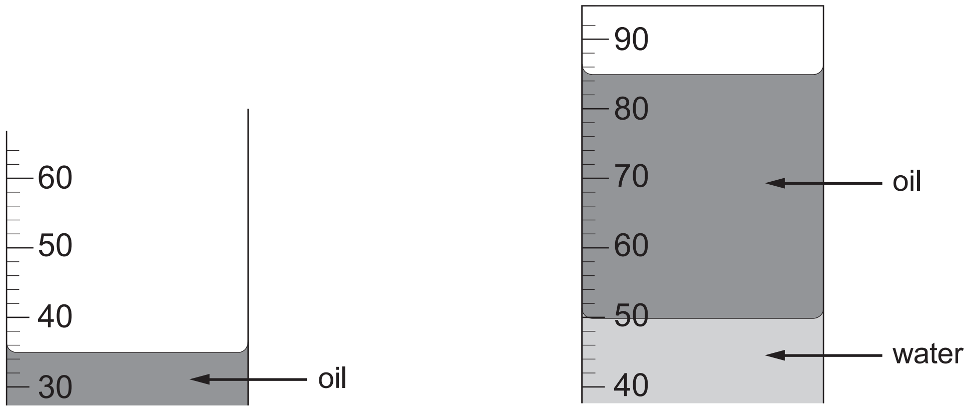
The liquid levels in the measuring cylinder are shown below.



(a) (i) Use the diagrams **to complete the table** below. [3]

	Volume (cm^3)	Mass (g)
oil	35	....
water	....	....

(ii) Use the data above and an equation from page 2 to calculate the density of oil and give its unit in this experiment. [3]

density of oil = ...

unit = ...

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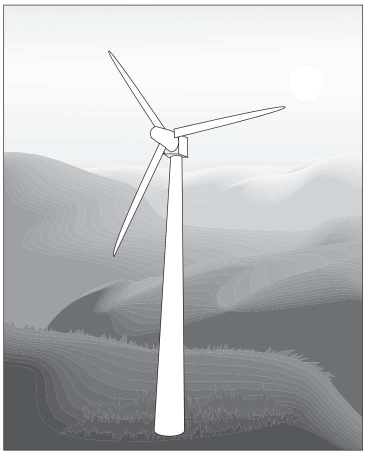
(b) Electrical energy can be generated from wind and from moving water. The density of air is 1.3 kg/m^3 and the density of water is 1 000 kg/m^3.

TIDAL WATER TURBINE



WIND TURBINE

(i) Give two **advantages** of producing electricity by using tidal water turbines compared to wind turbines sited on land. [2]

....

....

....

....

(ii) Give two **disadvantages** of producing electricity by using tidal water turbines compared to wind turbines sited on land. [2]

....

....

....

....

10

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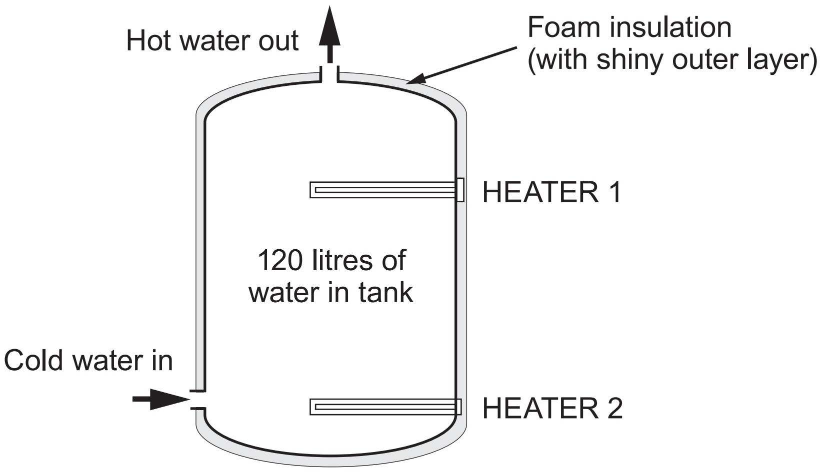
2. A hot water tank that is covered in foam insulation contains a total of 120 litres of water. It has two electric heaters, either of which may be used to heat water to the same final temperature. Heater **1** is used during the day and heater **2** is used during the night. A simplified diagram is shown below.



(a) Explain why heater **1** does not heat all of the water in the tank. [2]

....

....

(b) (i) Explain why foam is used to cover the hot water tank to reduce heat loss. [2]

....

....

....

(ii) State how the shiny outer surface of the foam reduces heat loss. [2]

....

....

....

(c) Explain how the foam covering benefits the environment. [2]

....

....

....

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(d) The following table gives information about heating water by either of the two heaters.

	Electric heater **1**	Electric heater **2**
Volume of water that is heated by the heater (litres)	40	120
Time to heat this volume of water (hours)	0.5	3
Power (kW)	4	2
Cost per unit (p)	16	5

A householder has to decide which heater (**1** or **2**) to use. She will need to use 30 litres of hot water.
Use data from the table and equations from page 2 to compare the two methods of heating in terms of: [6 QWC]

- the number of units used to heat the water;
- the cost of electricity used;
- the impact on the environment;
- advice that should be given to the householder.

Assume the water in the tank is initially cold.

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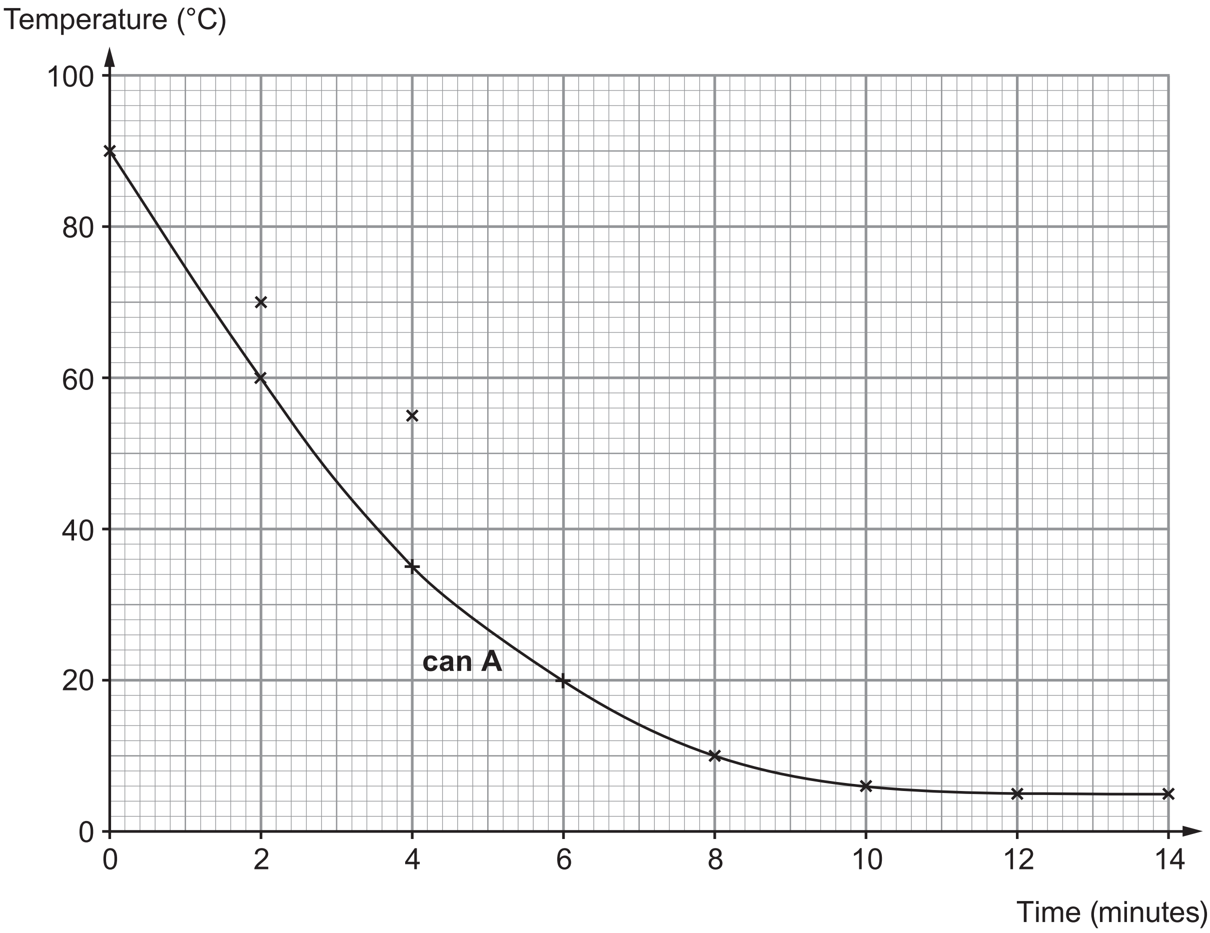
3. Two metal cans, labelled **A** and **B** are identical apart from their colour. One is painted black and the other silver. They are both filled with 100 cm^3 of water at 90 °C and left to cool in a fridge. Their temperatures are recorded every 2 minutes.
The data for **can A** has been presented on the graph below.
The data collected for **can B** is shown in the table.

Time (minutes)	0	2	4	6	8	10	12	14
Temperature of **can B** (°C)	90	70	55	43	34	27	22	18

(a) (i) Plot the data for **can B** on the grid below and draw a suitable line.
(The first three points have been plotted for you.) [3]



(ii) At what time is the **difference** in temperature between the two cans 10 °C ? [1]

.... minutes

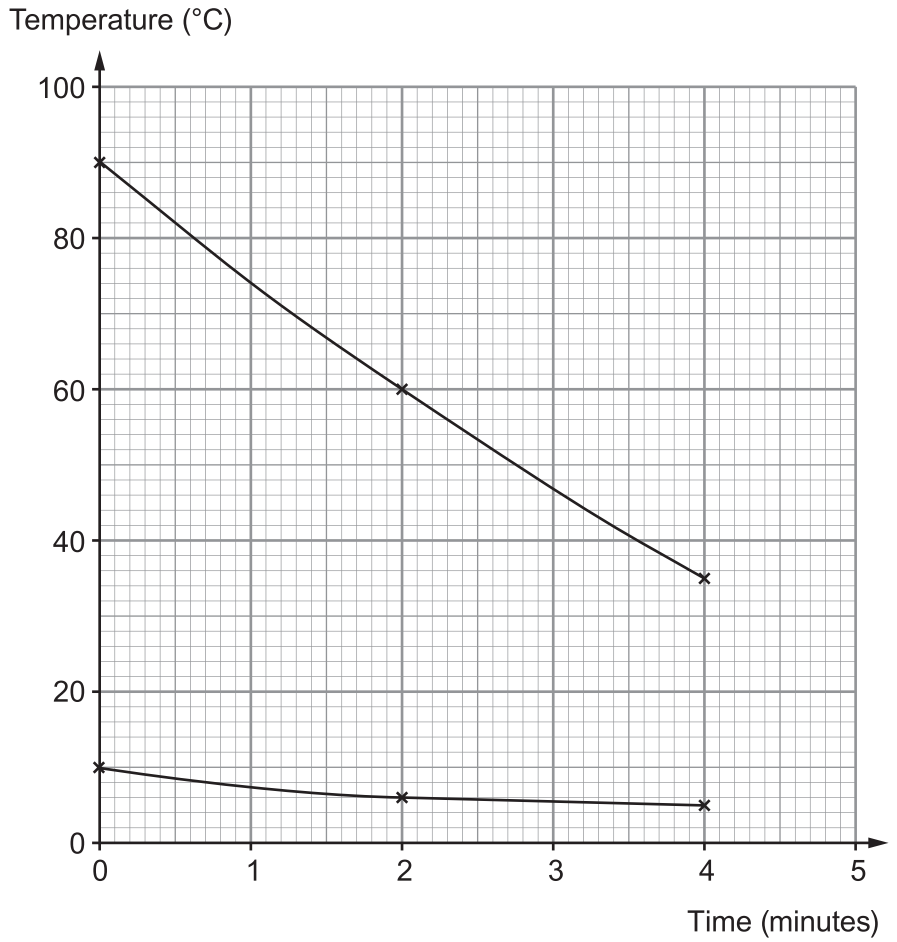
(iii) State the temperature in the fridge during the experiment. [1]

.... °C

Examiner only

(b) A student decides to do an experiment **using can A only**. This time, **only the starting temperature of the water is changed each time**.
The chosen starting temperatures are 90 °C, then 35 °C and finally 10 °C.
Only can A was used and data was collected for just 4 minutes. The cooling curves for starting temperatures of 90 °C and 10 °C are drawn on the graph below.

(i) **Add to the graph** a line showing the cooling curve for the can with a starting temperature of 35 °C. [2]



(ii) Explain in terms of conduction and radiation why the temperature drop for the top curve is greater than for the bottom curve. [3]

....

....

....

....

Examiner only

(c) **Can B** emits infra-red radiation with a range of wavelengths between 8 μm and 10 μm. Use an equation from page 2 to calculate the **maximum** frequency of the infra-red radiation emitted from **can B**. (Speed of light, $c = 3 \times 10^8$ m/s) [4]

frequency = ... Hz

14

Examiner only

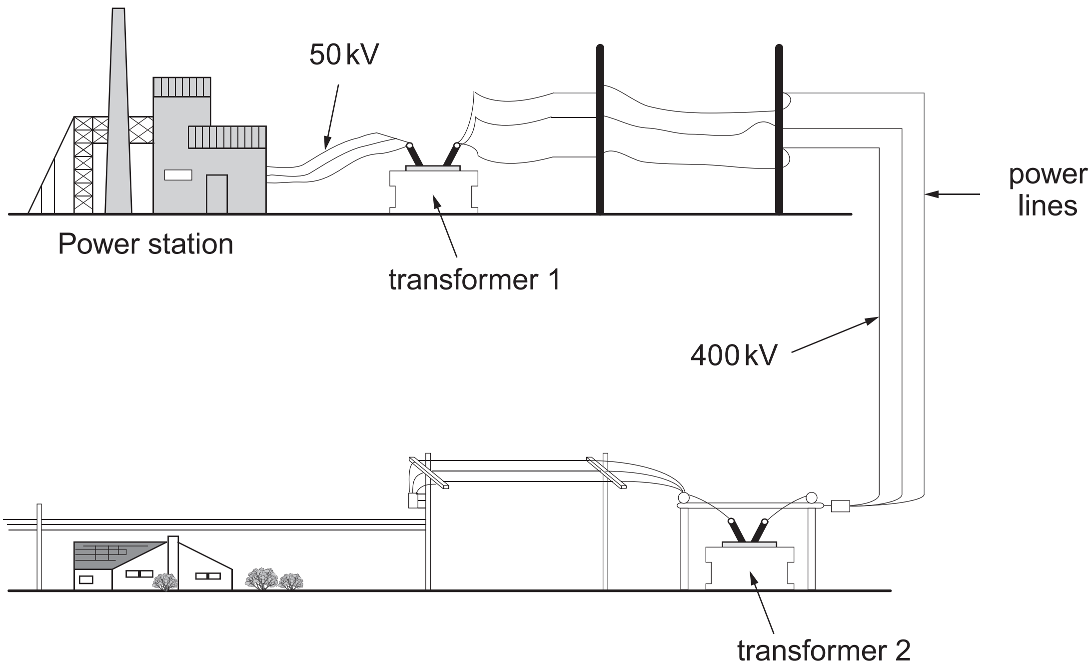
4. A power station delivers an output of 2×10^8 W of electricity at 50 kV which is changed to 400 kV for transmission.

(a) Explain how the National Grid provides a reliable supply of electricity. [2]

....

....

....



(b) Use an equation from page 2 to calculate the current in the National Grid power lines. (You can assume that transformer 1 is 100% efficient.) [3]

current = ... A

(c) In fact some energy is lost as heat in transformers. Explain how the use of the **two** transformers is still more **energy efficient** than transmitting the electricity at 50 kV along the National Grid. [3]

....

....

....

....

8

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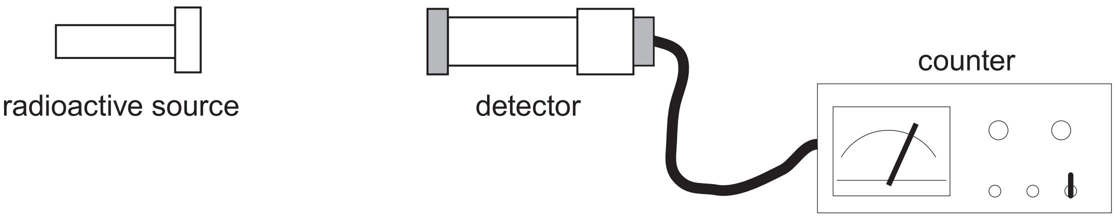
5. Some radioactive elements emit more than one type of radiation. The apparatus below was used to investigate the radiation emitted from a particular source which was placed 5 cm from a detector.



The table shows the mean count rate in counts per minute (cpm) read from the detector when different absorbers were placed, **one at a time**, between it and the source.
All figures have been **corrected for background radiation**.

Original count rate (cpm) with no absorber	Count rate (cpm) with 2 cm lead absorber	Count rate (cpm) with 5 cm lead absorber	Count rate (cpm) with a paper absorber	Count rate (cpm) with 3 mm aluminium absorber
2000	400	60	600	600

(a) (i) By how many counts per minute does the 2 cm lead absorber reduce the count rate? [1]

.... cpm

(ii) What type of radiation passes through 3 mm of aluminium? [1]

....

Examiner only

(b) (i) State how much of the original count rate was produced by beta radiation. [1]

.... cpm

(ii) Explain your answer. [2]

....

....

....

(c) The figures in this experiment have all been **"corrected for background radiation"**.
State what is meant by the phrase "corrected for background radiation". [1]

....

....

6

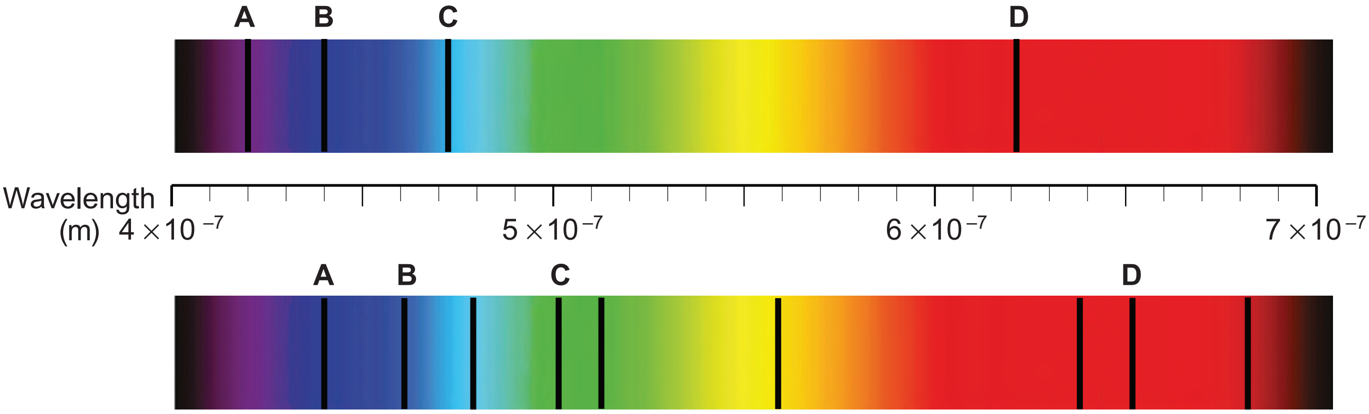
Examiner only

6. The first diagram below shows the spectrum of white light after it is passed through hydrogen in the laboratory.

The second spectrum comes from a galaxy that is 4×10^9 light years away.

(i) State the time taken for light to travel from the galaxy to us. [1]

....



(ii) Calculate the change in wavelength of the line **A** between the laboratory spectrum and the galaxy's spectrum. [1]

wavelength change = ... m

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(iii) Explain what information can be obtained about the galaxy by comparing the spectra opposite.
(Do not include in your answer the development of theories of the Universe.) [6 QWC]

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