Candidate Name	Centre Number					Candidate Number				

GCSE COMBINED SCIENCE

COMPONENT 1

Concepts in Biology

HIGHER TIER

SAMPLE PAPER

(1 hour 45 minutes)

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**10**	
2.	**5**	
3.	**8**	
4.	**11**	
5.	**8**	
6.	**13**	
7.	**12**	
8.	**9**	
9.	**14**	
Total	**90**	

ADDITIONAL MATERIALS

In addition to this examination paper you will need a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
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.
The assessment of the quality of extended response (QER) will take place in question **9(c).**

Answer **all** *questions.*

1. There are three main types of blood vessel in the human body. They all have different roles in the body and so have different structures.

(a) Give **three** differences between the structure of an artery and a vein which will allow you to distinguish between them. [3]

1. ……

2. ……

3. ……

(b) (i) Describe how the structure of capillaries allows the movement of molecules between the blood and the body tissues. [1]

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(ii) Explain the importance of a concentration gradient in maintaining the movement of molecules **from** the blood to the body tissues. [2]

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(c) (i) State **two** molecules that pass from the blood to the body tissues. [2]

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(ii) State **two** molecules that pass **into** the blood from the body tissues.[2]

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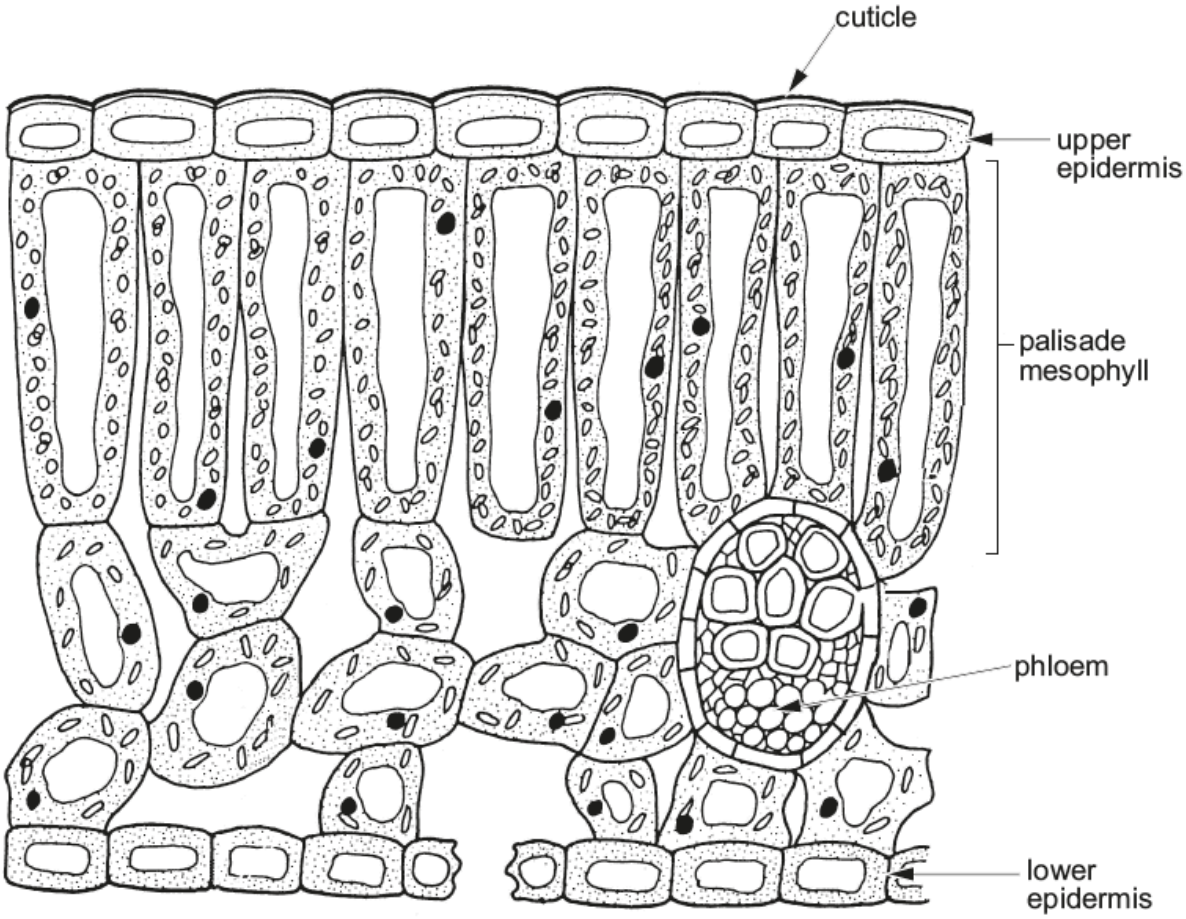
2. The diagram below shows a section through a leaf.



(a) (i) State the number of stomata shown in the diagram. [1]

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(ii) **On the diagram** label the xylem. [1]

(iii) Draw an arrow **on the diagram** to show the path of water molecules from the xylem to the air outside the leaf. [1]

(b) Explain the effect of **increasing** air temperature on the rate of transpiration from the leaf. [2]

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3. John and Susan carried out an investigation into reflex actions. Susan applied a hairpin sharply to John's hand and he moved his hand away quickly. A wifi touch sensor was attached to the tip of the hairpin and a movement sensor attached to John's little finger. The time taken for the hand to move, after the hairpin was applied, was recorded on a laptop monitor. The hairpin was applied seven more times to John's hand. The results are shown in the table below.

Trial	1	2	3	4	5	6	7	8
Time taken to move hand (s)	0.22	0.27	0.23	0.23	0.27	0.22	0.25	0.24

The table below shows how the mean value for moving the hand changed with the number of readings they took.

Trials used to calculate mean	1 & 2	1, 2 & 3	1, 2, 3 & 4	1, 2, 3, 4 & 5	1, 2, 3, 4, 5 & 6	1, 2, 3, 4, 5, 6 & 7	1, 2, 3, 4, 5, 6, 7 & 8
Mean value of time to move hand (s)	0.245	0.240	0.238	0.244	0.240	0.241	0.241

(a) What is the name given to this type of reflex action? [1]

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(b) For the example shown, describe the path taken by the nerve impulse as it passes from the receptor in the skin to the effector in the arm. [3]

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(c) (i) Check that Susan and David have correctly calculated the mean for all eight readings (0.241 s). *Show your workings.* [1]

(ii) Susan says that:

- they have not recorded the mean to the correct number of decimal places;
- they did not need to take so many repeats.

Explain whether Susan is correct. [3]

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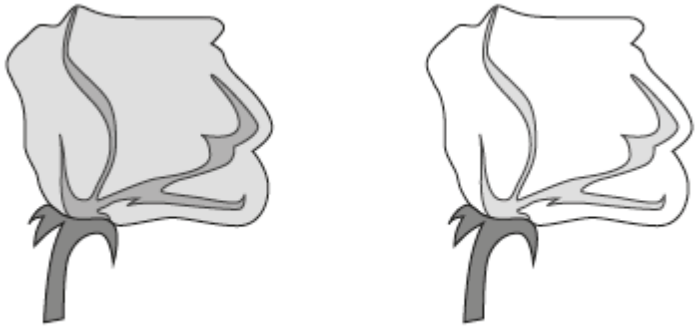
4. When Mendel crossed purple flowered pea plants with white flowered pea plants all the F1 were purple flowered.



(a) (i) Using the letters **D** and **d** to represent the alleles complete the following genotypes: [1]

Purple flowered pea plant …….. x White flowered pea plant ……..

(ii) **Complete** the Punnett squares to show:

I the cross between the purple and white flowered plants. [2]

F1

Gametes		

II the genotypes produced when the F1 generation are selfed. [2]

F2

Gametes		

III Give the ratio of the phenotypes in the F2 generation. [1]

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(b) When Mendel selfed two of the F1 plants he obtained a large number of seeds which he sowed. When these seeds grew he obtained:

705 purple flowered plants and 224 white flowered plants

(i) What ratio of purple flowered plants to white flowered plants did Mendel obtain? [1]

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(ii) Suggest **two** reasons why the ratio Mendel obtained differed from the ratio given in your answer in (a)(ii)III above. [2]

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(c) A commercial seed producer wanted to sell pea seeds that she could guarantee would produce purple flowering plants.

Select from the list below all the genetic crosses she could carry out which would guarantee only purple flowering plants.

Underline **all** correct answers. [2]

(i)	homozygous dominant	×	homozygous dominant
(ii)	heterozygous	×	heterozygous
(iii)	homozygous dominant	×	recessive
(iv)	recessive	×	recessive
(v)	homozygous dominant	×	heterozygous

11

5. (a) Mitosis and meiosis are the two types of cell division which occur in animals and plants. How do the outcomes of these two types of cell division differ? [3]

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(b) (i) Myeloma is a cancer of the bone marrow. What is cancer? [1]

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(ii) Stem cells can be used to help treat some types of cancer such as myeloma. What are stem cells? [1]

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(iii) Stem cells can be used to treat many diseases and conditions in humans.Once obtained they can be grown in a laboratory in order to multiply in number. They can then be injected into the body.

There are three main sources of stem cells:

I **Own-donor stem cells** - these are removed from the body and then injected back into the donor's body.

II **Embryonic stem cells** – these are obtained from embryos produced by in-vitro fertilization and then injected into a patient.

III **Cord stem cells** – these are obtained from the umbilical cord of babies, after they are born, and then injected into a patient.

Compare the ethical issues that may exist in the use of these three different sources of stem cells. [3]

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6. Rhian investigated osmosis in a school laboratory. She cut 15 potato chips, each exactly 5 cm long and with a cross sectional area of 1 cm^2. Five of the chips were placed in water, five in a 0.4% sugar solution and the remaining five in a 10% sugar solution.
After two hours the chips were removed and their lengths measured. The results are recorded in the table below.

Length of potato chips after 2 hours (cm)		
Water	**0.4% sugar solution**	**10% sugar solution**
5.10	5.00	4.70
5.20	5.00	4.40
5.30	5.00	4.65
5.20	5.00	4.30
5.25	5.00	4.60
mean = 5.21 cm	mean = 5.00 cm	mean = 4.53 cm

(a) The mean length of the chips kept in water was greater than the mean length of the chips kept in 10% sugar solution. Explain, in detail, this observation. [4]

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(b) Explain why there was no change in length in the chips kept in 0.4% sugar solution. [2]

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(c) Explain why this experiment will not work if boiled potato is used. [1]

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(d) Give **one** example of the use of osmosis in a living plant. [1]

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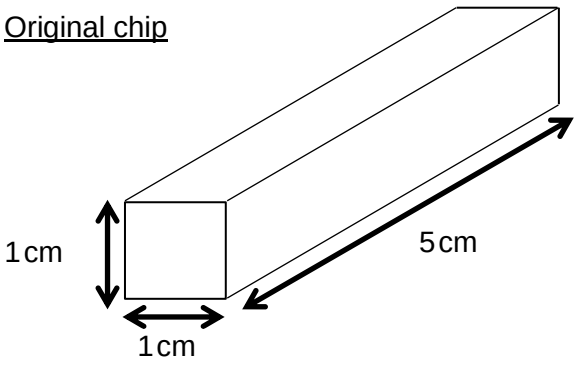
(e) Rhian repeated part of her investigation with 5 larger chips. She placed 5 cm chips, with a cross sectional area of 4 cm^2, in water. She left the chips for 2 hours.

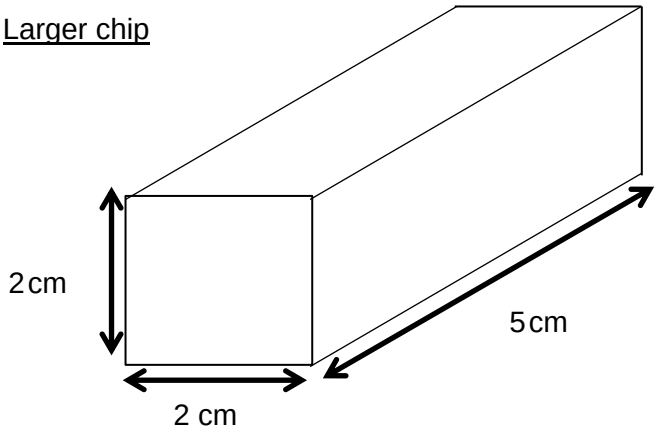
Original chip



Height = 1 cm
Width = 1 cm
Length = 5 cm

Surface area = 22 cm^2
Volume = 5.0 cm^3

Larger chip



Height = 2 cm
Width = 2 cm
Length = 5 cm

Volume = 20.0 cm^3

(i) Calculate the surface area of the larger chip. [2]

surface area = ……cm^2

After leaving the larger chips in water for 2 hours Rhian found that their mean increase in length was less than that found in the smaller chips.

(ii) Explain this observation in terms of surface area : volume ratio. [1]

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(f) The table shows the concentration of certain mineral ions in the soil solution and in the root hair cells of a plant.

	Concentration (mmol dm^{-3})		
	potassium	**sodium**	**chloride**
soil solution	0.1	1.1	1.3
vacuole of root hair cells	93.0	51.0	58.0

(i) From the table, give the evidence that shows that the uptake of mineral ions from the soil is by active transport. [1]

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(ii) Explain why the active transport of these mineral ions stops if a respiratory poison is applied to the roots of the plant. [1]

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13

7. (a) Write the word equation for photosynthesis in the space below. [2]

(b) State why chloroplasts are important in the process of photosynthesis. [2]

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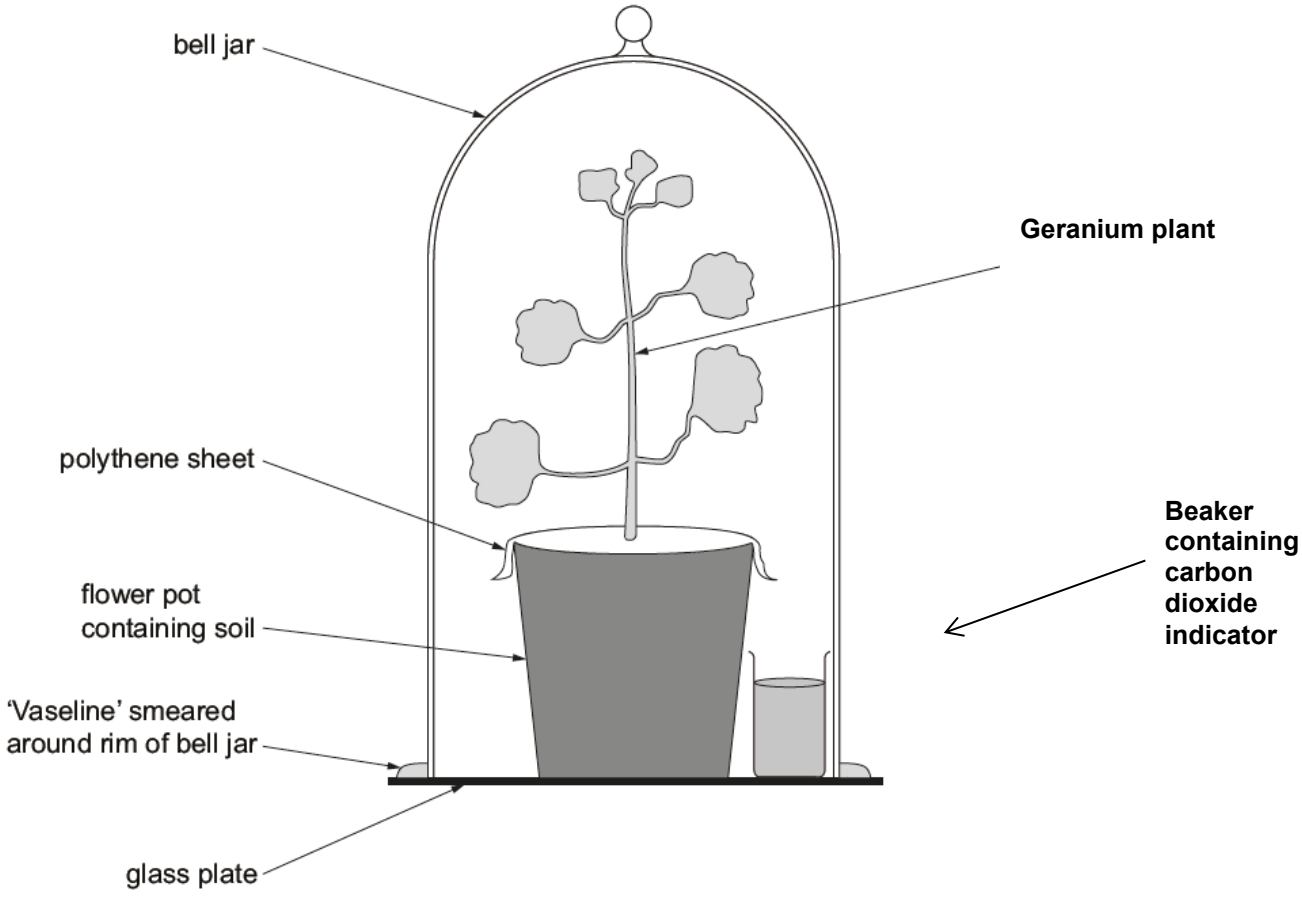
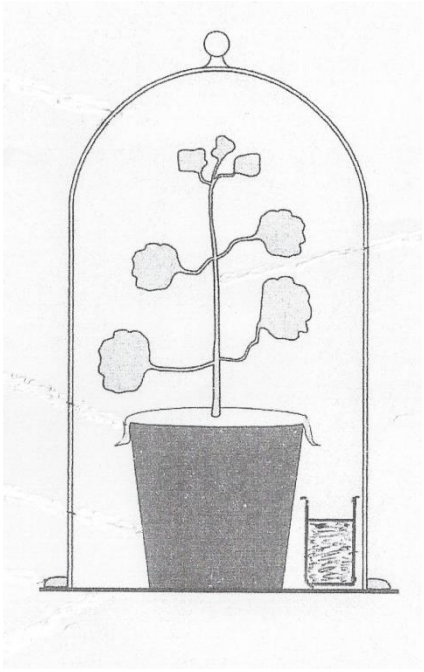
(c) The following apparatus was set up to investigate some of the factors affecting photosynthesis.

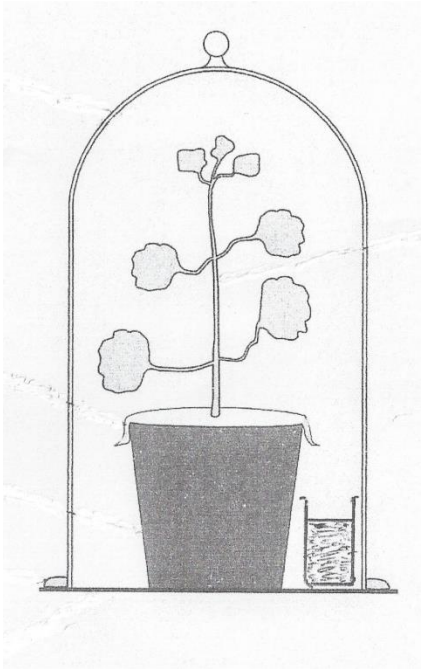


Three identical sets of the apparatus were set up and treated as shown below

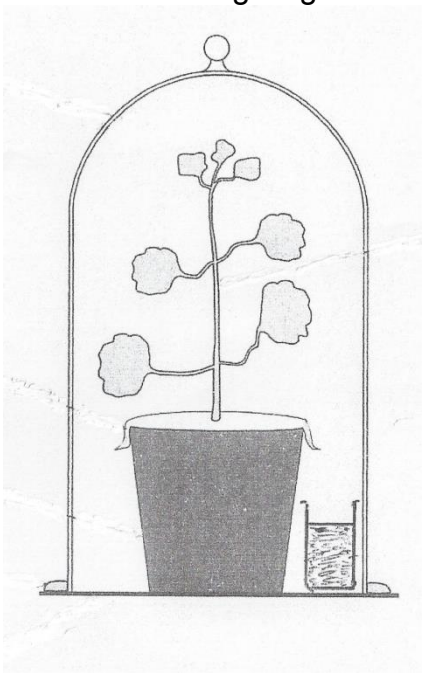
A
Plant in darkness



B
Plant in shaded conditions



C
Plant in bright light



The beaker in each flask contained a carbon dioxide indicator which changes colour as shown in the table below.

Concentration of carbon dioxide in air	Colour of indicator
less than normal	purple
normal	red
more than normal	yellow

(i) **Complete the table below** to show the expected final colour of the indicator and the reason for the final colour. [6]

Bell jar	Expected final colour of indicator	Reason for final colour of indicator
A		
B		
C		

(ii) Temperature, light intensity and carbon dioxide concentration are the limiting factors which affect the rate of photosynthesis.

Which of these limiting factors were being investigated in the above experiment? Underline the correct answer. [1]

(I) temperature
(II) light intensity and carbon dioxide concentration
(III) light intensity
(IV) carbon dioxide concentration
(V) temperature and light intensity

(iii) Explain why the soil in the flower pot was covered with a polythene sheet. [1]

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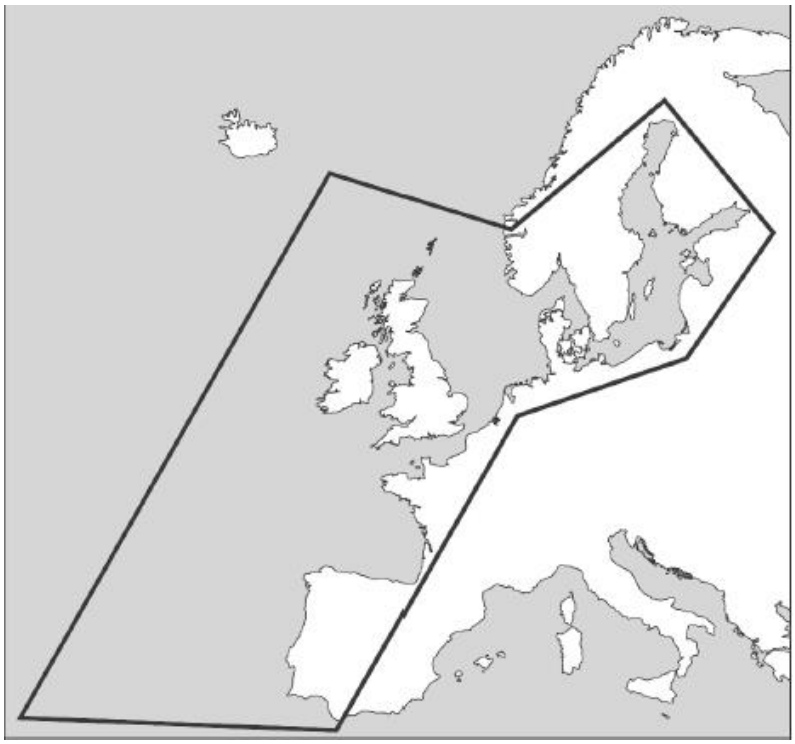
12

8. EARTHDIVE is a global diving organisation that encourages recreational divers to report sightings of various indicator species in the regions of the world in which they are diving. Divers upload data from their sightings online into the EARTHDIVE Global Dive Log.

EARTHDIVE divides the world's seas and oceans into 30 eco-regions.
Eco-region 6a is Europe – Temperate.



In this Eco-region the five indicator species, or groups of indicator species monitored by divers are:

- all marine lobsters
- all marine mussels
- John Dory *(Zeus faber)*
- scallops
- European plaice *(Pleuronectes platessa)*

(a) (i) What is meant by an indicator species? [2]

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(ii) Shown below are two *Post-dive logs* recorded by the same diver in the same part of Eco-region 6a on two different dates.

Species	**Number of indicator species seen during dive**	
	20.06.2009	**04.06.2014**
lobsters	18	4
mussels	>250	>250
John Dory	48	18
scallops	41	17
plaice	19	3

I Explain whether the following statement is correct:
"The % decrease in numbers of John Dory between 20.06.09 and 04.06.2014 > 60%." [2]
Show any calculations that you make.

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II Based upon these two *Post-dive logs* what has happened to the biodiversity between 2009 and 2014? [3]

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(b) EARTHDIVE estimates that there are over 2 million recreational divers in the world. Suggest why EARTHDIVE are prepared to collect data from these divers rather than just depending on data collection from professional divers and marine biologists. [2]

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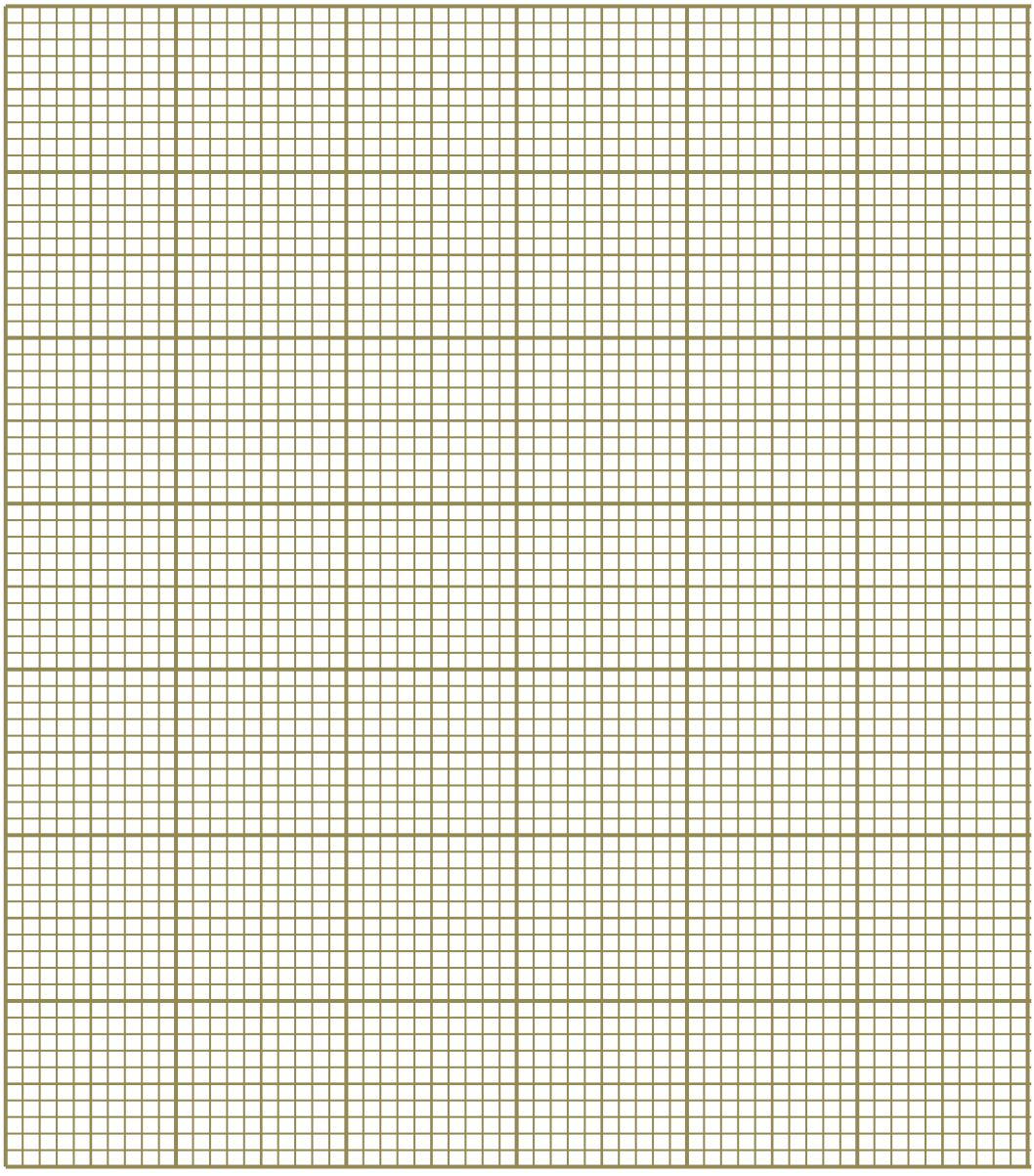
9. Some women experience difficulty in becoming pregnant. One method of treating infertility is to artificially induce the production of more eggs by a woman's ovaries. These are then harvested, fertilized and the resulting embryos implanted into the woman's uterus.

The table below shows how the number of eggs released by a group of women undergoing infertility treatment depends on the volume of fertility drug injected.

Volume of fertility drug injected (arbitrary units)	**Total number of eggs released per menstrual cycle**
0	1
5	5
10	7
15	26
20	57
25	65

(a) (i) Plot the data as a line graph on the grid below and join the plots. Label the axes and use a suitable scale. [3]



(ii) I Describe the trend shown in the graph. [1]

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II Estimate the volume of fertility drug required to produce 45 eggs. [1]

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(b) Puregon is a synthetic form of a human hormone which is used to treat infertility in women by inducing the production of large numbers of eggs.

It can be produced by genetic engineering using Chinese hamster ovary (CHO) cells. Name the synthetic hormone found in Puregon and outline how CHO cells could be modified to produce Puregon. [3]

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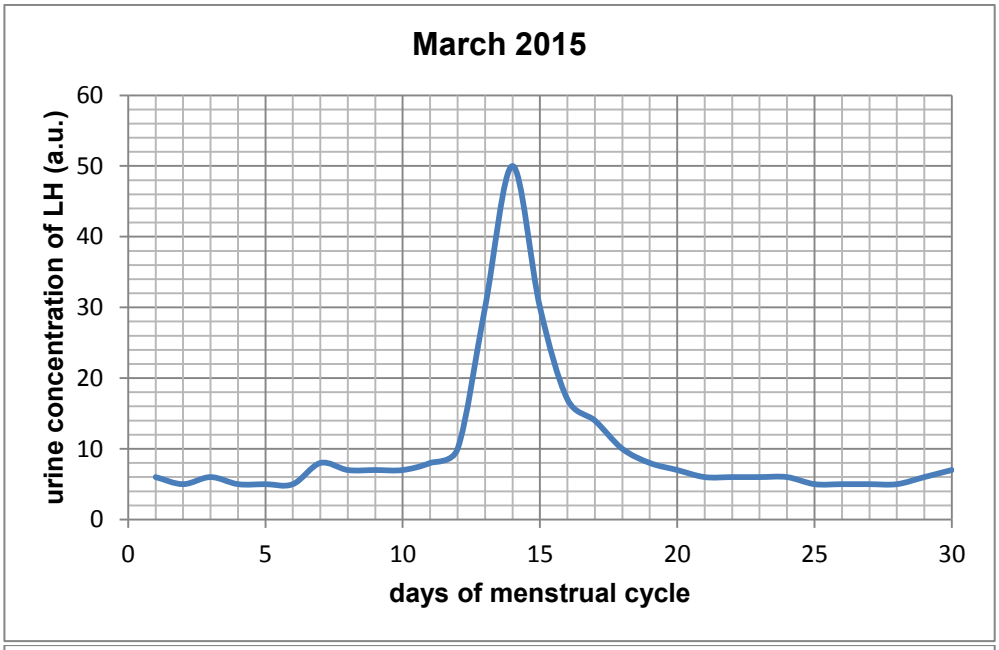
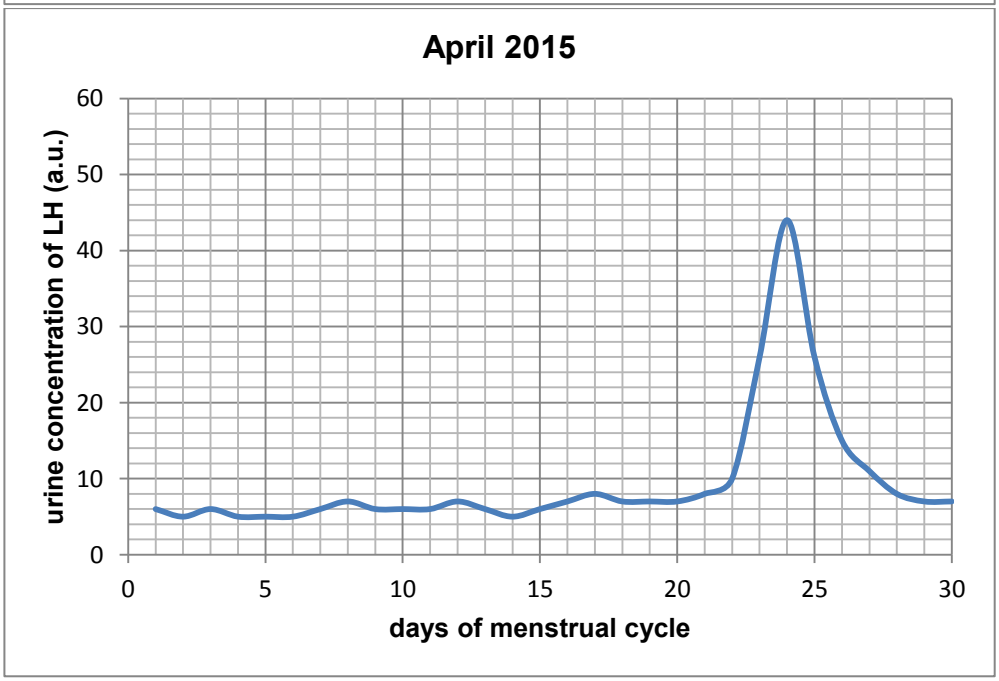
(c) Estimating the day of ovulation during the menstrual cycle can be used by women who want to increase their chance of becoming pregnant. Test kits are available which detect the level of luteinising hormone (LH) in urine. Ovulation usually occurs 24 – 28 hours following the appearance of a high level of LH in urine.
The graphs below show how the urine concentration of LH varies for the same woman.





Explain the changes in LH concentration in a typical cycle and explain why, in this case, measuring the LH concentration may not help the woman identify her most fertile time in the month. [6 QER]

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