

Name \_\_\_\_\_

## **AS Biology 2015 Spec – Maths Question Practice**

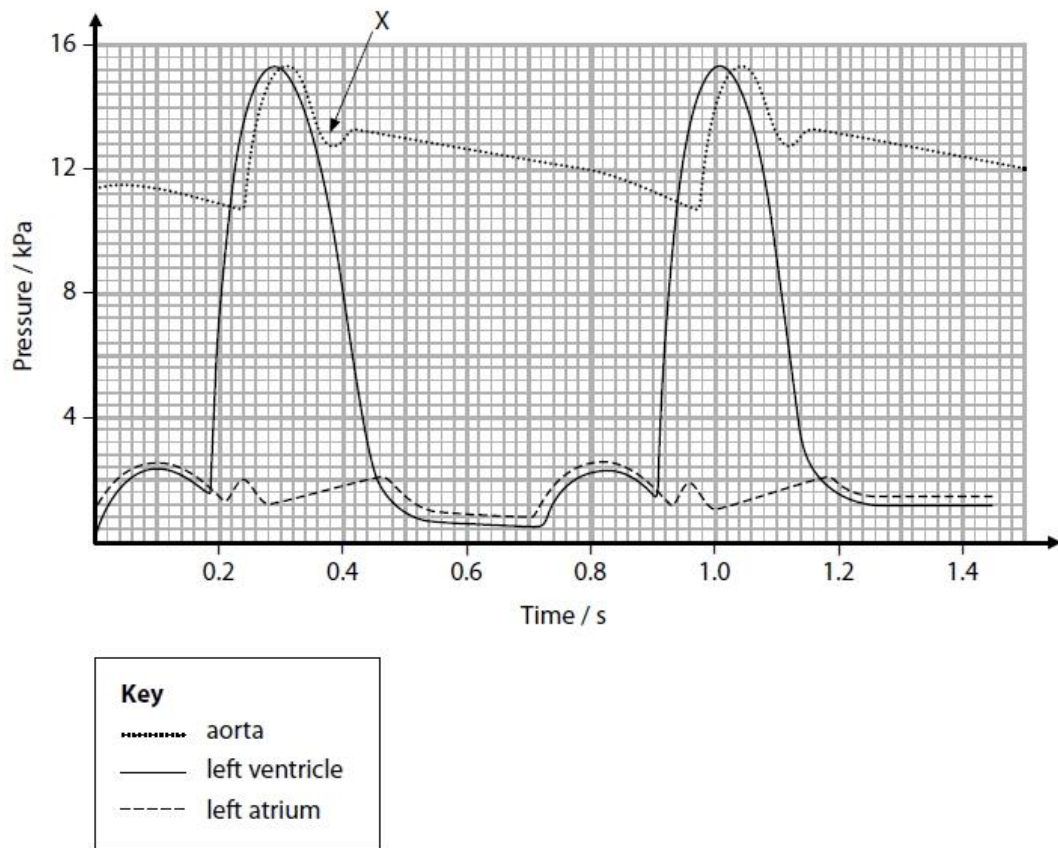
Questions 1-5.....Heart calculations

Questions 6-11.....Magnification calculations  
(*NB scales may be different due to print size*)

Questions 12-15.....Percentage Change

Questions 16-25.....Data analysis / general maths

1. During the cardiac cycle, there are pressure changes in the left atrium, left ventricle and aorta. The graph shows these pressure changes in the left atrium, left ventricle and aorta of a person.



(a) (i) Which time period corresponds with ventricular systole?

(1)

- ☐ A 0.52 to 0.72
- ☐ B 0.72 to 0.92
- ☐ C 0.92 to 1.20
- ☐ D 0.24 to 0.98

(ii) Which of the following is occurring in the heart at 1.0 second on the graph?

(1)

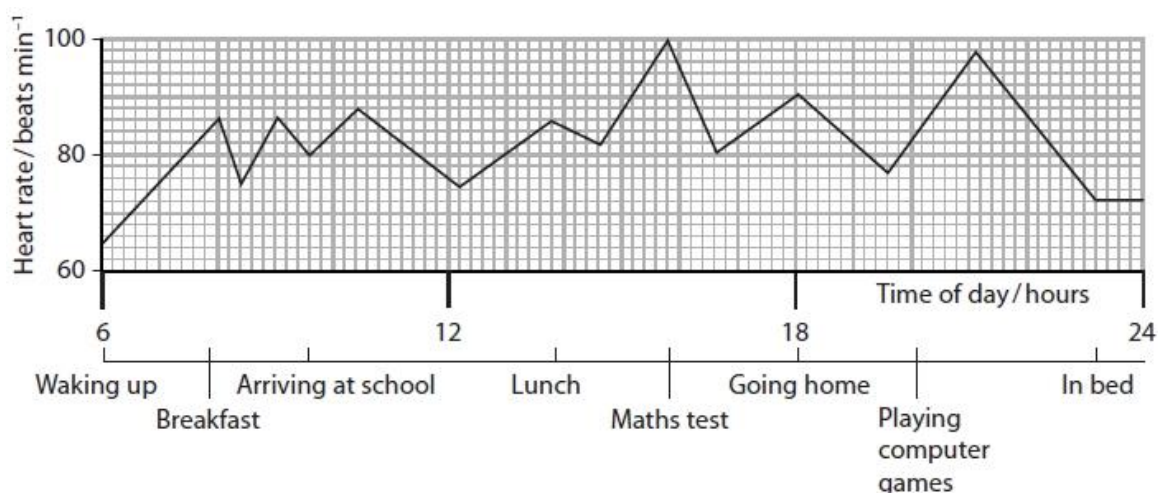
- ☐ A semilunar valve is closed and atrioventricular valve is closed
- ☐ B semilunar valve is closed and atrioventricular valve is open
- ☐ C semilunar valve is open and atrioventricular valve is closed
- ☐ D semilunar valve is open and atrioventricular valve is open

(iii) Use the information on the graph to calculate the heart rate of this person.

(2)

Answer ..... beats per minute

2. A student was interested to find out how his heart rate would vary throughout the day. He wore a heart rate monitor from the time he woke up until the time he went to bed. The graph shows the data collected and some of the student's activities during the day.

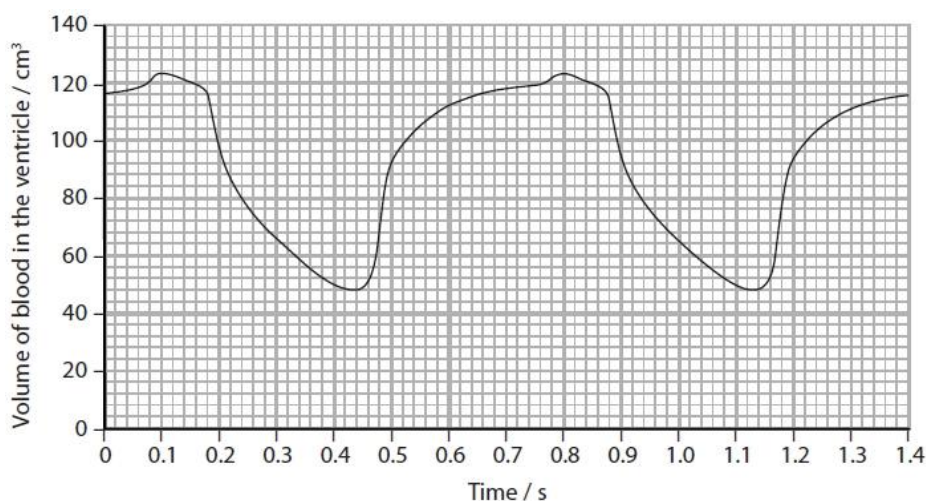


Calculate the rate of increase in the student's heart rate between 6 am and 8 am.

(2)

Answer .....

3. A scientist investigated the volume of blood pumped by the heart of a healthy individual. The graph shows the volume of blood measured in the left ventricle.



(i) Calculate the heart rate.

(2)

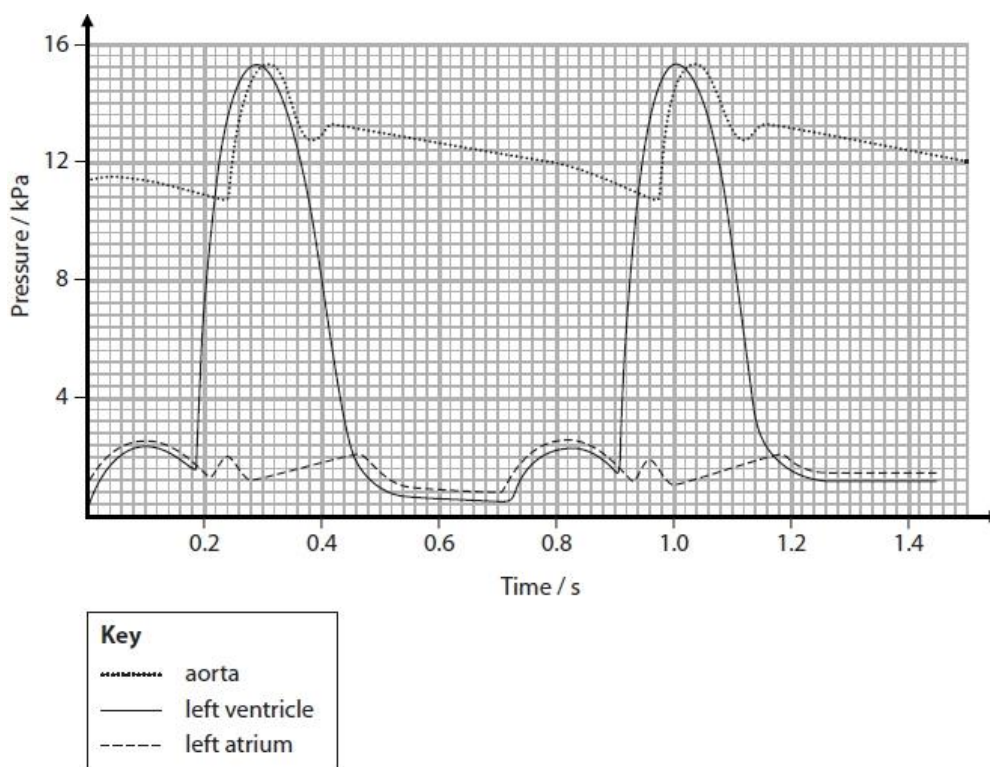
Answer ..... beats  $\text{min}^{-1}$

(ii) Calculate the volume of blood, in  $\text{dm}^3$ , pumped by the left ventricle each minute.

(3)

Answer .....  $\text{dm}^3$

4. During the cardiac cycle, there are pressure changes in the left atrium, left ventricle and aorta. The graph shows these pressure changes.



(a) (i) Which of the following statements is correct?

(1)

- ☐ **A** the pressure in the left ventricle is always higher than in the aorta
- ☐ **B** the highest pressure in the left atrium causes an increase in pressure in the aorta
- ☐ **C** the time taken for the pressure to change from its lowest value to its highest value is greatest in the left ventricle
- ☐ **D** the increase in pressure in the left atrium at 0.24 s causes the increase in pressure in the left ventricle

(ii) Which of the following is occurring in the heart at 1.0 s on the graph?

(1)

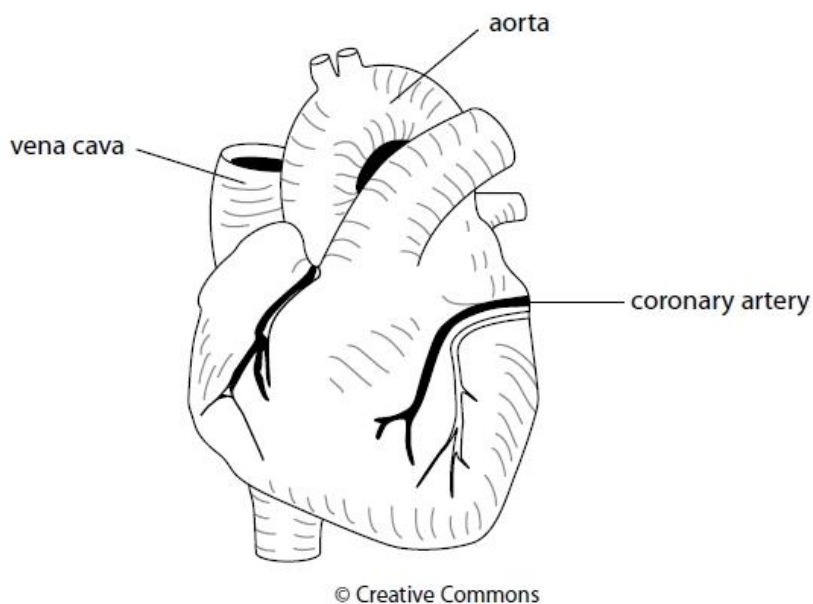
|                                   | Semilunar valve | Atrioventricular valve |
|-----------------------------------|-----------------|------------------------|
| <input type="checkbox"/> <b>A</b> | closed          | closed                 |
| <input type="checkbox"/> <b>B</b> | closed          | open                   |
| <input type="checkbox"/> <b>C</b> | open            | closed                 |
| <input type="checkbox"/> <b>D</b> | open            | open                   |

(iii) Use the information in the graph to calculate the heart rate of this person.

(2)

Answer ..... beats per minute

5. A student studied the external view of a mammalian heart, as shown in the diagram.



The student wanted to compare the size of the aorta and the vena cava of this heart.

She determined the cross-sectional area of the aorta, which was  $72.22 \text{ mm}^2$ .

She also measured the diameter of the vena cava which was  $17.0 \text{ mm}$ .

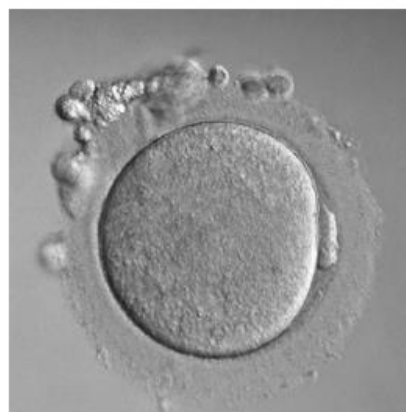
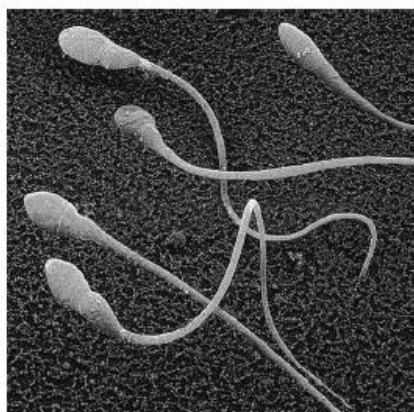
(i) Calculate the difference in the cross-sectional area of the vena cava and the aorta.

(2)

Answer .....  $\text{mm}^2$

6. In animals, sperm cells and egg cells are involved in sexual reproduction.

The photomicrographs show human sperm cells and a human egg cell. They are not shown to scale.



Using an eyepiece graticule (micrometer), the head of a human sperm cell was measured as  $5\text{ }\mu\text{m}$  in length and the egg cell  $0.1\text{ mm}$  in width.

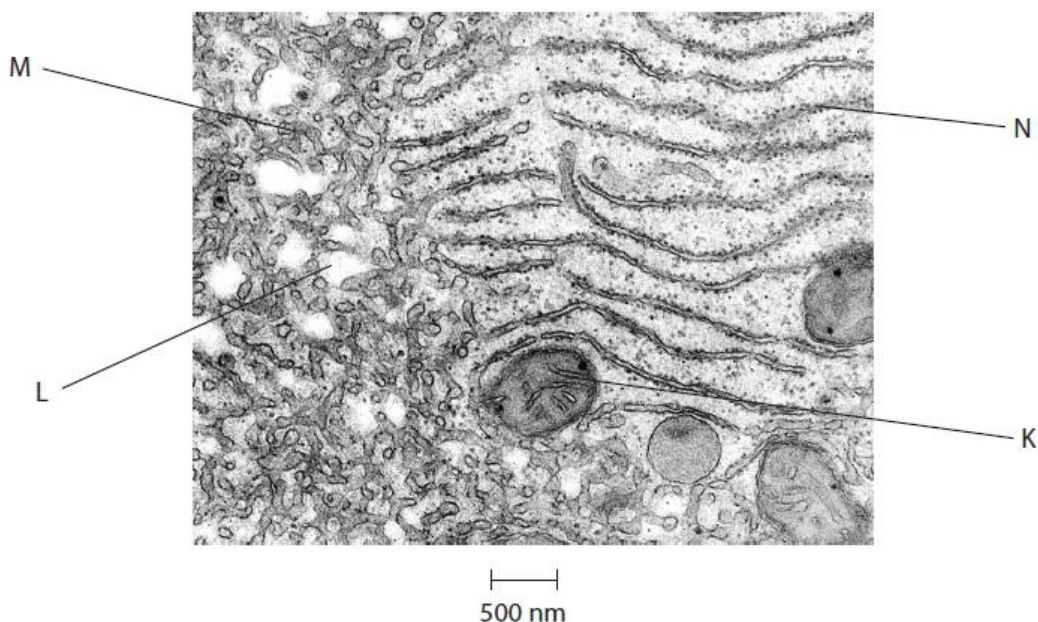
Calculate how many times larger the egg cell is compared to the head of the sperm cell.

(2)

Answer .....

7. Liver cells synthesise and export a variety of proteins.

The image is a transmission electron micrograph of part of a liver cell.

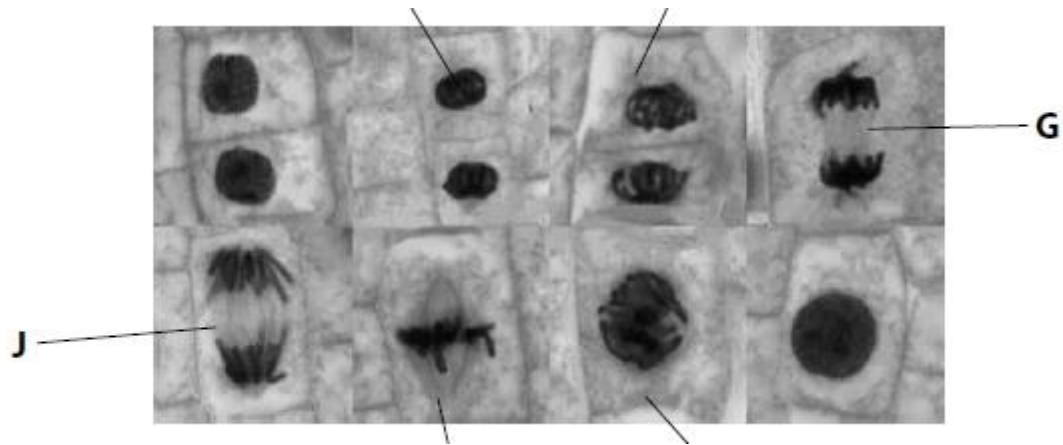


(iv) Calculate the maximum width of the structure labelled K.

(2)

Maximum length ..... nm

8. The photograph below shows cells dividing by mitosis.



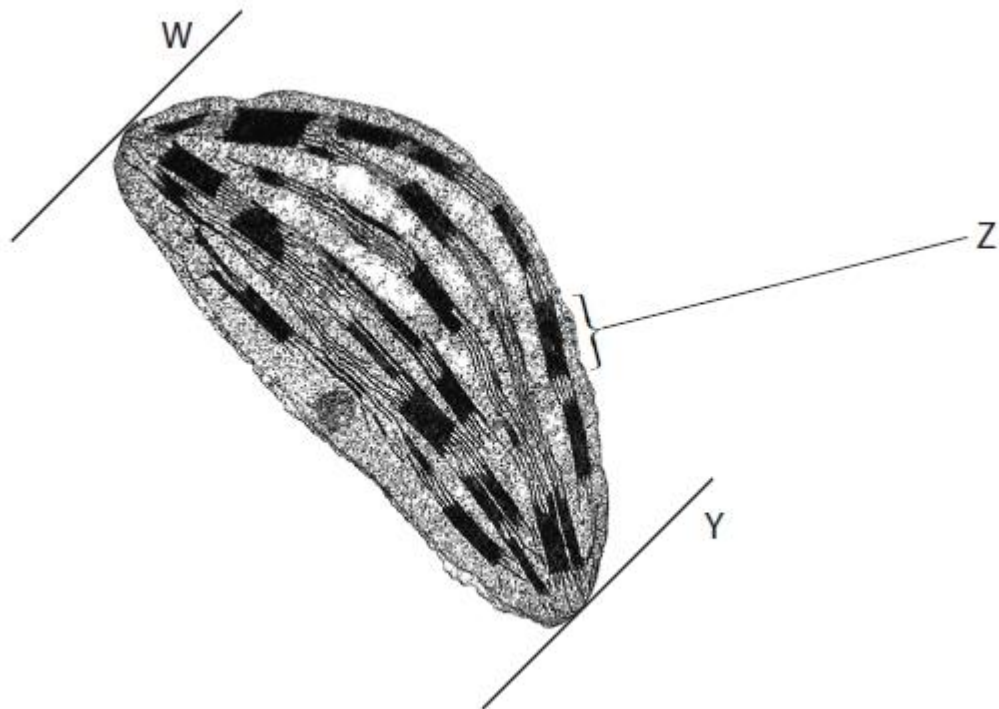
(a) The actual length of cell **J** is  $23.5\ \mu\text{m}$ .

(i) Calculate the magnification of this photograph.

(3)

Answer .....

9 The electronmicrograph below shows an image of a chloroplast.



(ii) The equation below can be used to calculate the magnification of this chloroplast.

$$\text{image length} = \text{actual length} \times \text{magnification}$$

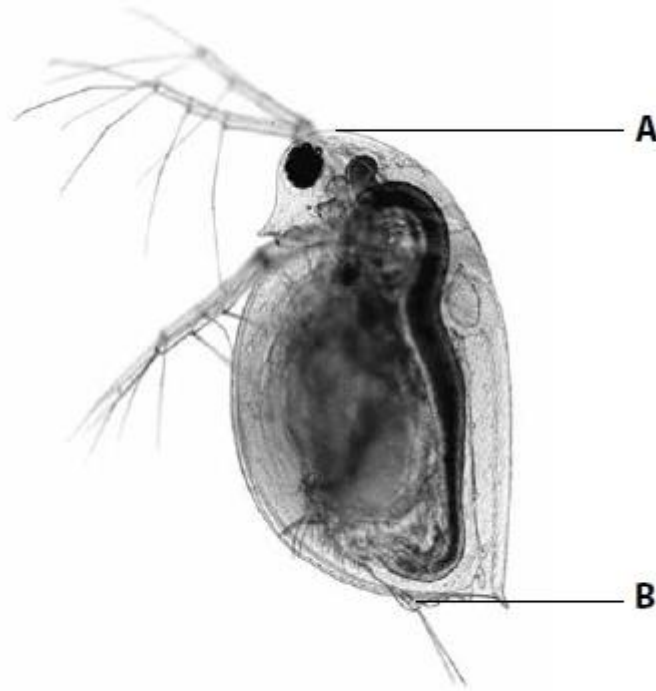
The actual length of this chloroplast is  $0.007\ \text{mm}$ .

Measure the image length between lines **W** and **Y**. Use this equation to calculate the magnification of the image.

(3)

magnification = .....

10. A student investigated the effect of temperature on the heart rate of *Daphnia*.



Magnification  $\times 60$

(a) Use the lines A to B to calculate the actual length of this *Daphnia*.

(2)

Answer .....

(b) The student used five *Daphnia* in the investigation.

The *Daphnia*'s heartbeats were counted over a 20-second period.

A stopwatch was used and a pencil mark made on a piece of paper while observing the *Daphnia* through a low powered microscope.

The number of heartbeats was counted three times for each *Daphnia*.

This was repeated at five different temperatures using the same *Daphnia* each time.

This was then repeated using the four other *Daphnia*.

The results obtained are shown in the table below.

| <i>Daphnia</i> | Heart rate / beats in 20 seconds |    |    |      |    |    |      |    |    |      |    |    |      |    |    |
|----------------|----------------------------------|----|----|------|----|----|------|----|----|------|----|----|------|----|----|
|                | 5°C                              |    |    | 10°C |    |    | 15°C |    |    | 20°C |    |    | 25°C |    |    |
| 1              | 20                               | 18 | 19 | 30   | 26 | 29 | 36   | 35 | 36 | 42   | 45 | 44 | 53   | 47 | 53 |
| 2              | 22                               | 23 | 19 | 36   | 32 | 29 | 36   | 39 | 34 | 42   | 46 | 42 | 50   | 51 | 63 |
| 3              | 16                               | 18 | 20 | 26   | 30 | 27 | 35   | 33 | 36 | 39   | 41 | 40 | 58   | 52 | 50 |
| 4              | 19                               | 22 | 21 | 30   | 32 | 35 | 38   | 36 | 37 | 45   | 46 | 42 | 62   | 62 | 58 |
| 5              | 20                               | 25 | 21 | 35   | 32 | 34 | 36   | 39 | 38 | 44   | 48 | 42 | 52   | 55 | 59 |

(2)

(ii) The mean heart rate at 5 °C is 20.2 beats in 20 seconds. Calculate how many times faster the mean heart rate is at 25 °C than at 5°C.

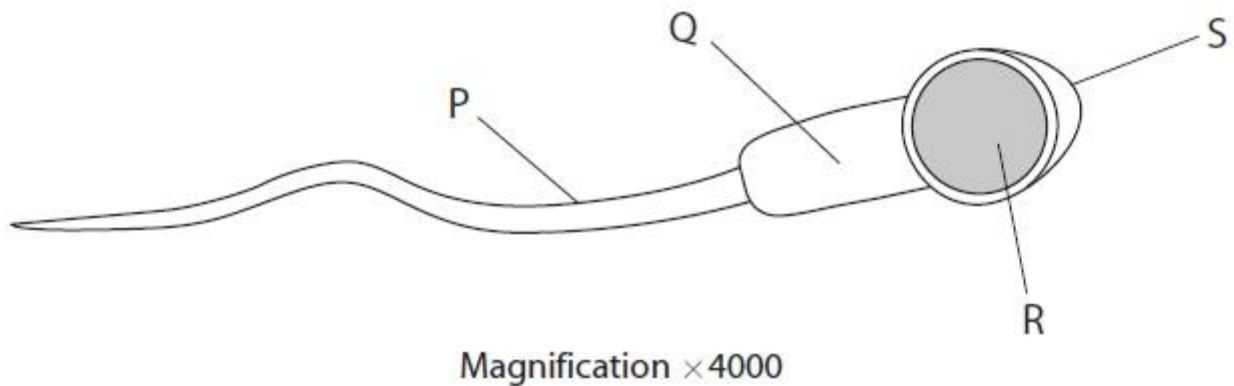
(2)

Answer .....

11.

Many animals reproduce sexually.

The diagram shows a healthy human sperm cell.



(ii) Which of the following is the approximate diameter of the sperm cell nucleus?

(1)

- ☐ A 0.4  $\mu\text{m}$
- ☐ B 4  $\mu\text{m}$
- ☐ C 0.4 nm
- ☐ D 4 nm

12 In some species of mammal, at fertilisation most of the sperm cell enters the egg cell. The fertilised cell then divides by mitosis.

- (i) A sperm cell containing 65 mitochondria fertilises an egg cell containing 100 000 mitochondria. Calculate the percentage of the total mitochondria in this fertilised cell that come from the sperm cell. Show your working.

(2)

Answer ..... %

- (ii) State how many cells there would be after the fertilised egg has divided, by mitosis, **four** times.

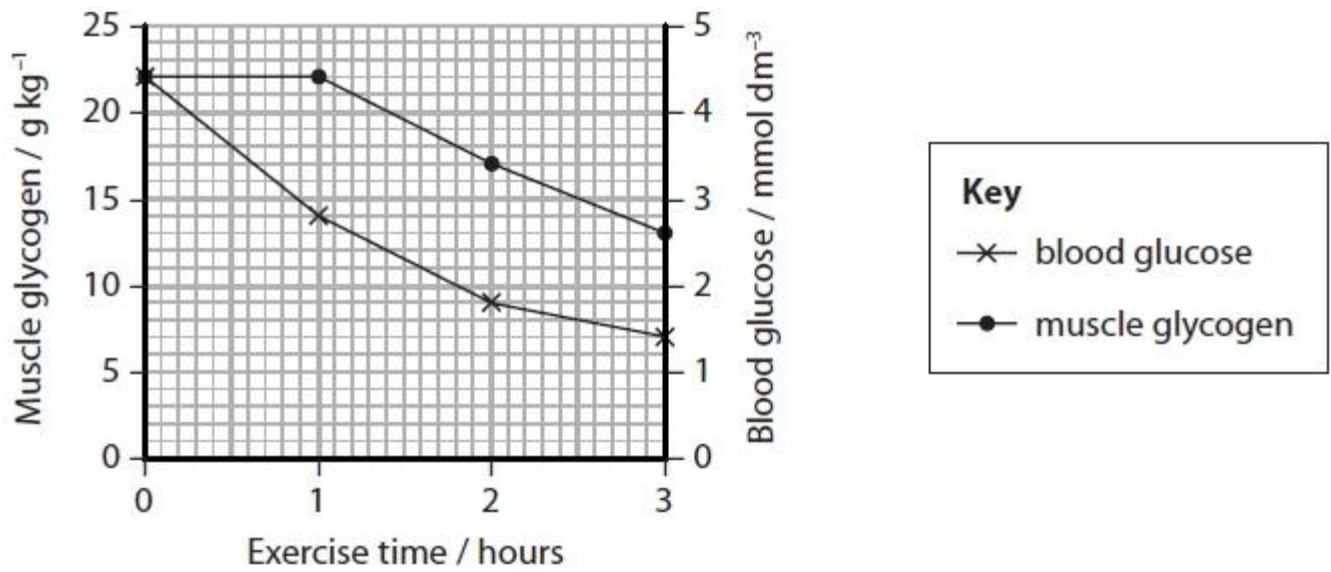
(1)

.....

13.

Carbohydrates are the body's main energy source.

The graph shows the change in concentration of blood glucose and muscle glycogen during exercise.

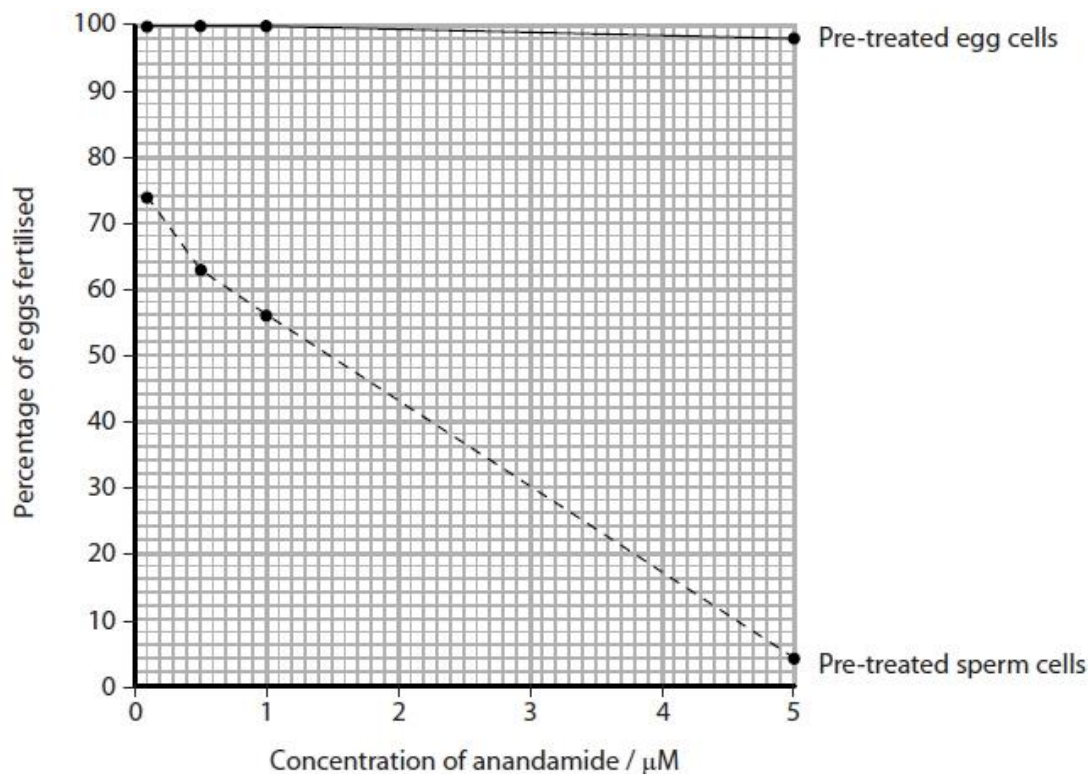


Calculate the percentage change in muscle glycogen during the three hours of exercise.

(2)

Answer ..... %

**14.** Fertilisation can be affected by anandamide, a chemical found in cannabis. The effect of anandamide on fertilisation in sea urchins was investigated. Sperm cells were pre-treated with different concentrations of anandamide. These sperm cells were then mixed with untreated egg cells. The percentage of successful fertilisations was calculated. A separate investigation was carried out using pre-treated egg cells that were then mixed with untreated sperm cells. The percentage of successful fertilisations was calculated. The graph shows the results of the investigations.



(i) Calculate the percentage change in fertilisation using pre-treated sperm cells when the concentration of anandamide increased from 0.1 to 1.0  $\mu\text{M}$ .

(2)

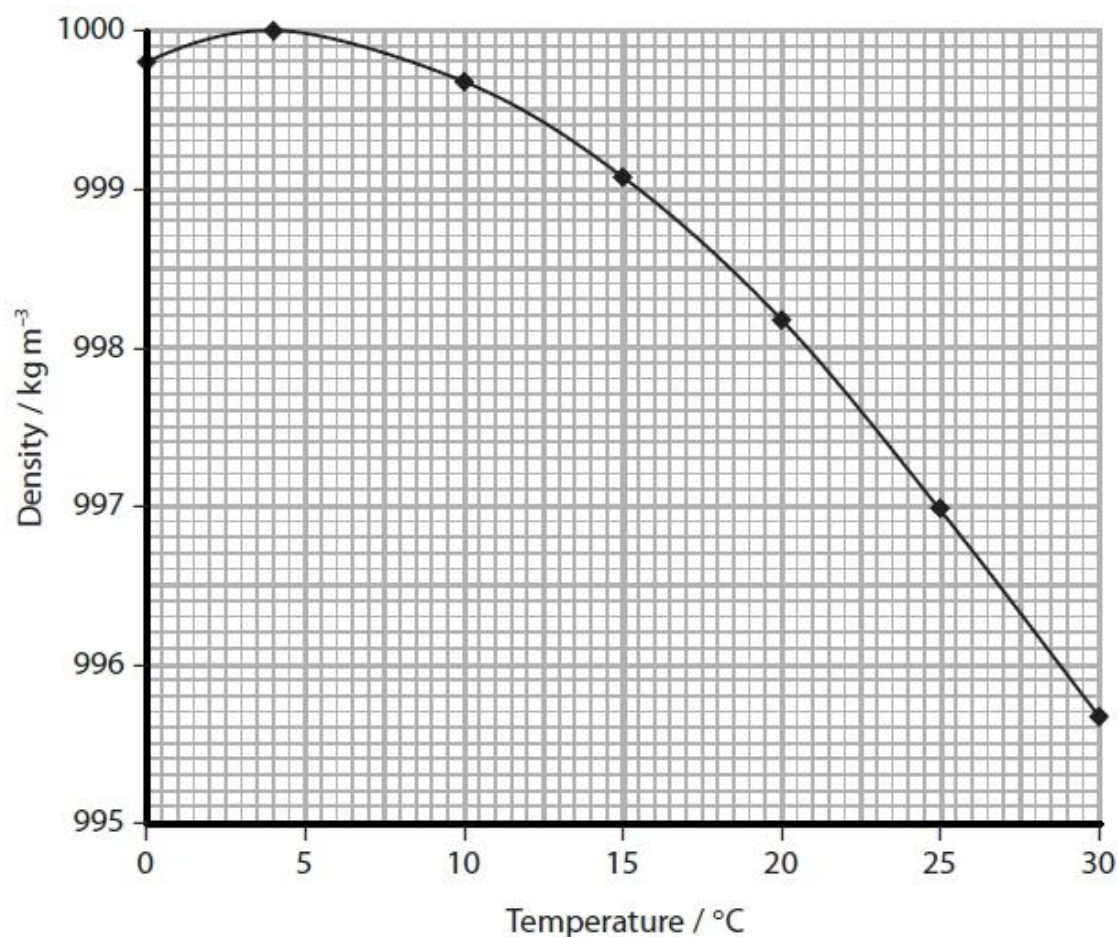
Answer ..... %

15.

The cells of all living organisms contain over 60% water. The physical properties of water have significant effects on the cells of living organisms.

A student investigated the effect of temperature on the density of water.

The graph shows the results of her investigation.



(i) Calculate the percentage change in density of water as temperature falls from 4°C to 0°C.

(2)

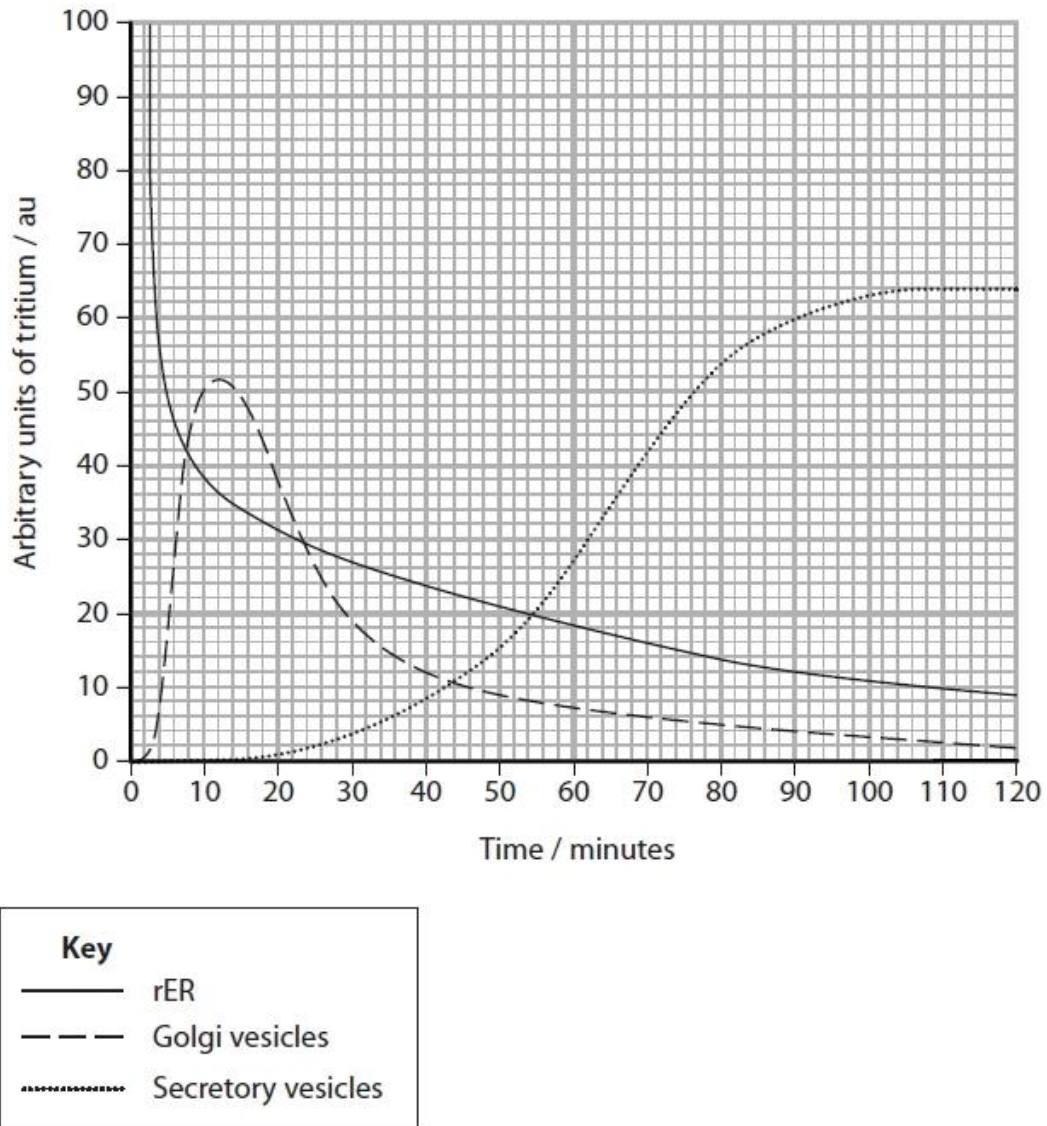
Answer ..... %

16

The pancreas is an organ in mammals that secretes enzymes and hormones.

In an experiment, cells of the pancreas were provided with amino acids labelled with a radioactive element called tritium.

The graph below shows the distribution of tritium within different organelles in the cells over a period of 120 minutes.



(i) Calculate the rate at which tritium moved out of the Golgi apparatus between 12 and 25 minutes.

(2)

Answer .....

17

Cancer cells undergo uncontrolled mitosis.

- (i) Which of the following shows the correct number of cancerous cells there would be after a single cell carries out six mitotic cell divisions?

(1)

- ☐ A  $2^6$   
☐ B  $6^2$   
☐ C  $2^3$   
☐ D  $3^2$

18

After fertilisation, cell division occurs to form a blastocyst.

Give the number of cell divisions that produce a blastocyst with 256 cells.

(1)

- ☐ A 6  
☐ B 7  
☐ C 8  
☐ D 9

19

A study in 2015 showed that some tissues are far more likely to develop cancer than other tissues.

- (i) Some tissue types divide more quickly than others.

This study suggested that there was a positive correlation of 0.81 between the chance of developing cancer and the rate of cell division in normal cells.

Describe what is meant by this positive correlation of 0.81.

(2)

.....  
.....  
.....  
.....

20.

Part of a DNA molecule contained 250 bases of which 22% of these bases were guanine.

- (i) Determine the number of each of the bases present.

(4)

Answer .....

21

In a drug trial, people with a heart condition were given one of three drug treatments. The table shows the recorded improvement in their condition for each of the three treatments.

| Treatment | Concentration of drug<br>/ mg | Recorded improvement<br>/ arbitrary units |
|-----------|-------------------------------|-------------------------------------------|
| 1         | 0                             | 18.8                                      |
| 2         | 400                           | 24.8                                      |
| 3         | 600                           | 30.9                                      |

It was concluded that the drug treatment improved the condition of the patients.

Analyse the data to comment on this conclusion.

(3)

.....

.....

.....

.....

(Total for question = 3 marks)

22.

LDL cholesterol found in plasma binds to receptor proteins and is taken into cells by endocytosis.

Familial hypercholesterolaemia (FH) is an inherited condition which affects the structure of the receptor protein.

In women with FH, 30% will develop coronary heart disease if untreated.

In men with FH, 50% will develop coronary heart disease if untreated.

Calculate the number of women who will develop coronary heart disease, as a consequence of FH, in a population of 60 million, with equal numbers of men and women.

(2)

Answer .....

(Total for question = 2 marks)

Some snakes bite their prey and inject venom. The venom is sometimes lethal.

In an investigation, scientists estimated the toxicity of venom from different species of snake. They did this by measuring the dose that can kill 50% of mice after injection with the venom.

This dose is called the  $LD_{50}$ .

Two scientists, P and Q, investigated the  $LD_{50}$  values for the venom produced by each snake.

Their results are shown in the table.

| Scientist | Species of snake             | $LD_{50}$                           |
|-----------|------------------------------|-------------------------------------|
| P         | <i>Ophiophagus hannah</i>    | $0.125 \text{ mg kg}^{-1}$          |
|           | <i>Oxyuranus scutellatus</i> | $0.013 \text{ mg kg}^{-1}$          |
| Q         | <i>Crotalus scutulatus</i>   | $30.0 \text{ } \mu\text{g kg}^{-1}$ |
|           | <i>Daboia russelii</i>       | $80.0 \text{ } \mu\text{g kg}^{-1}$ |

Scientist P measured the toxicity in  $\text{mg kg}^{-1}$  and scientist Q measured the toxicity in  $\mu\text{g kg}^{-1}$ .

(i) Name the species with the most toxic venom.

(1)

.....

(ii) The venom of one species of snake can kill a human by activating a substance called factor X. This causes prothrombin in the plasma to change to its active form.

Explain why this venom can be lethal.

(4)

.....

.....

.....

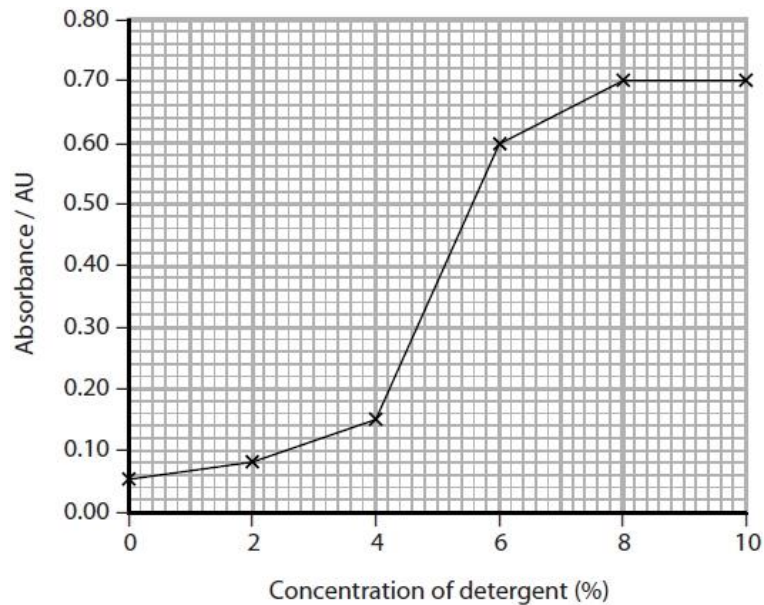
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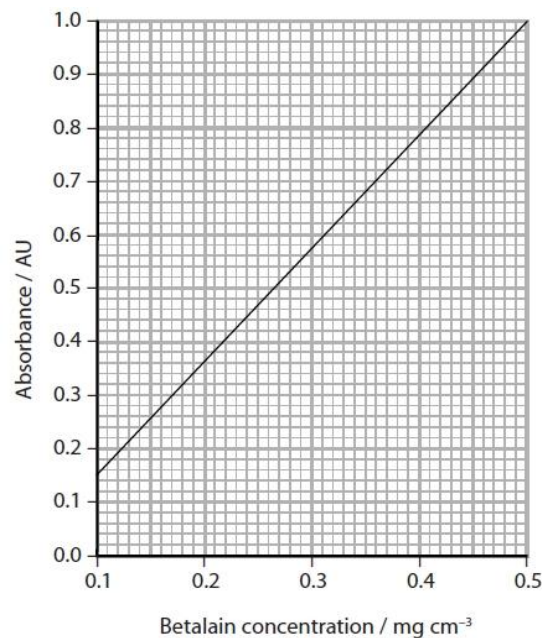
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.....

The cell vacuoles of beetroot, *Beta vulgaris*, contain the red pigment betalain.  
 A student investigated the effect of detergent on the permeability of beetroot cell membranes.  
 A cube of beetroot was placed in water for 20 minutes.  
 After 20 minutes the beetroot cube was removed and the intensity of the colour of the water was measured using a colorimeter.  
 The same procedure was carried out for other cubes of beetroot using detergent concentrations of 2%, 4%, 6%, 8% and 10%.  
 The results are shown in the graph.



The student prepared a standard curve to convert absorbance units into concentrations.

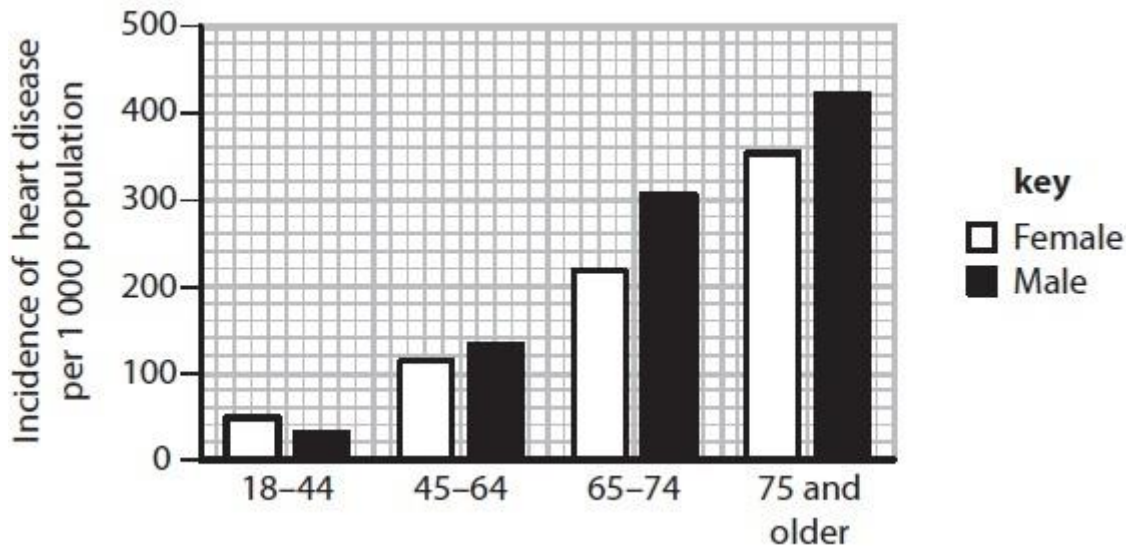


Use the graphs to predict the concentration of betalain if 5% detergent solution was used.

(2)

Answer .....  $\text{mg cm}^{-3}$

25. The graph below shows the results of a survey in America, on the incidence of heart disease in adults aged 18 and older.



(ii) Calculate the increased risk that a man who is 75 or older has of developing heart disease, compared to a man aged between 18 and 44 years old.

(2)

Answer

.....

26. On a farm in Wales, an investigation was carried out to assess the effect of diet on the milk yield and methane production of cows.

A herd of cows was divided into two groups, A and B. The cows in group A were fed a traditional diet and those in group B were fed the same diet with a mixture of chopped hay and straw added.

The table below shows the results of this investigation.

| Group | Diet                                         | Mean milk yield per cow / dm <sup>3</sup> day <sup>-1</sup> | Methane emission for each dm <sup>3</sup> milk produced / dm <sup>3</sup> |
|-------|----------------------------------------------|-------------------------------------------------------------|---------------------------------------------------------------------------|
| A     | Traditional with no added material           | 24.0                                                        | 30.0                                                                      |
| B     | Traditional with added chopped hay and straw | 27.6                                                        | 24.0                                                                      |

(i) Using the information in the table, calculate the rate of methane production per cow on each of the two diets.

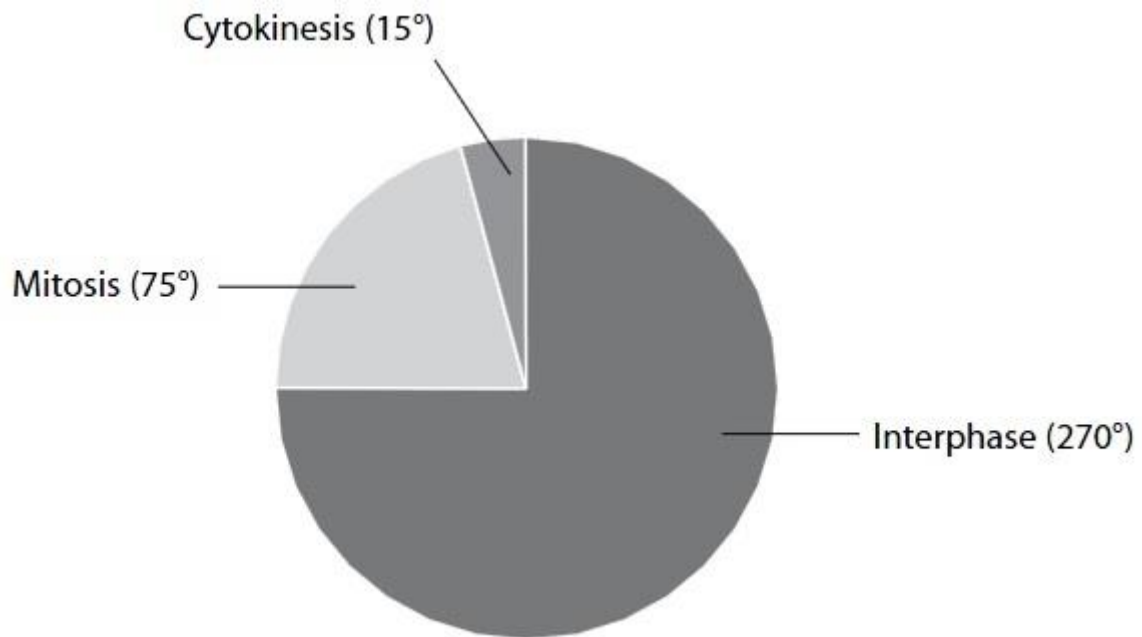
(2)

Group A = .....

Group B = .....

27 In onion cells, interphase lasts an average of 18 hours. Using this information and the diagram below, calculate how long mitosis takes. The figures in brackets show the number of degrees for each sector of the circle. Show your working.

(2)



Answer ..... hours

28 Obesity is a significant problem in western countries and an increasing problem in other parts of the world. An obese person has a greater risk of developing heart disease. Body Mass Index (BMI) is one measure used to help decide if a person's weight is reasonable for their height. The BMI can be calculated by dividing mass in kilograms by height in metres squared. A table is then used to judge if the BMI is reasonable or not. A copy of this table is shown below.

| BMI range   | Less than 18.5 | 18.5 to 24.9   | 25.0 to 29.9 | 30.0 to 39.9 | 40.0 or above  |
|-------------|----------------|----------------|--------------|--------------|----------------|
| Description | Underweight    | Healthy weight | Overweight   | Obese        | Morbidly obese |

(a) A man was concerned that he was overweight and could be at risk from coronary heart disease. He was 1.8 m tall and had a mass of 83.0 kg.

(i) Calculate this man's body mass index (BMI) using the formula below.

$$\text{BMI} = \frac{\text{mass in kilogrammes}}{(\text{height in metres})^2}$$

(2)

Answer .....

\_\_\_\_\_

## Mark Scheme

1.

| Question Number | Acceptable Answer | Additional guidance | Mark |
|-----------------|-------------------|---------------------|------|
| (a)(i)          | C                 |                     | (1)  |

| Question Number | Acceptable Answer | Additional guidance | Mark |
|-----------------|-------------------|---------------------|------|
| (a)(ii)         | C                 |                     | (1)  |

| Question Number | Acceptable Answer                              | Additional guidance                                                                                     | Mark |
|-----------------|------------------------------------------------|---------------------------------------------------------------------------------------------------------|------|
| (a)(iii)        | one cycle = 0.72 s (1)<br>60 ÷ 0.72 = 83.3 (1) | Allow ± 0.02 s for the duration of the cycle<br><br>Allow full marks for the correct answer, no working | (2)  |

2.

| Question Number | Acceptable Answer                                                                                              | Additional Guidance                                                                                                      | Mark |
|-----------------|----------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|------|
|                 | <ul style="list-style-type: none"> <li>correct numerical calculation (1)</li> <li>correct units (1)</li> </ul> | <u>Example of Calculation:</u><br>$22 \div 120 = 0.183$<br><br>beats per minute per minute / beats minutes <sup>-2</sup> | (2)  |

3.

| Question Number | Acceptable Answer                                                                                                          | Additional Guidance                                                                                                                                                                                                                                            | Mark       |
|-----------------|----------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| <b>(i)</b>      | <ul style="list-style-type: none"> <li>two correctly identified times (1)</li> <li>correct answer 85.6 / 86 (1)</li> </ul> | <u>Example of calculation</u><br>$1.14 - 0.44 = 0.70 \text{ s}$<br>$60 \div 0.70 = 85.6 = 86 \text{ beats min}^{-1}$<br>Allow +/- 0.02 for cycle length<br>Allow correct numerical value with no units<br>Allow full marks for correct answer with no workings | <b>(2)</b> |

| Question Number | Acceptable Answer                                                                                                                                                                                         | Additional Guidance                                                                                                                                                                                                             | Mark       |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| <b>(ii)</b>     | <ul style="list-style-type: none"> <li>correct calculation of volume of blood per contraction (1)</li> <li>correct multiplication of volume by heart rate (1)</li> <li>correct answer 6.54 (1)</li> </ul> | <u>Example of calculation</u><br>$124 - 48 = 76 \text{ cm}^3$<br>$86 \times 76 = 6536 \text{ cm}^3$<br>$= 6.54$<br>Allow +/-4 for volume of blood expelled<br>Allow ECF<br>Allow full marks for correct answer with no workings | <b>(3)</b> |

4.

| Question Number | Answer                                                                                                                     | Additional Guidance | Mark       |
|-----------------|----------------------------------------------------------------------------------------------------------------------------|---------------------|------------|
| <b>(a)(i)</b>   | C (the time taken for the pressure to change from its lowest value to its highest value is greatest in the left ventricle) |                     | <b>(1)</b> |

| Question Number | Answer            | Additional Guidance | Mark       |
|-----------------|-------------------|---------------------|------------|
| <b>(a)(ii)</b>  | C (open – closed) |                     | <b>(1)</b> |

| Question Number | Acceptable Answer                                                                                               | Additional Guidance                                                                                                                               | Mark       |
|-----------------|-----------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| <b>(a)(iii)</b> | <ul style="list-style-type: none"> <li>calculation of one cycle (1)</li> <li>calculation of rate (1)</li> </ul> | <u>Example of calculation</u><br>0.72 s<br>$60 \div 0.72 = 83.3$<br>Allow 83 as correct answer<br>Correct answer with no working gains full marks | <b>(2)</b> |

5.

| Question Number | Acceptable Answer                                                                                                                        | Additional guidance                                                                       | Mark       |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|------------|
| <b>(i)</b>      | $8.5 \times 8.5 = 72.25$<br>$72.25 \times \pi = 226.98 \text{ (mm}^2\text{)} (1)$<br>$226.98 - 72.22 = 154.76 \text{ (mm}^2\text{)} (1)$ | Allow rounded values of $\pi$ (e.g. 3.142)<br>Correct answer gains full marks, no working | <b>(2)</b> |

6.

| Question Number | Acceptable Answer                                                                                                                          | Additional Guidance                                                                                                               | Mark       |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|------------|
|                 | <ul style="list-style-type: none"> <li>conversion of micrometres to millimetres (1)</li> <li>calculation of how much larger (1)</li> </ul> | <u>Example of calculation</u><br>$1\ \mu\text{m} = 0.001\ \text{mm}$<br>$5\ \mu\text{m} = 0.005\ \text{mm}$<br>$0.1 / 0.005 = 20$ | <b>(2)</b> |

7.

| Question Number | Acceptable Answer                                                                                           | Additional Guidance                                                                                                                                                      | Mark       |
|-----------------|-------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| <b>(iv)</b>     | <ul style="list-style-type: none"> <li>measures width on diagram (1)</li> <li>correct answer (1)</li> </ul> | <u>Example of calculation</u><br>$(500 \times \text{width of K}) \div \text{length of bar}$<br>$= 940\ \text{nm}$<br>Allow full marks for correct answer with no working | <b>(2)</b> |

8.

| Question Number | Acceptable Answer                                                                                                                                                                                                                          | Additional guidance                                                                                                                                                   | Mark       |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| <b>(a)(i)</b>   | <ul style="list-style-type: none"> <li>length of cell = 20 (mm) (1)</li> <li>conversion into <math>\mu\text{m}</math> = <math>20000 \div 23.5</math> (1)</li> <li>magnification = 851 (1)</li> <li>[ecf applies for mp 2 and 3]</li> </ul> | Accept $\pm 1\ \text{mm}$<br>Accept other appropriate calculation, e.g. measure in cm or converting 23.5 $\mu\text{m}$ to mm or cm<br>Correct answer gains full marks | <b>(3)</b> |

9

| Answer                                                                                                                                                    | Additional Guidance            | Mark       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|------------|
| 1. (image length) 76 / 76.5 / 77 (mm) / eq ;<br>2. image length / 0.007 ;<br>3. (76) 10857.14286 / eq ;<br>(76.5) 10928.57143 / eq ;<br>(77) 11000 / eq ; | 2. CE applies<br>3. CE applies | <b>(3)</b> |

**Q10**

| Question Number | Acceptable Answer                                                                   | Additional guidance      | Mark       |
|-----------------|-------------------------------------------------------------------------------------|--------------------------|------------|
| <b>(a)</b>      | Measurement in 5.5 cm / 55 mm correct (1)<br><br>$55 \div 60 = 0.92 \text{ mm}$ (1) | need to measure on paper | <b>(2)</b> |

| Question Number | Acceptable Answer                                                  | Additional guidance | Mark       |
|-----------------|--------------------------------------------------------------------|---------------------|------------|
| <b>(b)(ii)</b>  | Calculation of mean = 55 (1)<br>Answer = $55 \div 20.2 = 2.72$ (1) |                     | <b>(2)</b> |

**11.**

| Question Number | Answer               | Additional Guidance | Mark       |
|-----------------|----------------------|---------------------|------------|
| <b>(ii)</b>     | B (4 $\mu\text{m}$ ) |                     | <b>(1)</b> |

12

| Question Number | Answer       | Mark |
|-----------------|--------------|------|
| (c)(i)          | 0.065 (%) ;; | (2)  |

| Question Number | Answer | Mark |
|-----------------|--------|------|
| (c)(ii)         | 16 ;   | (1)  |

Q13.

| Question Number | Acceptable Answer                                                                                                   | Additional Guidance                                                                                    | Mark |
|-----------------|---------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|------|
|                 | <ul style="list-style-type: none"> <li>values identified as 22 and 13 (1)</li> <li>correct answer 41 (1)</li> </ul> | $22 - 13 = 9$<br>$(9 \div 22) \times 100 = 41$<br>Allow full marks for correct answer with no workings | (2)  |

14.

| Question Number | Acceptable Answer                                                                                                                         | Additional Guidance                                                             | Mark |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|------|
| (i)             | <ul style="list-style-type: none"> <li>select correct points from graph (1)</li> <li>calculate correct percentage decrease (1)</li> </ul> | <u>Example of calculation</u><br>$(74-56) \div 74$<br>24% / 24.32% / 24.3% less | (2)  |

15.

| Question Number | Acceptable Answer                                                                                                                                      | Additional Guidance                                                                                                                                                        | Mark       |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| <b>(i)</b>      | <ul style="list-style-type: none"> <li>• difference in density between 4°C and 0°C (1)</li> <li>• calculate percentage change from 1000 (1)</li> </ul> | <u>Example of calculation</u><br>Decrease from 4°C to 0°C<br>$= 0.2 \text{ kg / m}^{-3}$<br>$0.2 / 1000 = 0.02\%$<br>Correct answer gains full marks with no working shown | <b>(2)</b> |

16

| Question Number | Acceptable Answer                                                                                                                                                            | Additional Guidance                                                                       | Mark       |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|------------|
| <b>(i)</b>      | <ul style="list-style-type: none"> <li>• correct readings from x axis (1)</li> <li>• correct answer using appropriate units (<math>\text{au min}^{-1}</math>) (1)</li> </ul> | <u>Example of calculation</u><br>$52 - 25 = 27$<br>$27 \div 13 = 2.1 \text{ au min}^{-1}$ | <b>(2)</b> |

17

| Question Number | Acceptable Answer | Additional guidance | Mark       |
|-----------------|-------------------|---------------------|------------|
| <b>(i)</b>      | A                 | $2^6$               | <b>(1)</b> |

18.

| Question Number | Answer | Additional Guidance | Mark       |
|-----------------|--------|---------------------|------------|
|                 | C (8)  |                     | <b>(1)</b> |

19

| Question Number | Acceptable Answer                                                                                                                                                                                                                                 | Additional Guidance | Mark       |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------------|
| <b>(i)</b>      | <p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> <li>0.81 is a strong / high / good correlation (1)</li> <li>the higher the rate of cell division, the greater the chance of cancer (1)</li> </ul> |                     | <b>(2)</b> |

20

| Question Number | Acceptable Answer                                                                                                                                                                                                                                                                                                                                                                                                                                         | Additional guidance                                                          | Mark       |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|------------|
| <b>(i)</b>      | <p>An answer that makes reference to the following:</p> <ul style="list-style-type: none"> <li><math>(22 \div 100) \times 250 = 55</math> guanine (1)</li> <li>Since guanine pairs with cytosine, 55 bases are cytosine (1)</li> <li>Therefore 110 bases are guanine plus cytosine, the rest must be adenine plus thymine = 140 (1)</li> <li>Since adenine pairs with thymine the number of adenine/thymine = <math>140 \div 2 = 70</math> (1)</li> </ul> | <p>All bases named gains 1 mark:<br/>guanine, cytosine, adenine, thymine</p> | <b>(4)</b> |

21

| Question Number | Acceptable Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Additional guidance | Mark       |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------------|
|                 | <p>An answer that makes reference to the following:</p> <ul style="list-style-type: none"> <li>the drug did improve the condition of the patients more than the placebo but it was only 6 au with a concentration of 400 mg so not much of an improvement (1)</li> <li>increasing the dosage by a further 200 mg doubled the improvement over the placebo (1)</li> </ul> <p>Plus one from:</p> <ul style="list-style-type: none"> <li>therefore to be effective higher doses of the drug would be required (1)</li> <li>statistical tests would be required in order to comment further (1)</li> </ul> |                     | <b>(3)</b> |

22

| Question Number | Acceptable Answer                                                                                                                              | Additional guidance                             | Mark |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|------|
|                 | $60\,000\,000 \div 500$<br>$= 120\,000$ (1)<br><br>$120\,000 \div 2 = 60\,000$ women in population<br>$30\% \text{ of } 60\,000 = 18\,000$ (1) | Allow full marks for correct answer, no working | (2)  |

23

| Question Number | Acceptable Answer            | Additional Guidance | Mark |
|-----------------|------------------------------|---------------------|------|
| (i)             | <i>Oxyuranus scutellatus</i> |                     | (1)  |

| Question Number | Acceptable Answer                                                                                                                                                                                                                                                                                                                                     | Additional Guidance | Mark |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------|
| (ii)            | <p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> <li>• blood clotting will occur (1)</li> <li>• because prothrombin changes to thrombin (1)</li> <li>• which catalyses fibrinogen to fibrin (1)</li> <li>• this blocks blood vessels preventing supply of { oxygen / glucose } to cells (1)</li> </ul> |                     | (4)  |

24

| Question Number | Acceptable Answer                                                                                                                   | Additional Guidance                                                                            | Mark |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|------|
|                 | <ul style="list-style-type: none"> <li>• correct absorbance reading (1)</li> <li>• correct concentration of betalain (1)</li> </ul> | $0.36 - 0.38$<br><br>$0.20 - 0.21$<br><br>Allow full marks for correct answer with no workings | (2)  |

25

| Question Number | Answer                                                               | Mark       |
|-----------------|----------------------------------------------------------------------|------------|
| <b>(c)(ii)</b>  | 1. $\{420 / 425\} - \{30 / 35\} / 390 / 385 / 395$ ;<br>2. 11 - 13 ; | <b>(2)</b> |

26

| Question Number | Answer                                                                                                                                      | Mark       |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------|------------|
| <b>(c)(i)</b>   | 1. group A = 720 and group B = $\{662 / 662.4\}$ ;<br>2. units correct = $\{\text{dm}^3 \text{ day}^{-1} / \text{dm}^3 \text{ per day}\}$ ; | <b>(2)</b> |

27

| Question Number | Answer                                                          | Mark       |
|-----------------|-----------------------------------------------------------------|------------|
| <b>(b)(iii)</b> | 1. $(75 \div 270) \times 18$ ;<br>2. answer correct 5 (hours) ; | <b>(2)</b> |

28

| Question Number | Answer                                                                                               | Mark       |
|-----------------|------------------------------------------------------------------------------------------------------|------------|
| <b>(a)(i)</b>   | correct substitution ( e.g. $83 / 1.8 \times 1.8$ ) ;<br>answer = 25.6 ;<br>correct answer = 2 marks | <b>(2)</b> |