Rewarding Learning

**General Certificate of Secondary Education
2013–2014**

Science: Single Award

Unit 3 (Physics)

Higher Tier

[GSS32]

GSS32

WEDNESDAY 26 FEBRUARY 2014, MORNING

TIME

1 hour 15 minutes.

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)**.

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) State the trend shown by this data.

_____

_____ [1]

(ii) Background radiation causes this increase in dose. Suggest **one** possible source of radiation which 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]

2 **(a)** The table below 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]
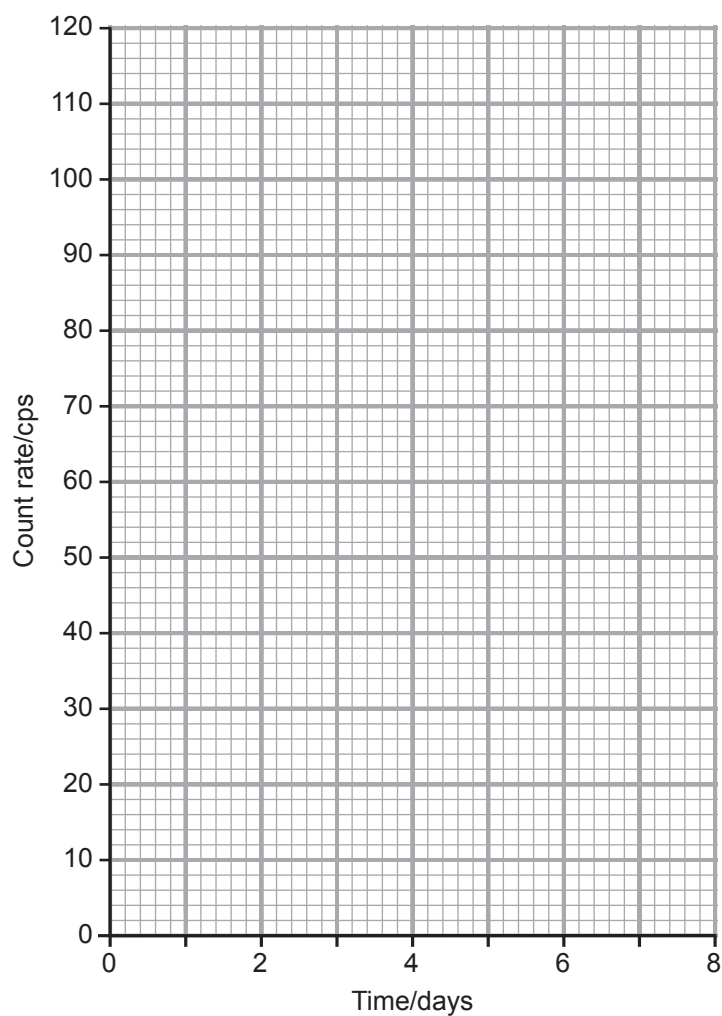
(ii) Use the graph to find the half-life of the radioactive isotope.

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]

[Turn over

3 The photograph below shows the Sun, our closest star.
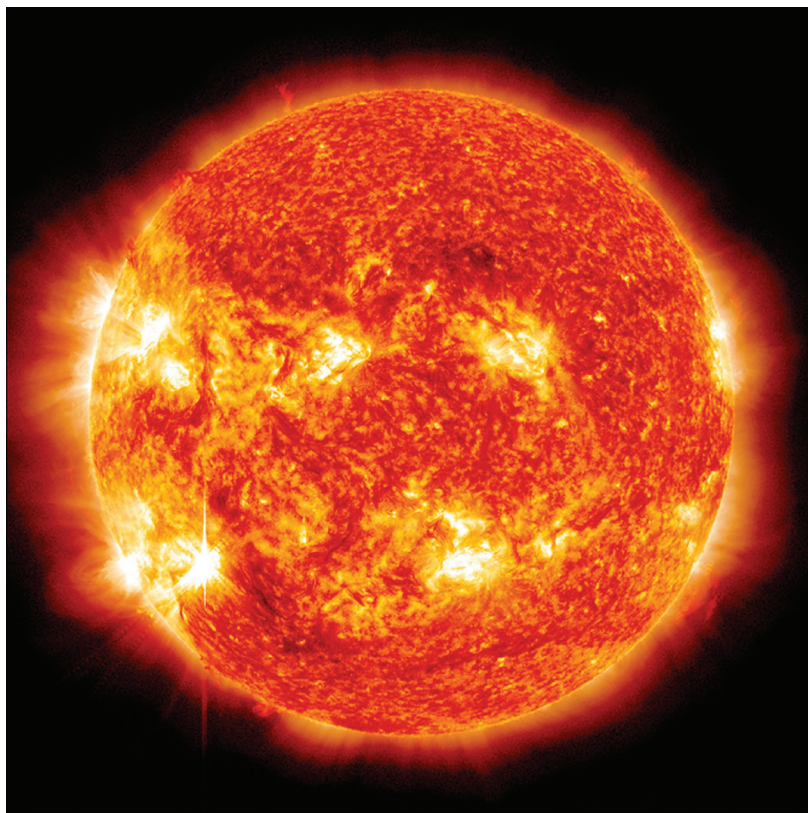
© NASA/SDO

Describe fully the formation of the Sun, naming the gases and forces involved.

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

_____

_____

_____

_____

_____

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_____

_____

_____

_____

_____ [6]

4 **(a)** The table below 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) Give **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) Given below are 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]

5 The graph below shows a wave.
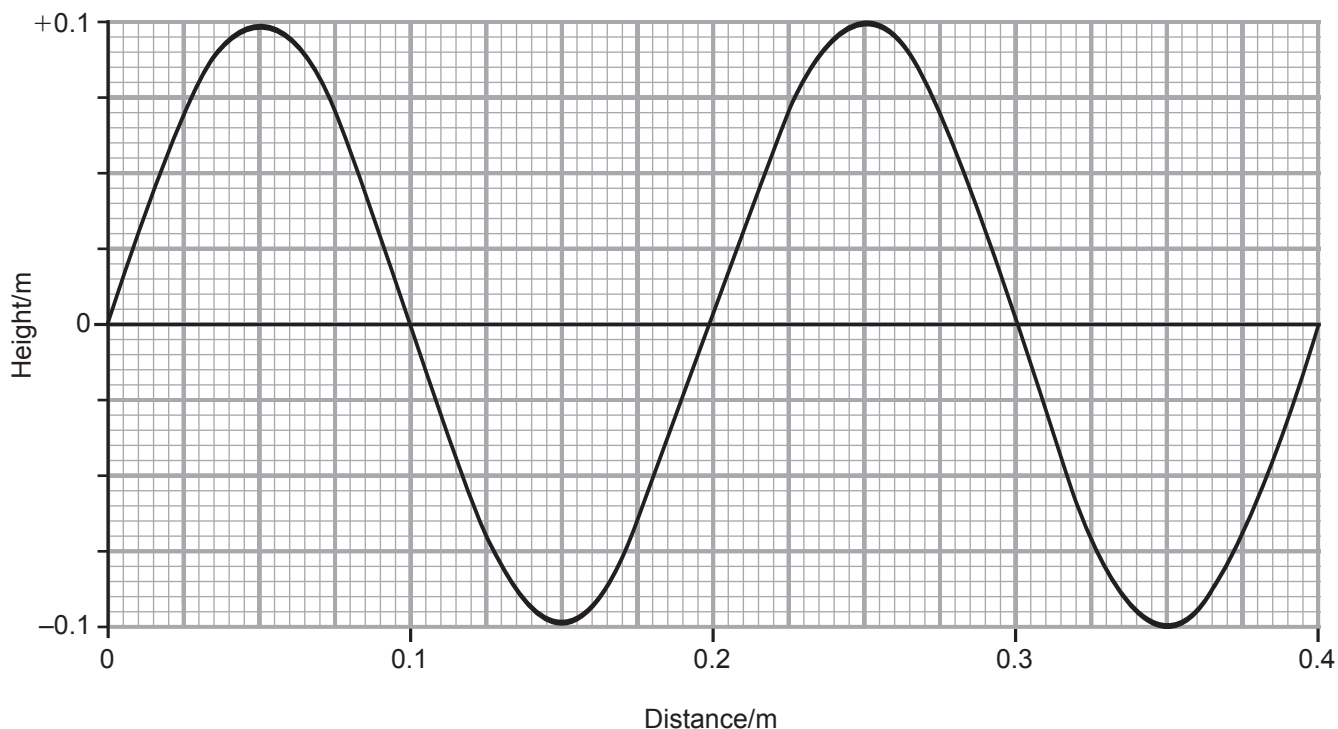
(a) Use the information in the graph to answer the following questions.

(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]

9

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

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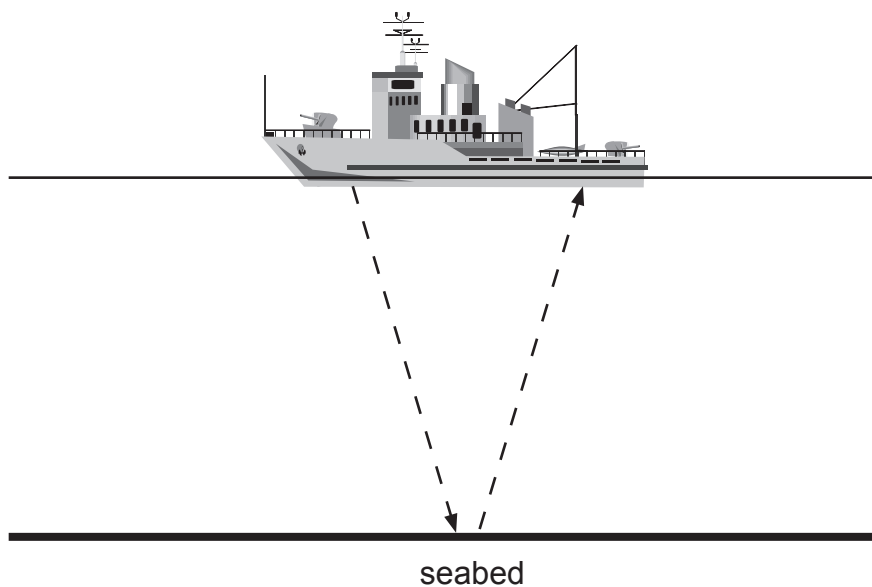
(i) Ultrasound travels at 1500 m/s in water.

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]

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.

5 year old
Skull thickness: 0.5 mm

10 year old
Skull thickness: 1 mm

Adult
Skull thickness: 2 mm

Mobile
phone

Brain

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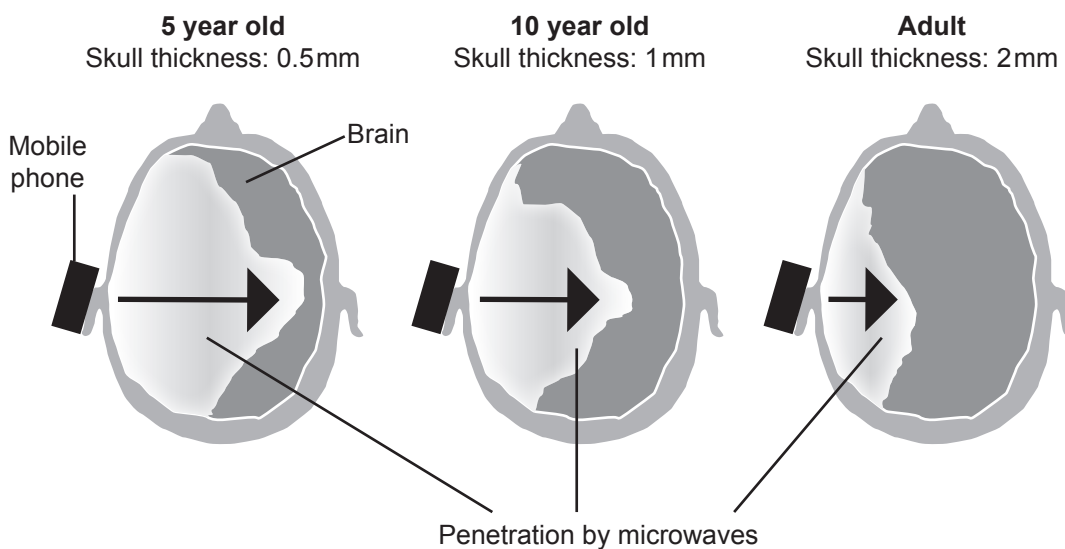
Use the information to explain fully why it may be dangerous for 5 year olds to use mobile phones.

_____

_____

_____ [2]

(b) The graph below 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) Apart from increasing the distance of a mobile phone from the head suggest **two** ways mobile phone users can reduce their exposure to microwave radiation.

1. _____

2. _____ [2]

7 (a) Describe, in detail, an investigation to find how the thickness of a wire affects its resistance. State 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) Give 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]

15

[Turn over

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

mass: 3500 kg
momentum: 56 000 kg m/s

© Kamaga / iStock / Thinkstock

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 collides with the wall some of the energy is absorbed. Give **one** feature of the van 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) Give an example of a fuel substitute and a fuel extender.

Substitute _____

Extender _____ [2]

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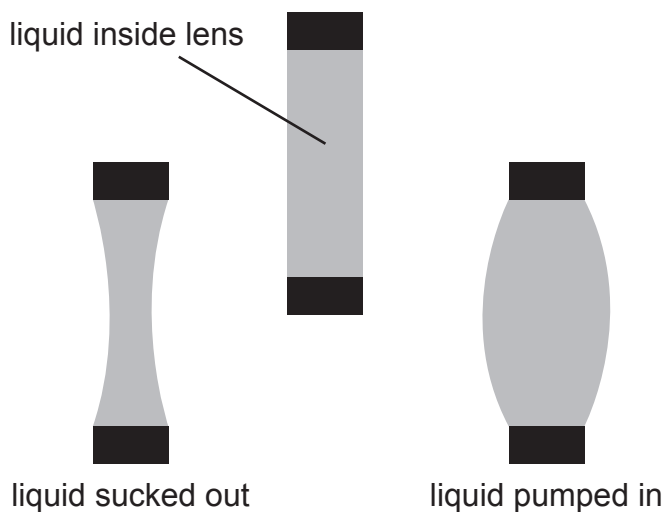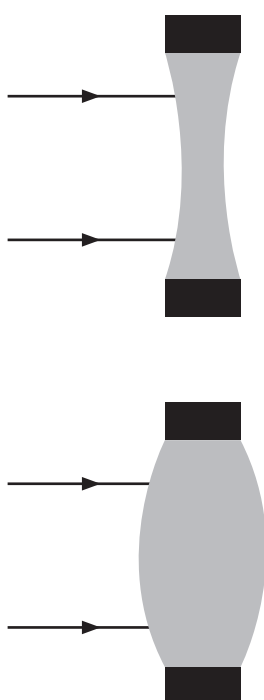
9 The first self-adjustable glasses were invented by Professor Josh Silver. He used liquid-filled lenses that could change shape as shown below.

syringe filled with liquid

© The Centre for Vision in the Developing World

liquid inside lens

liquid sucked out   liquid pumped in

(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]

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) Give 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.

blue   wavelength   red

galaxy A
(Milky Way)

galaxy B

galaxy C

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

_____

_____ [2]

11 The table below 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) Name 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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