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General Certificate of Secondary Education  
June 2006



**SCIENCE: DOUBLE AWARD A (MODULAR)**  
**Paper 1**  
**Higher Tier**

**3468/1H**  
**H**

Wednesday 7 June 2006 1.30 pm to 3.00 pm

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|---|
| <p><b>For this paper you must have:</b></p> <ul style="list-style-type: none"> <li>the Data Sheet (enclosed)</li> <li>a ruler</li> </ul> <p>You may use a calculator.</p> |
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Time allowed: 1 hour 30 minutes

**Instructions**

- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want marked.

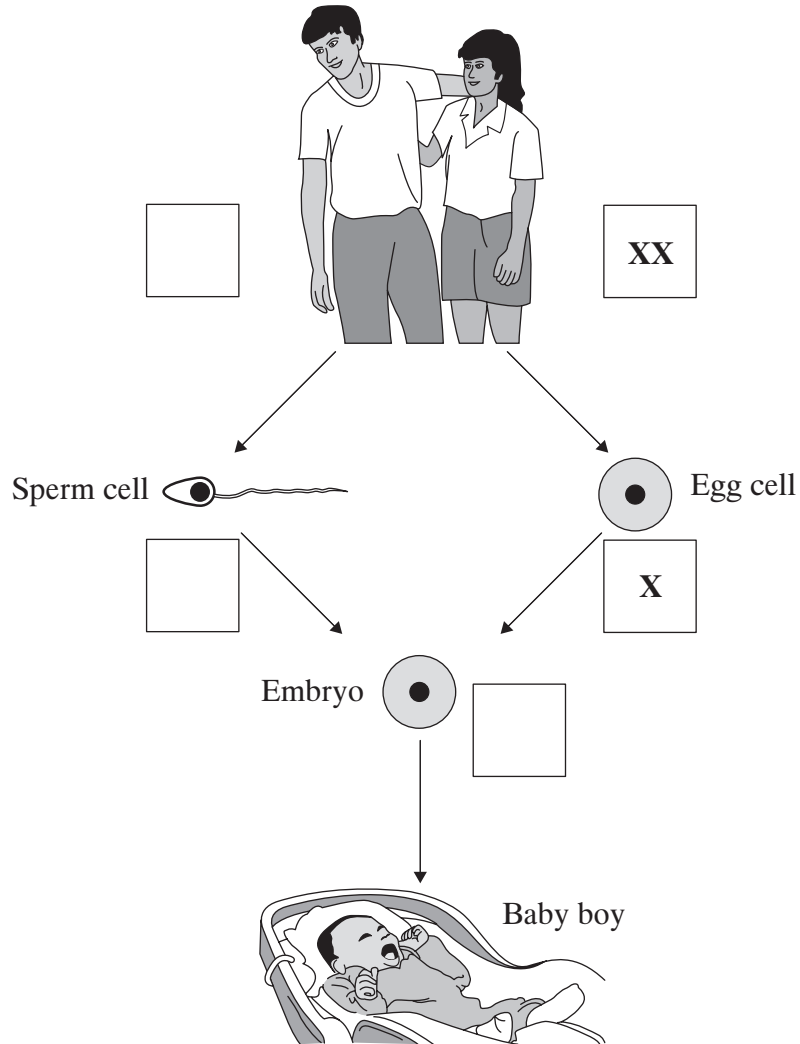
**Information**

- The maximum mark for this paper is 90.
- The marks for questions are shown in brackets.
- You are reminded of the need for good English and clear presentation in your answers.

| For Examiner's Use  |      |        |      |
|---------------------|------|--------|------|
| Number              | Mark | Number | Mark |
| 1                   |      | 9      |      |
| 2                   |      | 10     |      |
| 3                   |      | 11     |      |
| 4                   |      | 12     |      |
| 5                   |      | 13     |      |
| 6                   |      | 14     |      |
| 7                   |      | 15     |      |
| 8                   |      | 16     |      |
| Total (Column 1) →  |      |        |      |
| Total (Column 2) →  |      |        |      |
| TOTAL               |      |        |      |
| Examiner's Initials |      |        |      |

## INHERITANCE AND SELECTION

1 The diagram shows some stages in sexual reproduction in humans.



(a) The box for the woman shows her chromosomes.

On the diagram, write the sex chromosomes which should be in the empty boxes.

*(3 marks)*

(b) The child has inherited cystic fibrosis from its parents.

Neither parent has cystic fibrosis.

Explain, as fully as you can, how the child has inherited cystic fibrosis.

*To gain full marks for this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.*

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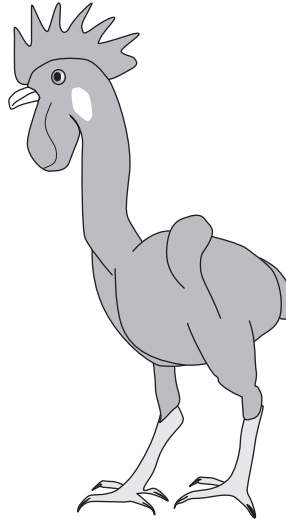
(4 marks)

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**Turn over for the next question**

**Turn over ►**

- 2 Scientists in Israel have created a featherless chicken by crossing a normal chicken with a breed which has a naturally bare neck.



These are some facts about chickens:

- featherless chickens cannot mate because they cannot flap their wings
- plucking normal chickens requires the use of large amounts of water
- featherless chickens are very vulnerable to temperature variations
- featherless chickens are more likely to suffer from sunburn
- air conditioning, to keep the temperature down, is needed for rearing normal chickens
- some of the food eaten by normal chickens goes into producing feathers.

Use the information above to answer these questions.

- (a) Give **two** advantages of using featherless chickens to produce food for humans to eat.

1 .....

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2 .....

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(2 marks)

- (b) Give **two** disadvantages of using featherless chickens to produce food for humans to eat.

1 .....

.....

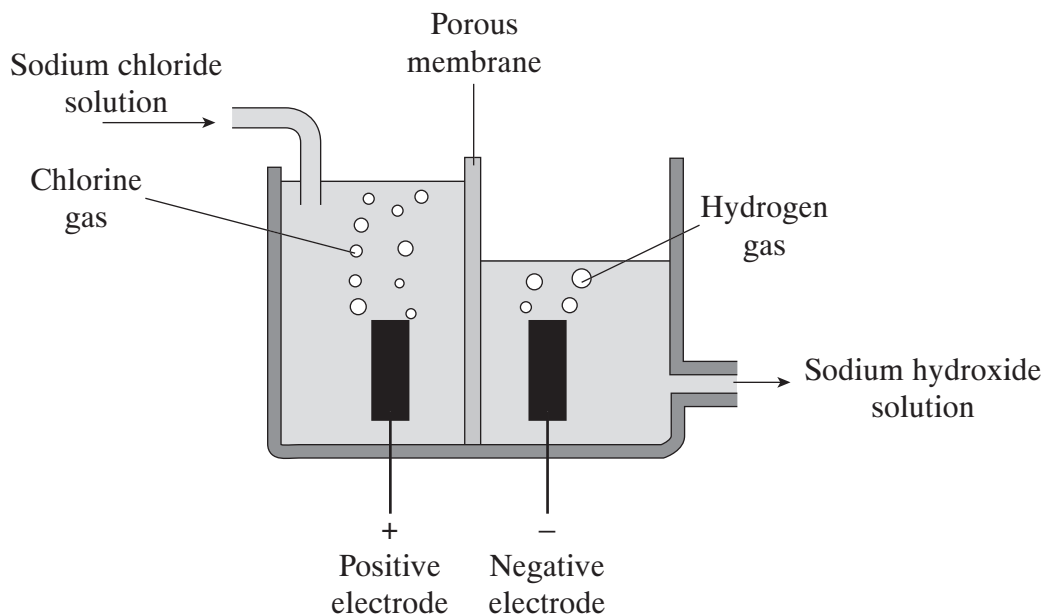
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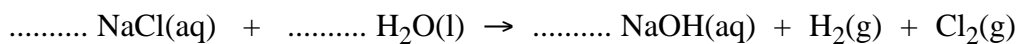
(2 marks)

## STRUCTURES AND BONDING

3 The diagram shows an industrial process for the electrolysis of sodium chloride.



The symbol equation for the process is:



(a) Write a word equation for this reaction.

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(2 marks)

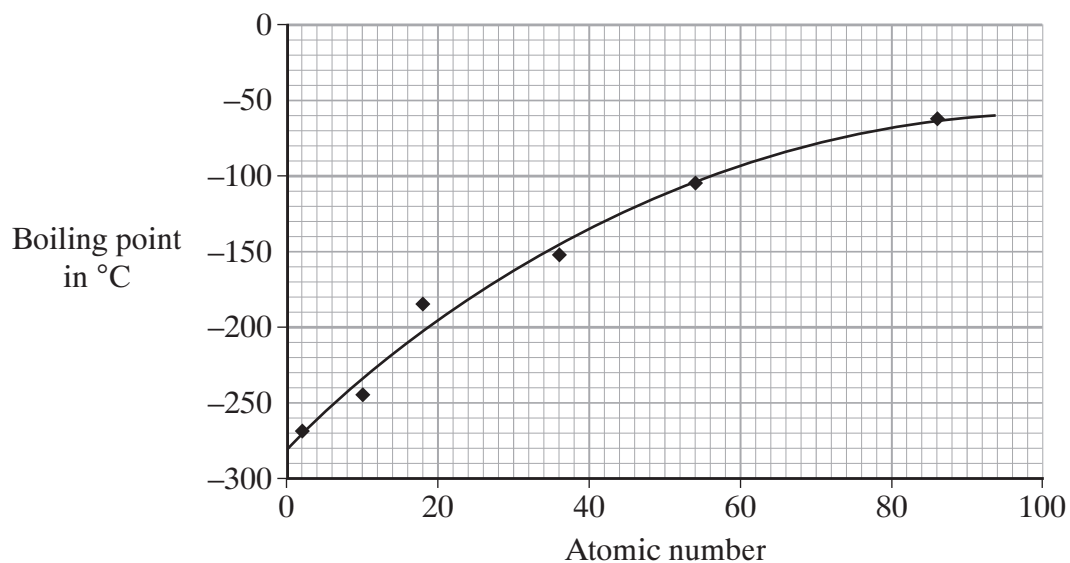
(b) Balance the symbol equation.

(1 mark)

(c) Give the meaning of the state symbol (aq). .....

(1 mark)

- 4 The graph shows how the boiling points of the Group 0 elements are related to their atomic numbers.



Use the periodic table on the Data Sheet to help you to answer these questions.

- (a) What is the state of radon at room temperature? ..... (1 mark)
- (b) What is the boiling point of krypton? ..... °C (1 mark)
- (c) Describe the trend in the boiling points of the Group 0 elements.

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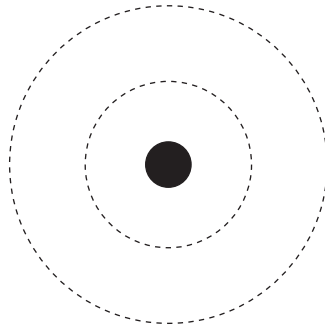
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(2 marks)

(d) Use dots or crosses to complete the diagram of the electronic structure of a neon atom.



(2 marks)

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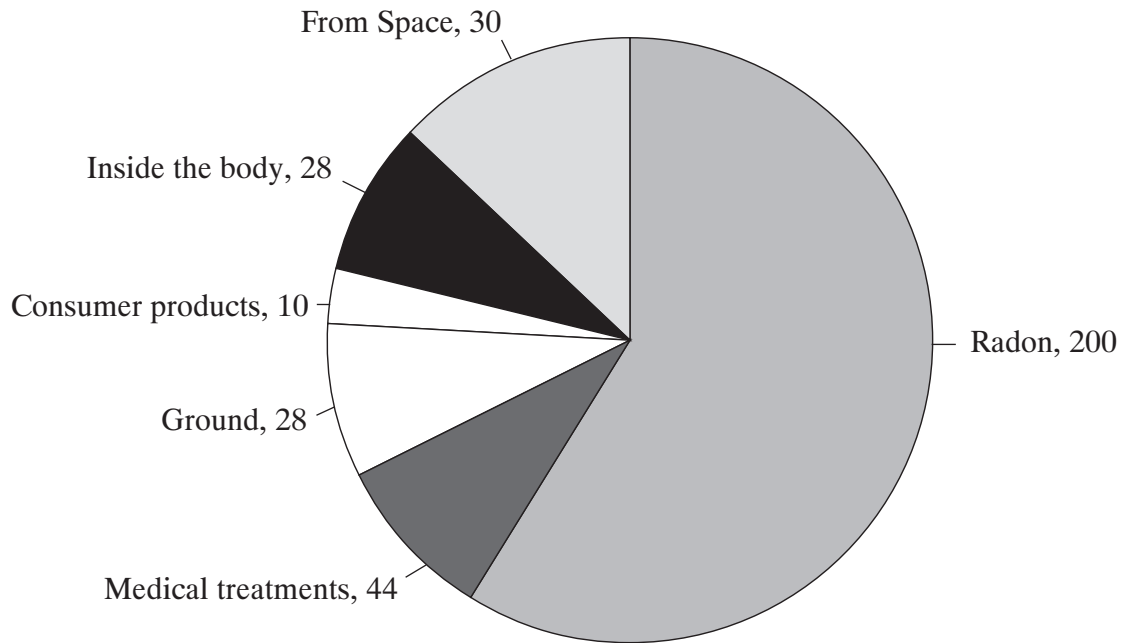
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## WAVES AND RADIATION

- 5 The pie chart shows the average amount of background radiation that a person receives each year.

**Amount of background radiation in mrem per year**



- (a) Calculate the proportion of background radiation which comes from radon.

Show your working.

.....

.....

Proportion of radon .....

*(2 marks)*



(b) Name **three** types of radiation which may be emitted by radioactive sources.

..... and ..... and ..... (1 mark)

(c) Which type of radiation is the most dangerous when the radioactive source is **outside** the body?

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Why is this type of radiation the most dangerous?

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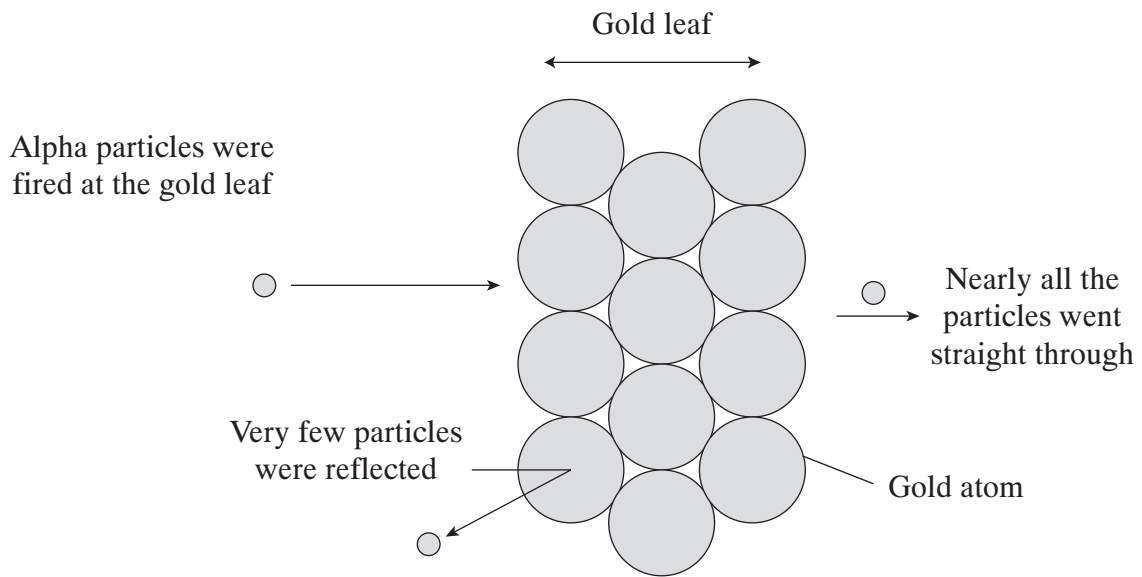
(2 marks)

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- 6 The diagram shows the results of an experiment carried out by a team of scientists led by Ernest Rutherford. They fired alpha particles at very thin pieces of gold leaf.



- (a) Most of the alpha particles went straight through the atoms in the gold leaf.

What did this tell Rutherford about gold atoms?

.....  
 .....

(1 mark)

- (b) Alpha particles are positively charged. A few alpha particles were reflected by the atoms in the gold leaf.

Explain why.

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 .....

(1 mark)

- (c) Many experiments since Rutherford's have given us more evidence about the structure of the atom.

Describe the structure of an atom.

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*(3 marks)*

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**QUESTIONS RELATING TO PREVIOUSLY TESTED MODULES**

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7 The table shows the mass of carbohydrate, fat and protein in five different foods, **A** to **E**.

| Food     | Mass in 100 g of food in g |     |         |
|----------|----------------------------|-----|---------|
|          | Carbohydrate               | Fat | Protein |
| <b>A</b> | 0                          | 1   | 20      |
| <b>B</b> | 50                         | 12  | 8       |
| <b>C</b> | 0                          | 42  | 0       |
| <b>D</b> | 12                         | 1   | 0       |
| <b>E</b> | 20                         | 0   | 2       |

(a) Calculate the mass of carbohydrate in a 40 g portion of food **E**.

Show your working.

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Mass = ..... g  
(2 marks)

(b) Carbohydrates and proteins release about the same amount of energy in the body.

Fats release about twice as much energy as carbohydrates and proteins.

Which food, **B** or **C**, releases most energy in the body?

Food .....

Show your working.

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(2 marks)

(c) Describe what happens to food in the small intestine.

You are **not** required to give the names of any enzymes.

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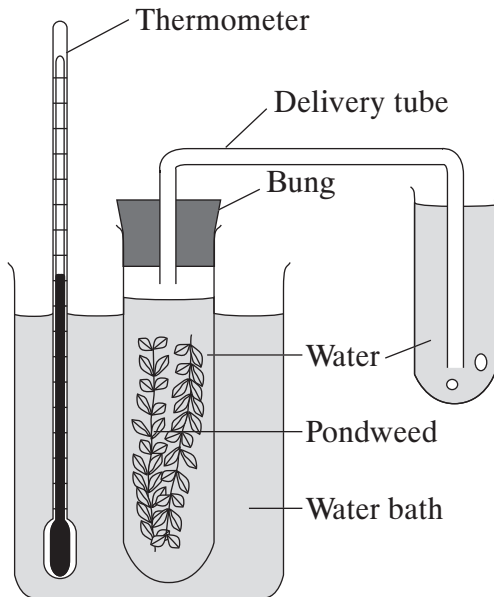
(3 marks)

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8 A student used the apparatus below to investigate the effect of temperature on the rate of photosynthesis. The student counted the number of gas bubbles given off in one minute by the pondweed at different temperatures. The table shows the results of the investigation.



| Temperature in °C | Number of gas bubbles given off per minute |
|-------------------|--|
| 5                 | 8  |
| 10                | 14   |
| 15                | 18   |
| 20                | 20   |
| 25                | 20   |

(a) Describe the effect of temperature on the number of gas bubbles given off per minute.

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(2 marks)

(b) Explain why there was no difference between the counts at 20 °C and 25 °C.

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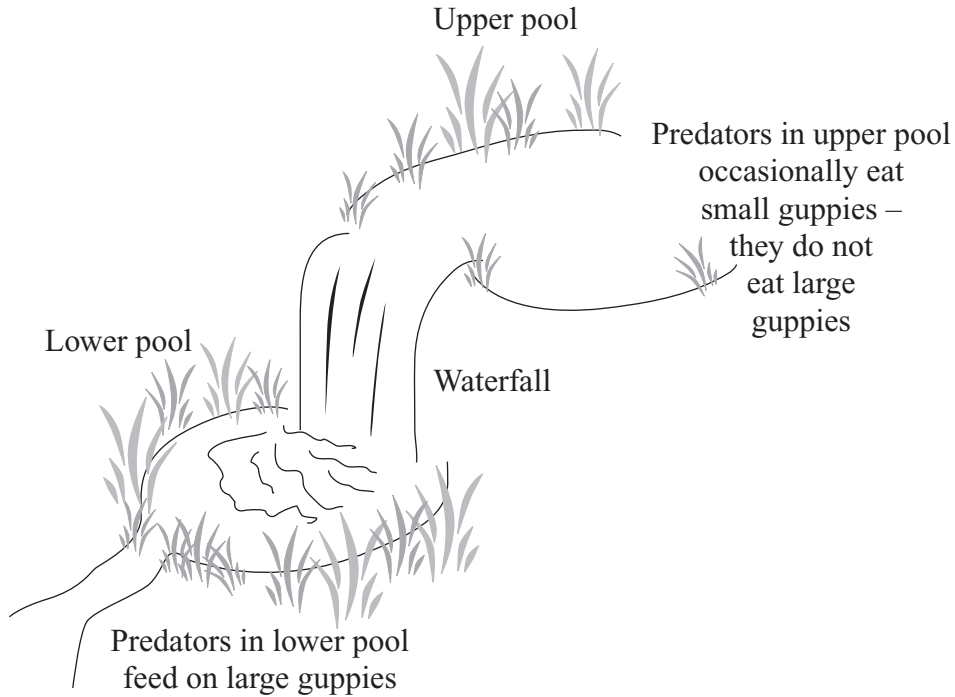
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(2 marks)

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**INHERITANCE AND SELECTION**

9 Fish called guppies live in rivers in South America. In one river, two pools are separated by a waterfall. Guppies cannot swim up the waterfall. There are different predators of guppies in the upper and lower pools, as shown in the diagram.



- Guppies in the lower pool are small and produce many small offspring.
- Scientists moved some guppies from the lower pool to the upper pool.
- After 18 generations, the descendants of the guppies which were moved to the upper pool were larger than their ancestors from the lower pool.
- They also produced fewer and bigger offspring.
- These changes were genetic changes.

Use the information above to explain the evolution of the guppies in the upper pool.

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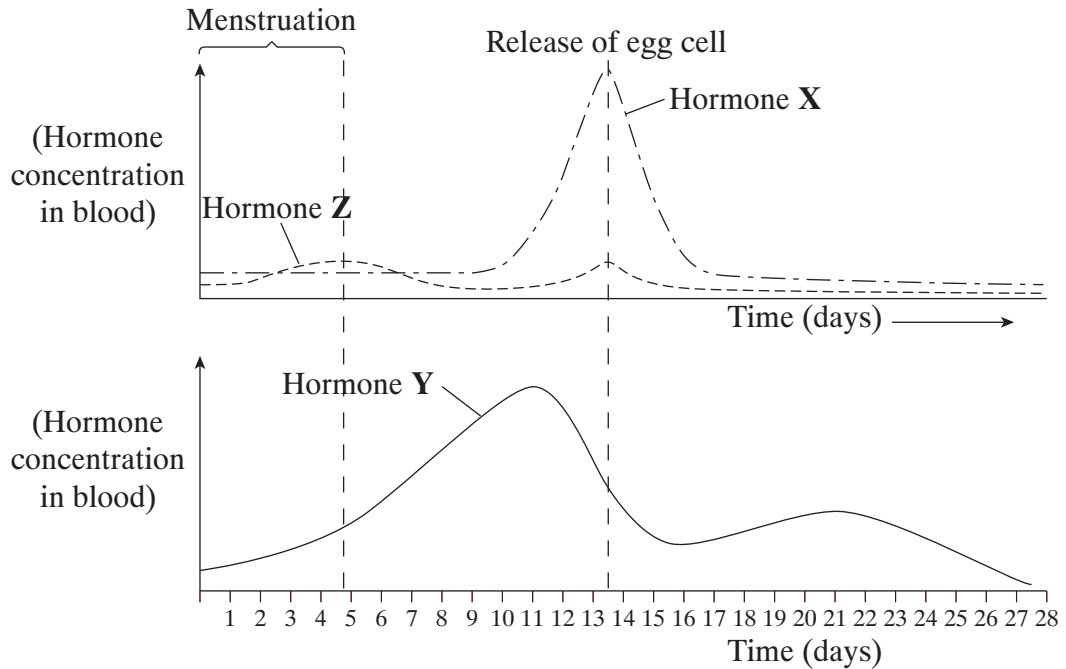
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10 The human menstrual cycle is controlled by hormones.

(a) The graph shows how different hormone levels vary in the menstrual cycle.



Which of the hormones, **X**, **Y** or **Z**, is:

- (i) FSH; .....
- (ii) LH; .....
- (iii) oestrogen? .....

(2 marks)

(b) Explain how hormones can be used to help women who find it difficult to become pregnant.

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(2 marks)



(c) Contraceptive pills work in different ways. ‘Morning-after pills’ are designed to prevent pregnancy in women who have had unprotected sex. One type of ‘morning-after pill’ stops fertilised eggs from embedding in the lining of the womb and developing into an embryo.

(i) Explain how the action of a contraceptive pill differs from the action of this type of ‘morning-after pill’.

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(2 marks)

(ii) Many groups of people are opposed to the use of this type of ‘morning-after pill’.

Explain why some people might hold this view.

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(2 marks)

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**STRUCTURES AND BONDING**

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11 Use the periodic table on the Data Sheet to help you to answer these questions.

- (a) (i) The electronic structure of fluorine is 2,7.

What is the electronic structure of chlorine?

.....  
(1 mark)

- (ii) What is the electronic structure of the chloride ion  $\text{Cl}^-$  ?

.....  
(1 mark)

- (iii) Explain, as fully as you can, why fluorine is more reactive than chlorine.

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(2 marks)

- (b) Fluorine does not react with helium, neon or argon.

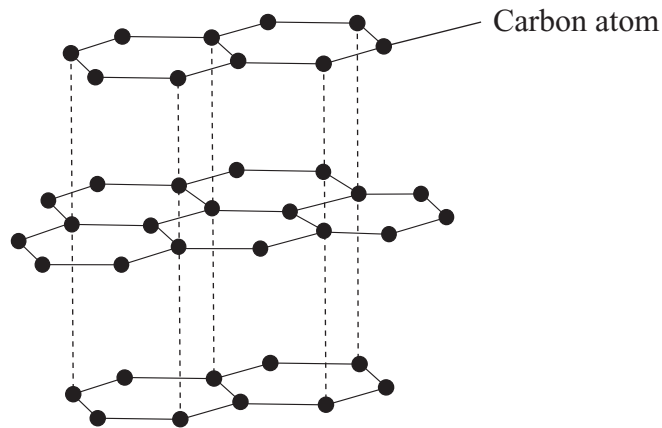
- (i) Explain why fluorine does not react with helium.

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(2 marks)

- (ii) Fluorine reacts with xenon. Do you think that fluorine will react with radon?  
Explain the reason for your answer.

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(2 marks)

12 The diagram represents the structure of graphite.



(a) Explain, as fully as you can, why graphite conducts electricity.

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(2 marks)

(b) Explain, as fully as you can, why graphite can be used in the 'lead' of some types of pencil.

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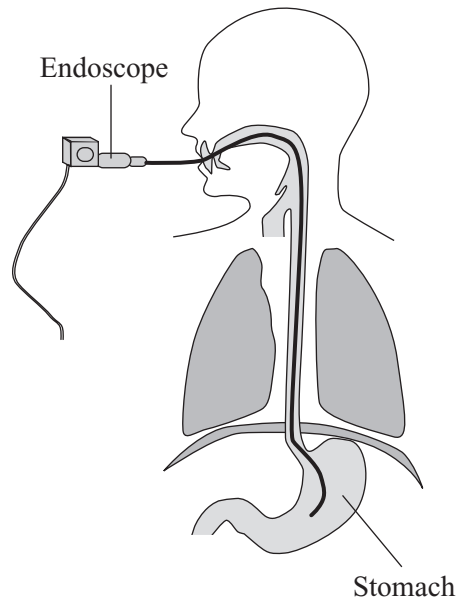
(2 marks)

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**WAVES AND RADIATION**

- 13 (a) The diagram shows an endoscope being used to observe the inside of a patient's stomach.



Light passes from the endoscope to the stomach along optical fibres.

Explain, as fully as you can, why light passes along optical fibres.

*To gain full marks for this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.*

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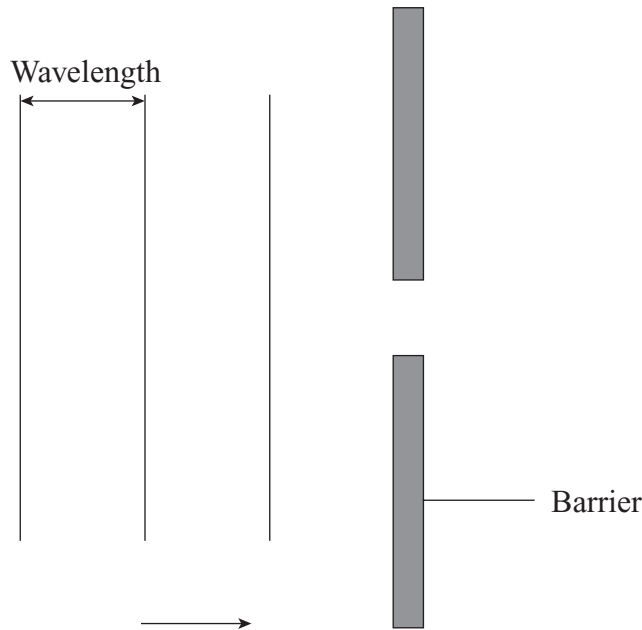
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(4 marks)

(b) The diagram shows waves approaching a gap in a barrier.



(i) Complete the diagram to show what happens to the waves as they pass through the gap in the barrier. (1 mark)

(ii) Name this effect. .... (1 mark)

(c) A local radio station broadcasts on a frequency of 100 megahertz (100 million hertz).

The speed of the radio waves through air is 300 million metres per second.

Calculate the wavelength of the radio waves.

Show all your working.

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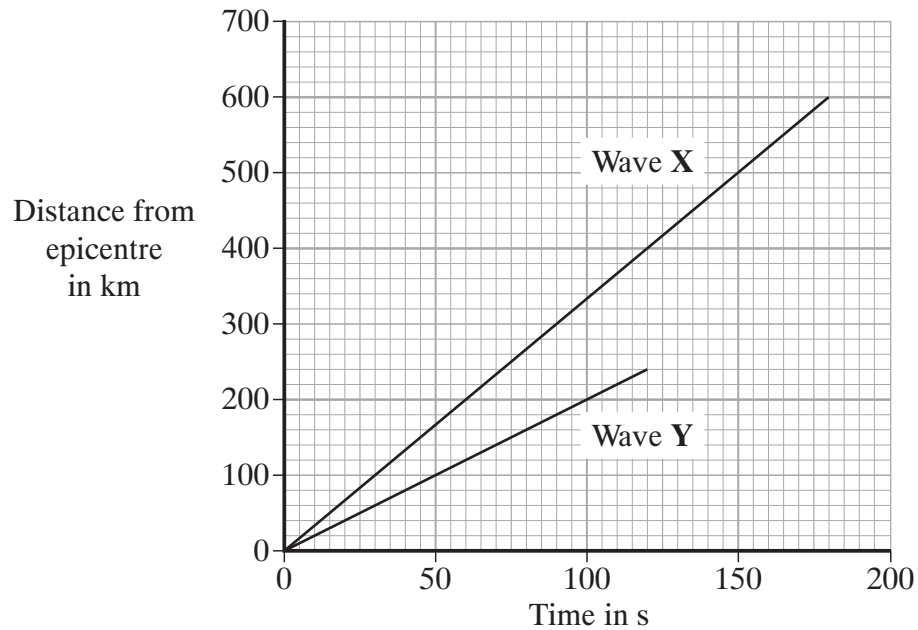
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Wavelength ..... m  
(2 marks)

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Turn over ►

- 14 (a) The graph shows the distance travelled from the epicentre of an earthquake by two types of shockwave, **X** and **Y**.



- (i) The graph for wave **Y** is incomplete.

How far would it travel in 180 s? ..... km (1 mark)

- (ii) Which wave, **X** or **Y**, is a P wave? .....

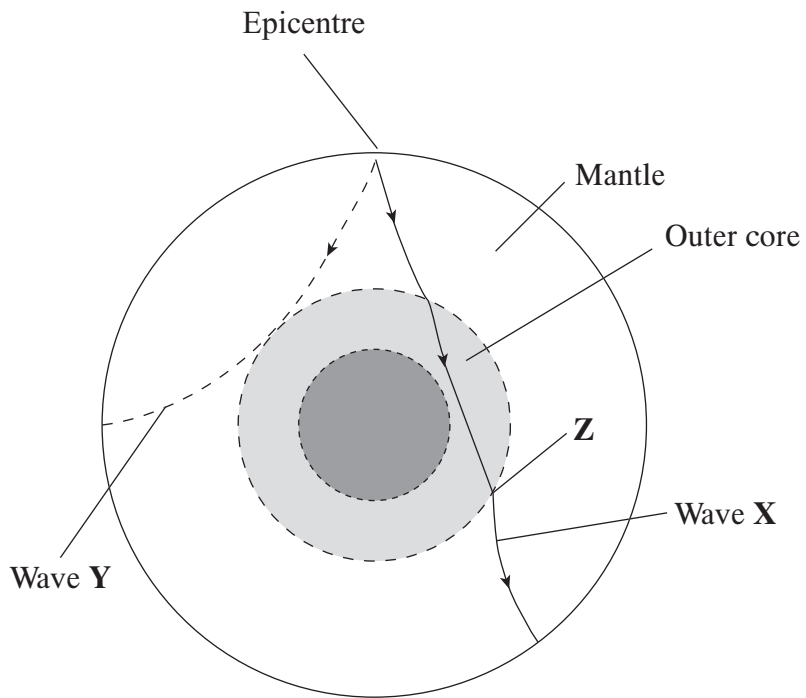
Give the reason for your answer.

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(1 mark)

(b) The diagram shows the passage of waves **X** and **Y** through the Earth.



(i) Why is the path of wave **Y** through the mantle curved?

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.....

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(1 mark)

(ii) Why does wave **X** change direction at **Z**?

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(1 mark)

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**QUESTIONS RELATING TO PREVIOUSLY TESTED MODULES**

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**15** The table shows data on the functioning of the kidney.

| Substance | Percentage concentration of substance |  |          |
|-----------|---------------------------------------|--|----------|
|           | In blood plasma                       | In liquid immediately after filtration | In urine |
| Protein   | 7.0                                   | 0                                      | 0        |
| Ions      | 0.35                                  | 0.35                                   | 0.5      |
| Glucose   | 0.1                                   | 0.1                                    | 0        |
| Urea      | 0.03                                  | 0.03                                   | 2.0      |

Use information from the table to answer these questions.

(a) Describe, in as much detail as you can, what happens to each of the following as blood flows through the kidney.

(i) Glucose

.....

.....

.....

.....

*(2 marks)*

(ii) Ions

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.....

.....

*(2 marks)*

(iii) Protein

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*(1 mark)*



(b) Explain why the concentration of urea is higher in the urine than in blood plasma.

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(1 mark)

(c) Describe the effect of an increase in ADH secretion on the production of urine.

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(2 marks)

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**Turn over for the next question**

**Turn over ►**

16 The table shows the positions of some metals in the periodic table.

| 1  | 2  |  |  |  |  |  |  |  |    |    | 3  | 4  |
|----|----|--|--|--|--|--|--|--|----|----|----|----|
|    |    |  |  |  |  |  |  |  |    |    |    |    |
| Na | Mg |  |  |  |  |  |  |  |    |    | Al |    |
| K  | Ca |  |  |  |  |  |  |  |    | Cu |    |    |
|    |    |  |  |  |  |  |  |  |    | Ag |    | Sn |
|    |    |  |  |  |  |  |  |  | Pt | Au |    | Pb |
|    |    |  |  |  |  |  |  |  |    |    |    |    |

(a) Use the Reactivity Series and the periodic table from the Data Sheet to help you to answer these questions.

(i) How is the reactivity of the metals in Group 1 related to their atomic numbers?

.....  
 .....  
 (1 mark)

(ii) How is the reactivity of the metals in Group 4 related to their atomic numbers?

.....  
 .....  
 (1 mark)

(b) Explain why the transition metals shown in the table are used to make jewellery.

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 (2 marks)

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**END OF QUESTIONS**

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