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Centre number						Candidate number				
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**OXFORD CAMBRIDGE AND RSA EXAMINATIONS  
GENERAL CERTIFICATE OF SECONDARY EDUCATION**

**A331/02**

**TWENTY FIRST CENTURY SCIENCE  
PHYSICS**

**Unit 1: Modules P1 P2 P3 (Higher Tier)**

**WEDNESDAY 26 JANUARY 2011: Afternoon**

**DURATION: 40 minutes**

**SUITABLE FOR VISUALLY IMPAIRED CANDIDATES**

**Candidates answer on the question paper.  
A calculator may be used for this paper.**

**OCR SUPPLIED MATERIALS:**

**None**

**OTHER MATERIALS REQUIRED:**

**Pencil**

**Ruler (cm/mm)**

**READ INSTRUCTIONS OVERLEAF**

## **INSTRUCTIONS TO CANDIDATES**

- **Write your name, centre number and candidate number in the boxes on the first page. Please write clearly and in capital letters.**
- **Use black ink. Pencil may be used for graphs and diagrams only.**
- **Read each question carefully. Make sure you know what you have to do before starting your answer.**
- **Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).**
- **Answer ALL the questions.**

## **INFORMATION FOR CANDIDATES**

- **The number of marks is given in brackets [ ] at the end of each question or part question.**
- **The total number of marks for this paper is 42.**

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**QUESTION 1 STARTS ON PAGE 4**

**Answer ALL the questions.**

- 1 Some medical research was carried out on a large sample of people working in different jobs. The research compared how many people in each type of job developed cancer.**

<b>TYPE OF JOB</b>	<b>NUMBER OF PEOPLE</b>	<b>NUMBER OF PEOPLE WHO DEVELOPED CANCER</b>	<b>PERCENTAGE OF PEOPLE DEVELOPING CANCER</b>
<b>dental</b>	<b>42 194</b>	<b>746</b>	<b>_____</b>
<b>medical</b>	<b>67 650</b>	<b>1430</b>	<b>2.1</b>
<b>industrial</b>	<b>59 544</b>	<b>997</b>	<b>1.7</b>
<b>nuclear power</b>	<b>21 945</b>	<b>564</b>	<b>2.6</b>

- (a) (i) Complete the table by filling in the missing percentage. [1]**

- (ii) Use the table to suggest which of these types of job has the greatest risk of people developing cancer.**

**answer \_\_\_\_\_ [1]**

**(b) Some people choose to work in jobs with the higher risks of cancer.**

**Explain why.**

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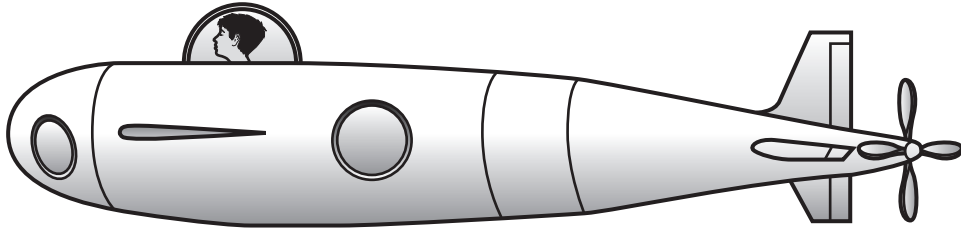
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**[2]**

**[Total: 4]**

- 2 (a) A scientist has suggested using very small nuclear reactors to power a new design of mini-submarine.



The Government uses the ALARA principle to make regulations for any type of submarine.

Use this idea of nuclear reactors in submarines to explain what is meant by the ALARA principle.

You should include

- a statement of the ALARA principle
- the risk of using a nuclear reactor to power a mini-submarine
- an example of how the principle can be applied to this risk.

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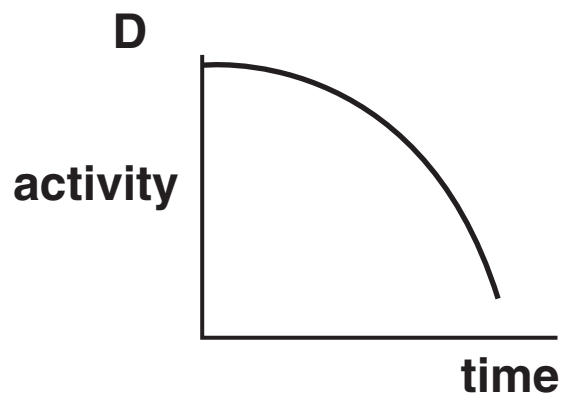
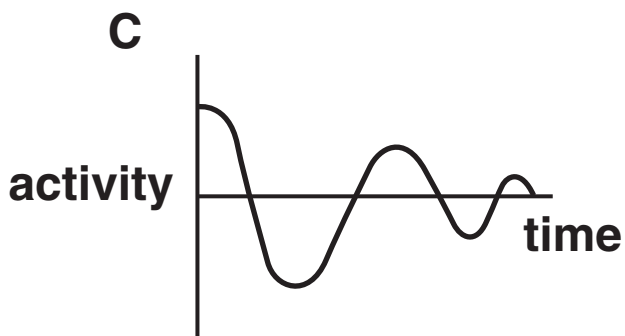
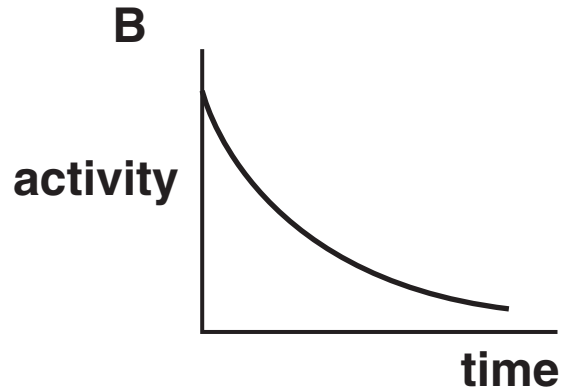
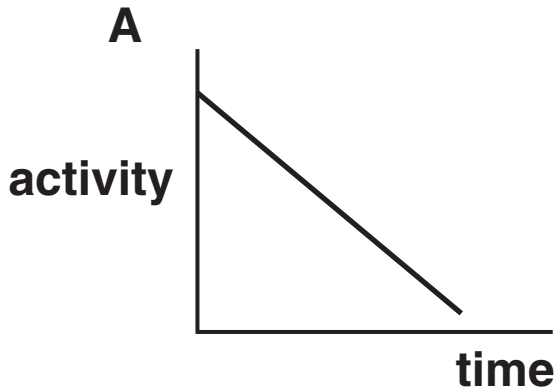
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[3]

**(b) The radioactive material used in the mini-submarine will become less active as time passes. The radioactive material has a half-life of 20 years.**

**(i)**



**Which graph, A, B, C or D, correctly shows how the activity of a radioactive material changes with time?**

**graph \_\_\_\_\_ [1]**

- (ii) Initially the radioactive material has an activity of 72 MBq.

What is the most likely activity after 3 half-lives?

Put a **ring** around the correct answer.

0 MBq      9 MBq      18 MBq      24 MBq      36 MBq

[1]

- (iii) The activity of a DIFFERENT radioactive material drops from 800 MBq to 200 MBq in 12 years.

What is the half-life of this material?

Put a **ring** around the correct answer.

3 YEARS

4 YEARS

6 YEARS

12 YEARS

36 YEARS

48 YEARS

[1]



**(c) Nuclear reactors are also used in power stations.**

**This article appeared in a local newspaper. It is about nuclear fission in a nuclear power station.**

**There are THREE mistakes in the passage.**

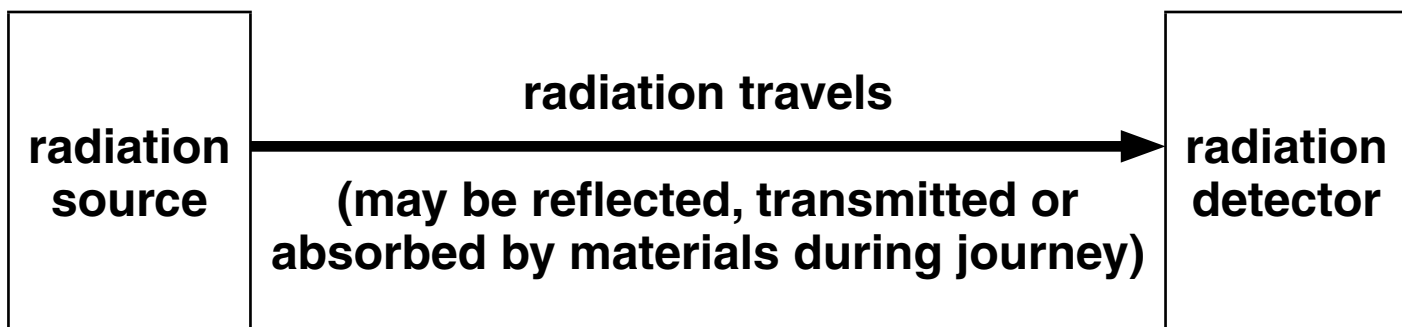
- A Nuclear power stations produce electrical energy from changes in the nuclei of radioactive materials.**
- B Uranium is commonly used as the nuclear fuel.**
- C In nuclear fission a proton hits an atom which then splits into two and produces some more protons.**
- D The fission chain reaction rate is changed by using control rods.**
- E When problems arise, the nuclear fission is slowed down by reacting the radioactive material with water.**
- F Nuclear fission produces less energy per atom than chemical reactions in fossil fuel power stations.**
- G Some of the nuclear waste produced is high level radioactive waste.**

**Write down the letters of the three statements that are INCORRECT.**

**statements \_\_\_\_\_ and \_\_\_\_\_ and \_\_\_\_\_ [3]**

**[Total: 9]**

**3 A general model for electromagnetic radiation is shown in the diagram.**



**Use the model to explain how people can see this exam paper.**

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**[4]**

**[Total: 4]**

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**QUESTION 4 STARTS ON PAGE 12**

- 4 (a) The following sentences are about the photon model of electromagnetic radiation.

Complete the sentences using words from this list.

ENERGY  
INTENSITY  
NUMBER  
RADIATION  
SHAPE  
SIZE

You may use each word once, more than once, or not at all.

The intensity of the radiation is the

\_\_\_\_\_ arriving at a surface each second.

The intensity depends on the \_\_\_\_\_ of photons and the energy of each photon.

The \_\_\_\_\_ of a beam of electromagnetic radiation in space decreases with the distance from the source.

[3]

**(b) How fast do photons travel in space?**

**Put a tick (✓) in the box next to the correct answer.**

**30 000 000 km/s**

**300 000 km/s**

**300 km/s**

**3 km/s**

**[1]**

**[Total: 4]**

- 5 (a) Some gases in the atmosphere are called greenhouse gases.

Which of the following statements identifies a greenhouse gas?

Put a tick (✓) in the box next to the BEST answer.

They allow sunlight to reach plants for photosynthesis and warm up the Earth.

They absorb electromagnetic radiation emitted by the Earth.

They produce reversible chemical changes in the ozone layer.

They are produced when fuel is used to heat greenhouses.

[1]

**(b) All of the following statements are true.**

**Which three statements, when taken together, provide evidence for human activity increasing global warming?**

**Put ticks (✓) in the boxes next to the THREE correct answers.**

**Carbon dioxide levels in the atmosphere have increased significantly in the last few hundred years.**

**Power stations use water as a coolant, producing steam.**

**Since the industrial revolution, huge quantities of coal, oil and gas have been used for fuel.**

**Steam is water molecules and is a greenhouse gas.**

**Global warming is causing climate change.**

**Carbon dioxide is a greenhouse gas.**

**CFCs used as coolants in fridges have helped create a hole in the ozone layer over the Antarctic.**

**Water vapour levels in the atmosphere have not changed much in the last few hundred years.**

**[3]**

**(c) A number of methods to reduce global warming have been suggested.**

**The precautionary principle could be used to decide whether or not these methods should be tried.**

**Suggest how the precautionary principle should be applied.**

**Your answer should include:**

- how to decide whether or not to apply the precautionary principle**
- the effect of applying the precautionary principle.**

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**[2]**

**[Total: 6]**



**6 Different types of electromagnetic radiation can have different effects on living cells.**

**Put ticks (✓) in the boxes to show which EFFECTS ON CELLS are caused by MICROWAVE radiation and which EFFECTS ON CELLS are caused by VISIBLE LIGHT radiation.**

**Each row may have ZERO, ONE or TWO ticks.**

<b>EFFECTS ON CELLS</b>	<b>MICROWAVE</b>	<b>VISIBLE LIGHT</b>
<b>heats up the cells</b>		
<b>increases vibrations of molecules</b>		
<b>produces ions</b>		
<b>provides energy for photosynthesis</b>		

**[3]**

**[Total: 3]**

- 7 (a) Where do most earthquakes, volcanoes and mountain building take place?**

**Put a tick (✓) in the box next to the BEST answer.**

**on the seafloor**

**at the edge of tectonic plates**

**on the continents**

**around the poles**

**[1]**

- (b) Which of the following is the best explanation of why seafloor spreading happens?**

**Put a tick (✓) in the box next to the correct answer.**

**Matching fossils are found on different continents.**

**The Earth's mantle moves.**

**The shapes of continents fit together.**

**The oldest rocks are about 4000 million years old.**

**[1]**

**(c) Changes in the Earth can cause major disasters.**

**Suggest something a government could do to reduce the damage or harm from an earthquake.**

**Your answer should include**

- the government action**
- an explanation of how it will reduce the damage or harm.**

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**[2]**

**[Total: 4]**

- 8 Scientists try to estimate how many planets in our galaxy have life on them. A way of modelling this is to use the Drake equation. Here is a simplified version of the equation.

$$L = N \times p \times S \times f$$

$L$  is the number of planets in our galaxy with life on them

$p$  is the fraction of stars that have planets

$S$  is the average number of planets that can potentially support life per star that has planets

$f$  is the fraction of these planets that actually go on to develop life at some point.

- (a) What must the symbol  $N$  stand for in this equation?

\_\_\_\_\_ [1]

- (b) Astronomers have now discovered that more of the observable stars have planets.

Which parts of the Drake equation must now have different values?

Put a **ring** around each correct answer.

$L$        $p$        $S$        $f$

[1]

- (c) What is the smallest number that  $L$  can be?

0      0.25      1      4      8

[1]

**(d) What evidence has been found of life on other planets?**

\_\_\_\_\_ **[1]**

**[Total: 4]**

- 9 (a) Astronomers' measurements of the distances to galaxies are uncertain.

Which of the statements below is the best explanation of this?

Put a tick (✓) in the box next to the correct answer.

There are difficulties in making observations.

The Universe started with a 'big bang'.

We do not know the mass of the Universe.

The further away a galaxy is, the faster it is moving away.

[1]

**(b) Astronomical distances are often measured in light-years.**

**Which of the following converts 12 light-years into kilometres?**

**Put a tick (✓) in the box next to the correct answer.**

**$12 \times 3 \times 10^8 \times 60 \times 60 \times 24 \times 52$  km**

**$12 \times 300\,000 \times 60 \times 60 \times 24 \times 365.25$  km**

**$12 \times 3 \times 10^8 \times 60 \times 60 \times 24 \times 365.25$  km**

**$12 \times 300\,000 \div (60 \times 60 \times 24 \times 52)$  km**

**$12 \times 3 \times 10^6 \div (60 \times 60 \times 24 \times 365.25)$  km**

**[1]**

**[Total: 2]**

10 (a) Which diagram correctly shows the magnetic patterns which support the theory of plate tectonics?

The pattern of bands represent reversals of the Earth's magnetic field.

The dotted line is a plate boundary.

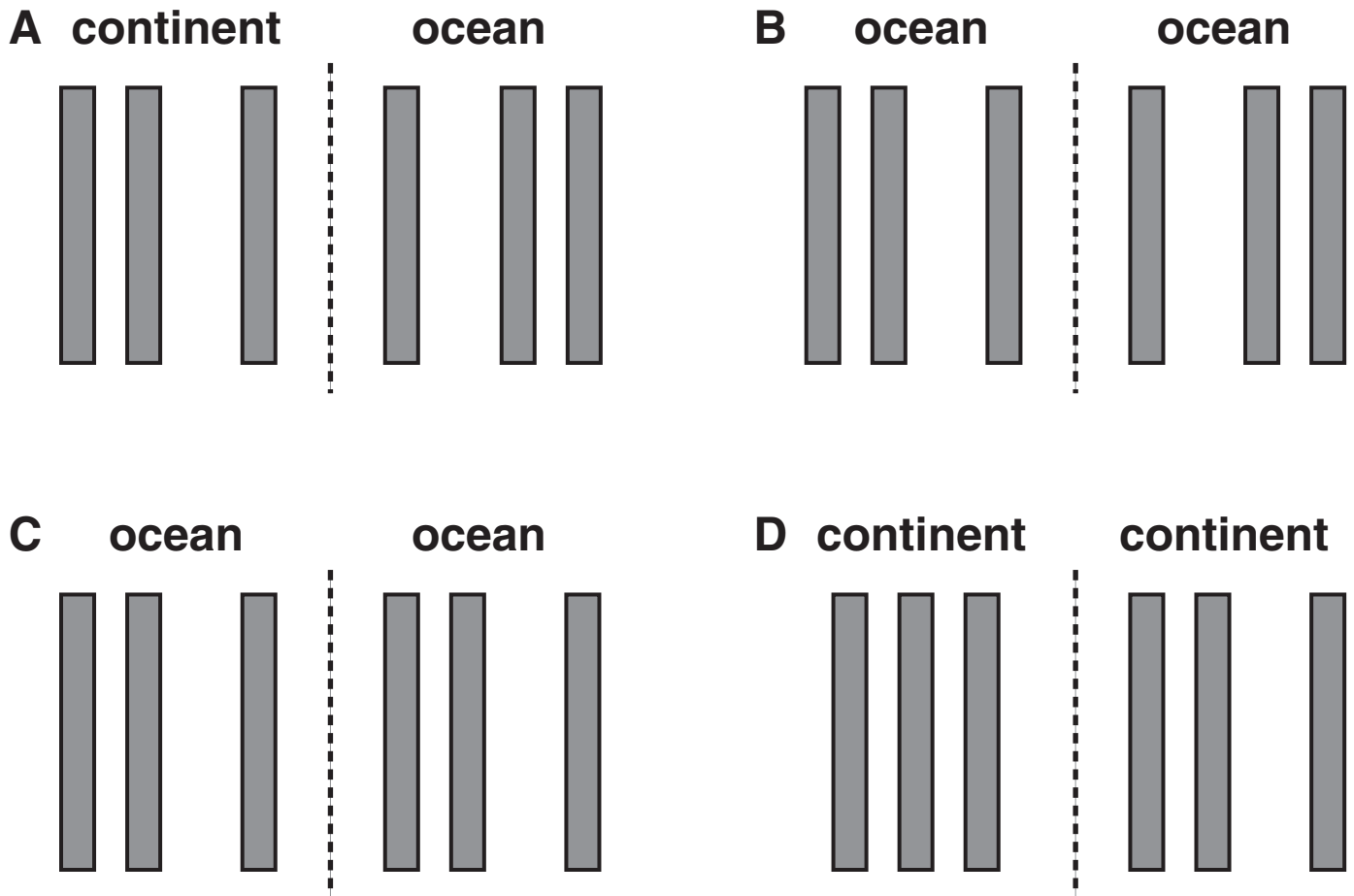


diagram \_\_\_\_\_ [1]



**(b) What is the approximate speed at which the continents move apart?**

Put a **ring** around the correct answer.

**1 mm/year**

**10 mm/year**

**10 cm/year**

**1 m/year**

**10 m/year**

**[1]**

**[Total: 2]**

**END OF QUESTION PAPER**

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