Rewarding Learning

Centre Number	
71	

Candidate Number

General Certificate of Secondary Education
2013–2014

Science: Single Award

Unit 3 (Physics)

Higher Tier

[GSS32]

ML

WEDNESDAY 26 FEBRUARY 2014, MORNING

TIME

1 hour 15 minutes, plus your additional time allowance.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
Answer **all eleven** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 75.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in Questions **3** and **7(a)**.

For Examiner's use only	
Question Number	**Marks**
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
Total Marks	

Examiner Only	
Marks	Remark

1 Pilots are exposed to higher levels of radiation because they spend long periods of time at high altitudes (heights).

© Victor De Schwanberg / Science Photo Library

The table below shows the amount of radiation (dose) received by pilots travelling to different destinations from Belfast.

Destination	Flight time/hrs	Amount of radiation/ mSv
Paris	1.75	8.34
New York	7.7	50.00
Sharm El Sheikh	6.2	24.18
Manchester	1.0	1.82

(i) Write down the trend shown by this data.

_____

_____ [1]

(ii) Background radiation causes this increase in dose. Write down **one** possible source of radiation that could affect the pilots at this height.

_____

_____ [1]

(iii) The maximum safe radiation dose for pregnant women is 2000 mSv. Use this information to calculate the maximum number of return flights a woman should make to New York during a pregnancy. (Show your working out.)

Answer _____ [2]

(iv) Explain fully how radiation can harm humans.

_____

_____

_____ [2]

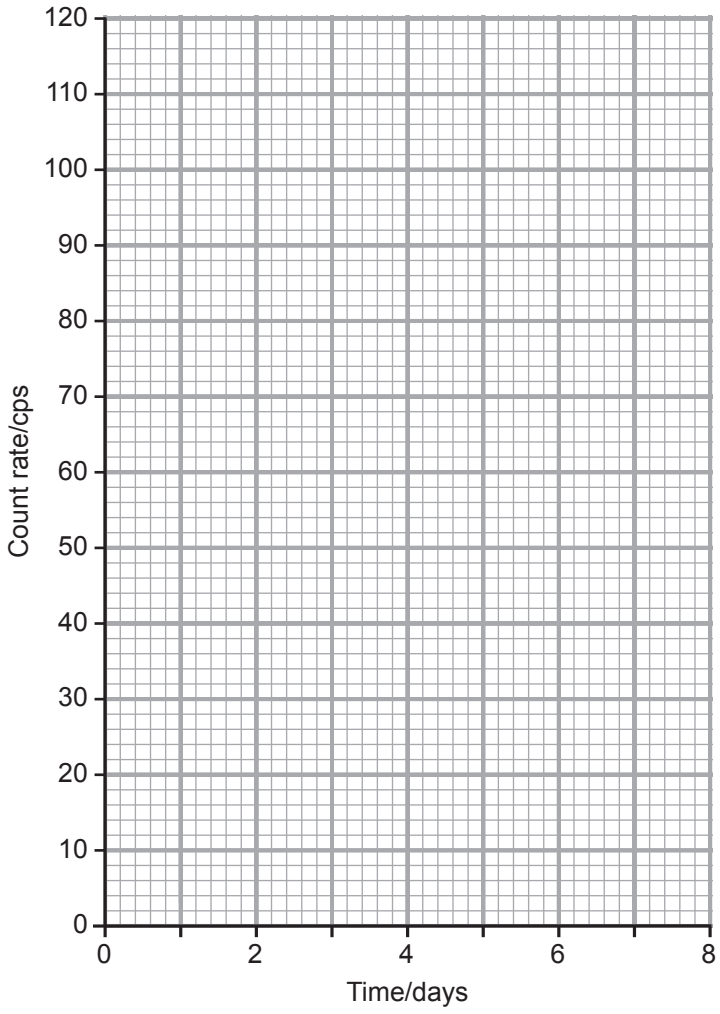
Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

2 **(a)** Look at the table below. It shows the count rate of a radioactive isotope.

Time/days	Count rate/ cps
0	120
2	76
4	48
6	30
8	19

(i) Plot these points on the axes below and draw a curve of best fit.



[3]

(ii) Use the graph to find the half-life of the radioactive isotope.

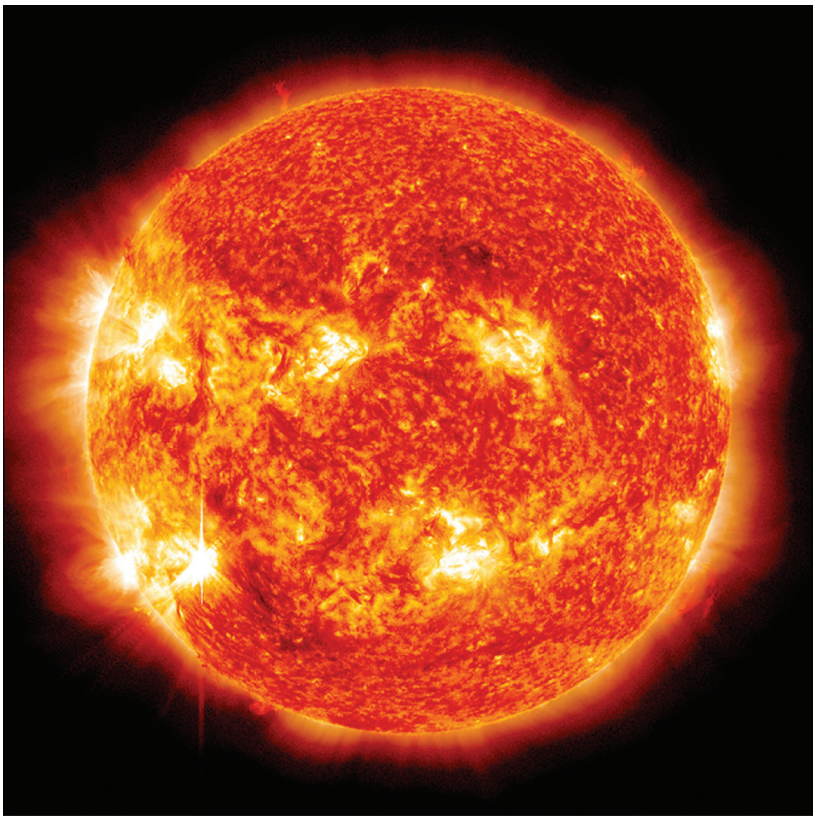
Answer _____ days [1]

(b) Radioactive phosphorus has a half-life of 20 days. What fraction of the original mass of phosphorus will be left after 40 days?

Answer _____ [1]

Examiner Only	
Marks	Remark

3 Look at the photograph below. It shows the Sun, our closest star.



© NASA/SDO

Describe fully the formation of the Sun. Name the gases and forces involved.

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

[6]

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Marks	Remark

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Marks	Remark

4 **(a)** Look at the table below. It shows information on generating electrical power.

	Tidal	Coal	Wind	
			Onshore	Offshore
Power output/ MW	12	1600	24	94
Life expectancy/ years	15	30	20	20
Annual operating costs per kW/£	56	24	24	57
Generating costs per kWh/p	6.63	3.33	5.35	7.19

(i) The government want to replace fossil fuel power stations with alternative sources.
Use the information to explain fully why this might not be the best option.

_____

_____

_____

_____ [3]

(ii) Write down **two** reasons why more alternative energy sources are being introduced.

1. _____

2. _____ [2]

(b) Explain fully the formation of fossil fuels from dead plants and animals.

_____

_____

_____ [2]

(c) Look at the table below. It shows some of the processes involved in producing electricity using a coal fired power station.

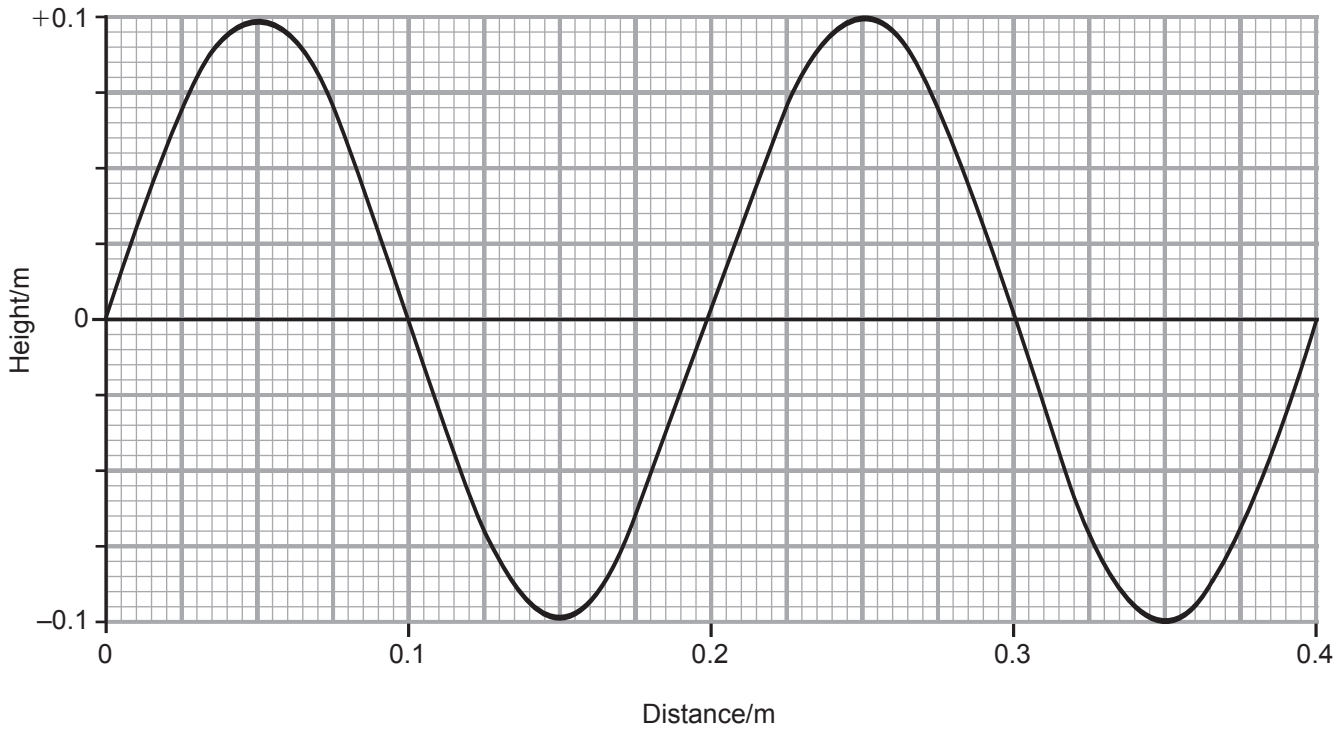
A	The coal produces heat	The boiler produces steam	The steam turns the blades of the turbine to make electricity directly
B	The coal produces heat	The heat turns the blades of the turbine	The turbine turns the generator which produces electricity
C	The boiler produces steam	The steam turns the blades of the turbine	The turbine turns the generator which produces electricity
D	The turbine heats the boiler	The boiler produces steam	The steam turns the generator which produces electricity

Which letter **A**, **B**, **C** or **D** gives the correct order of processes?

Answer _____ [1]

Examiner Only	
Marks	Remark

5 Look at the graph below. It shows a wave.



Examiner Only	
Marks	Remark

(a) Use the information in the graph to answer the questions below.

(i) What is the wavelength of this wave?

Answer _____ m [1]

(ii) What is the amplitude of this wave?

Answer _____ m [1]

(b) Describe fully the movement of particles in a transverse wave.

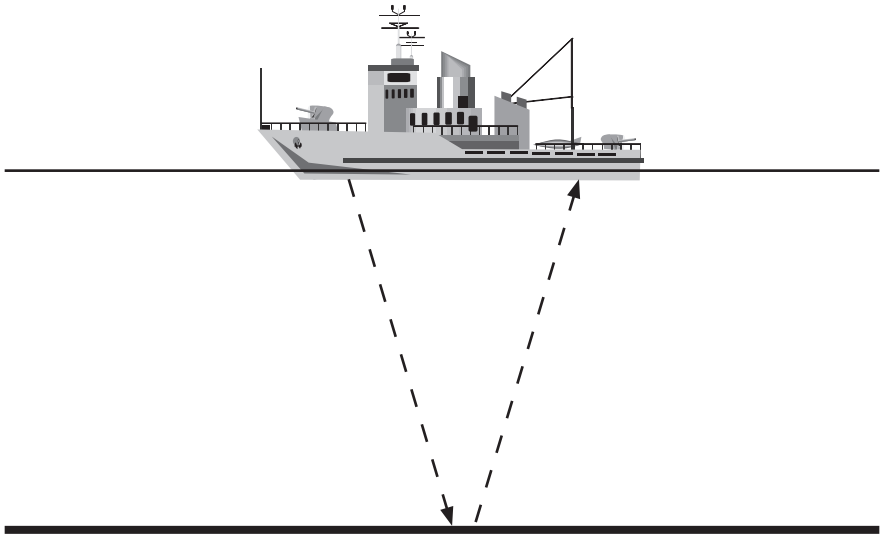
_____

_____

_____ [2]

Examiner Only	
Marks	Remark

(c) Ultrasound can be used to measure the depth of the sea as shown in the diagram below.



(i) Ultrasound travels at 1500 m/s in water.

The ship sends out an ultrasound pulse and the echo returns 6 seconds later.

Use the equation:

distance = speed × time

to calculate the depth of the water.
(Show your working out.)

Answer _____ m [3]

(ii) How will the captain of the ship know if a shoal of fish swims under the ship?

_____

_____ [1]

(d) Ultrasound can have a frequency of 30 000 Hz.

Use the equation:

$$\textbf{wavelength} = \frac{\textbf{speed}}{\textbf{frequency}}$$

to calculate the wavelength of this ultrasound.
(Show your working out.)

Answer _____ m [2]

Examiner Only	
Marks	Remark

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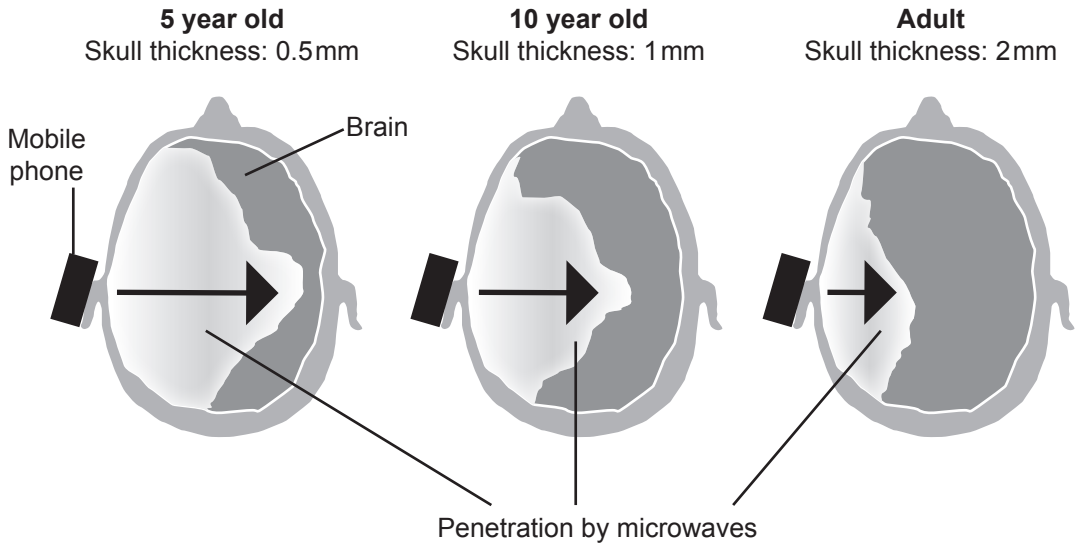
Marks	Remark

6 **(a)** SAR (specific absorption rate) is a measurement of how much radiation is absorbed by body tissue. The higher the value the more radiation is absorbed. The diagrams below show how microwaves penetrate the brain when using a mobile phone.



Use the information to explain fully why it may be dangerous for 5 year olds to use mobile phones.

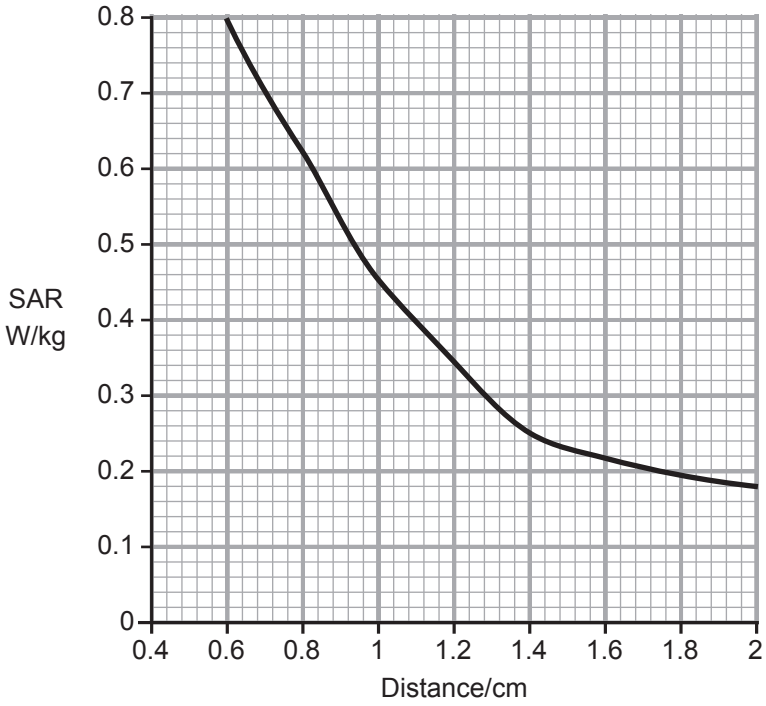
_____

_____

_____ [2]

Examiner Only	
Marks	Remark

(b) Look at the graph below. It shows how the SAR is affected by the distance of the phone from the head.



(i) Describe fully the trend shown by the graph.

_____

_____

_____ [2]

(ii) Write down **two** ways mobile phone users can reduce their exposure to microwave radiation. Do not write about increasing the distance of a mobile phone from the head in your answer.

1. _____

2. _____ [2]

Examiner Only	
Marks	Remark

7 **(a)** Describe, in detail, an investigation to find how the thickness of a wire affects its resistance. Write down the conclusion you would expect.

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____ [6]

(b) **(i)** Describe how a variable resistor changes the current in a circuit.

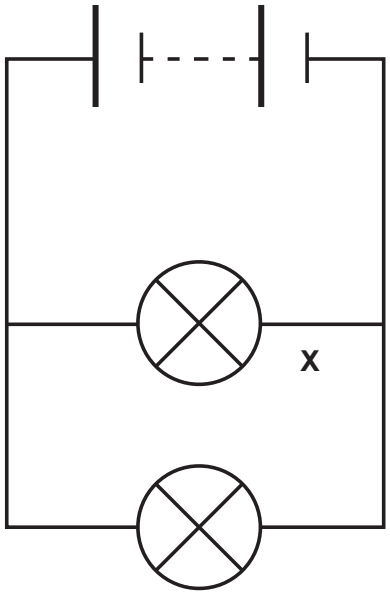
_____

_____ [1]

(ii) Write down an example of where a variable resistor is used.

_____ [1]

(c) On the circuit below, draw an arrow to show the direction of electron flow at position **X**.

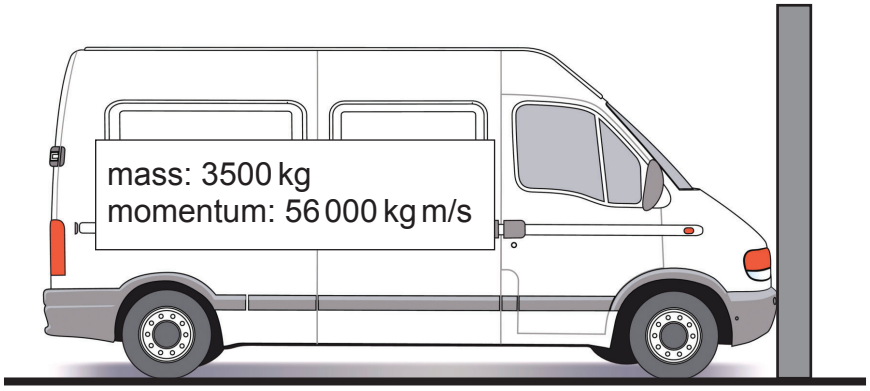


[1]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

8 **(a)** Look at the diagram below. It gives the mass and momentum of a van as it hits a wall.



Use the equation:

momentum = mass × velocity

to calculate the velocity of the van at impact.
(Show your working out.)

Answer _____ m/s [2]

(b) When the van hits the wall some of the energy is absorbed. Write down **one** feature of the van that is designed to absorb this energy.

_____ [1]

(c) Car manufacturers are trying to minimise the reliance on fossil fuels by using substitutes and extenders. Explain fully the difference between substitutes and extenders.

_____

_____

_____

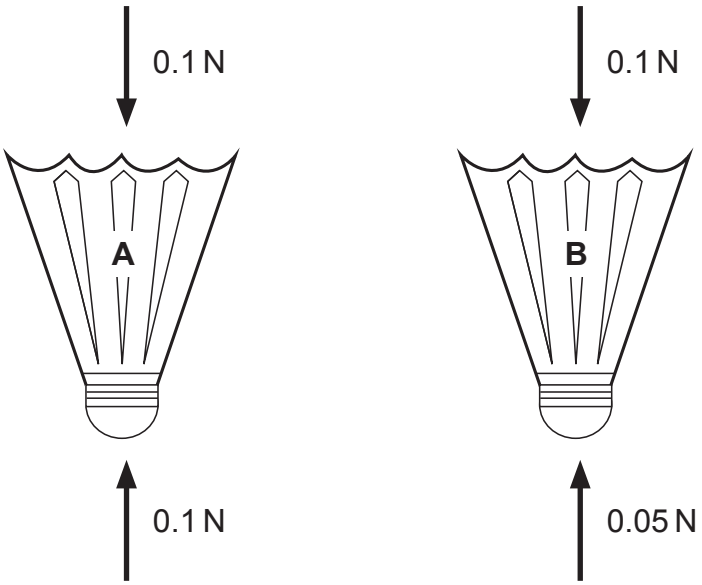
_____ [2]

(d) Write down an example of a fuel substitute and a fuel extender.

Substitute _____

Extender _____ [2]

(e) Look at the diagrams below. They show two shuttlecocks (**A** and **B**) falling.



(i) Describe and explain the motion of shuttlecock **B**.

_____

_____

_____ [2]

(ii) What is the value of the resultant force on shuttlecock **A**?

Answer _____ N [1]

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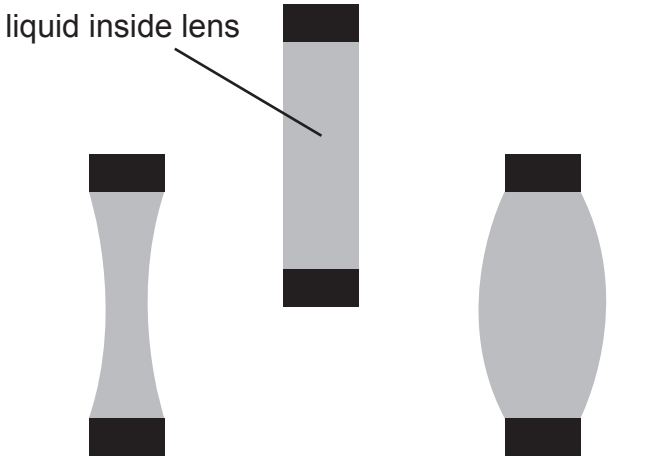
Marks	Remark

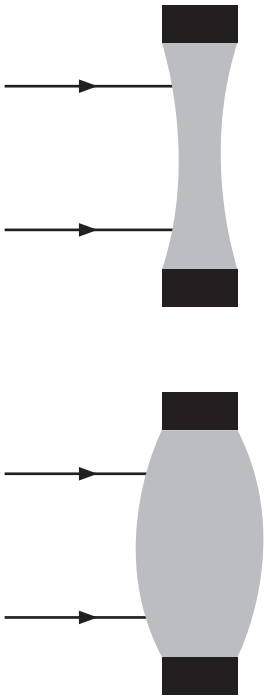
Examiner Only	
Marks	Remark

9 The first self-adjustable glasses were invented by Professor Josh Silver. He used liquid-filled lenses that could change shape as shown below.

© *The Centre for Vision in the Developing World*



(a) Complete the diagram below to show how the rays of light pass through these lenses.



[2]

(b) Long sight is caused by a weak lens which does not converge the light enough.
Describe the effect of long sight and suggest how these self-adjustable glasses can provide the greater convergence required.

_____

_____

_____

_____

_____ [3]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

10 **(a)** **(i)** What name is given to the present model of the Solar System?

_____ [1]

(ii) What is the main difference between this model of the Solar System and the model proposed hundreds of years ago?

_____

_____ [1]

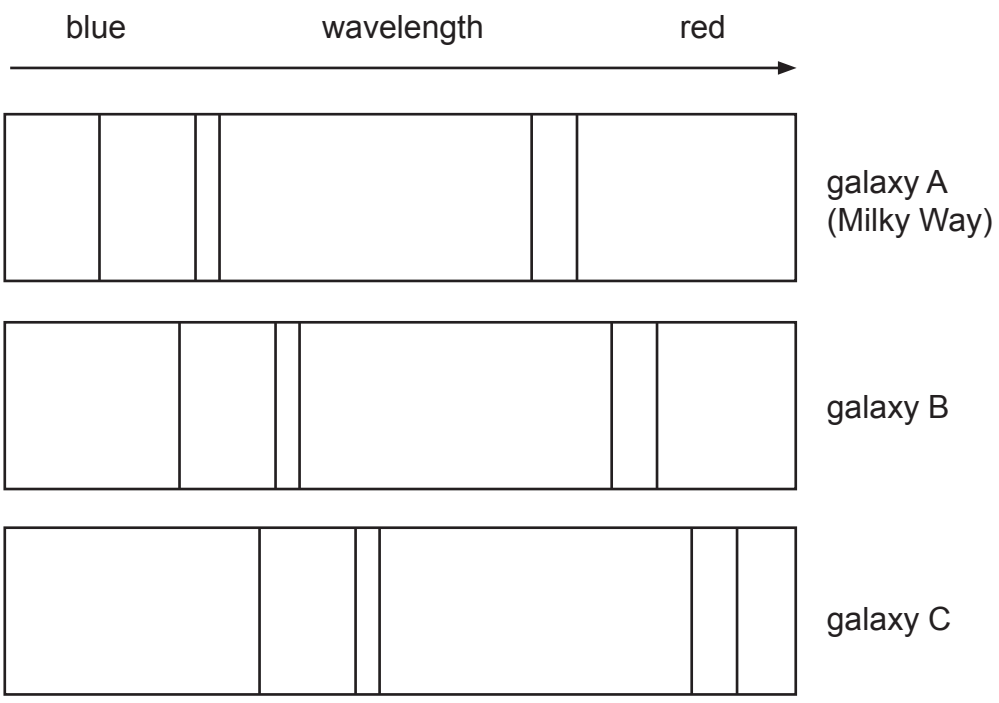
(b) Based on the Big Bang Theory how old is the Universe thought to be?

_____ [1]

(c) Write down an alternative scientific theory to the Big Bang.

_____ [1]

(d) When astronomers look at light from galaxies they see the following black lines in their spectrum.



Describe fully what this information suggests to astronomers about galaxy C compared to galaxy B.

_____

_____ [2]

11 Look at the table below. It gives information about electromagnetic radiation.

Radiation	Wavelength range/m
radio waves	1×10^{6} to 1×10^{-1}
microwaves	1×10^{-1} to 1×10^{-3}
infrared	1×10^{-3} to 7×10^{-7}
visible	7×10^{-7} to 4×10^{-7}
ultraviolet	4×10^{-7} to 1×10^{-8}
X-rays	1×10^{-8} to 1×10^{-13}
gamma rays	1×10^{-10} to 1×10^{-16}

(a) Which radiation has the smallest **range** of wavelengths?

_____ [1]

(b) Write down the name of the radiation which is most damaging to the body. Explain your choice fully.

_____

_____

_____

_____ [3]

THIS IS THE END OF THE QUESTION PAPER

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Marks	Remark

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