

Q1. (2018)

1 Look at some of the stages in mitosis.

- 1 The nuclear membrane forms.
- 2 The nuclear membrane breaks down.
- 3 Chromosomes separate.
- 4 Chromosomes line up on the equator.

What is the correct order of these stages during mitosis?

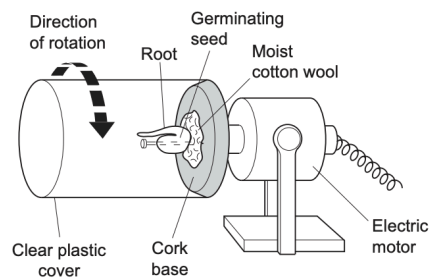
- A 1 → 3 → 2 → 4
- B 1 → 4 → 3 → 2
- C 2 → 4 → 3 → 1
- D 3 → 2 → 4 → 1

Your answer

[1]

Q2. (2018)

2 The diagram shows apparatus used in experiments on tropisms.



When the apparatus rotates, the root grows horizontally.

Which tropism is **not** showing its usual effect on the root?

- A Negative gravitropism
- B Positive gravitropism
- C Negative phototropism
- D Positive phototropism

Your answer

[1]

Q3. (2018)

- 3 During protein synthesis the DNA that codes for a particular protein is copied. This copy is called mRNA.

The diagram below shows the base sequence for a section of DNA.

G G T G C A T A T

What would be the complementary sequence of mRNA for this section of DNA?

- A C C A C G T A T A**
B C C A C G U A U A
C G G T G C A T A T
D G G U G C A U A U

Your answer ☐

[1]

Q4. (2018)

- 6 Which of these structures is found in eukaryotic but **not** prokaryotic cells?

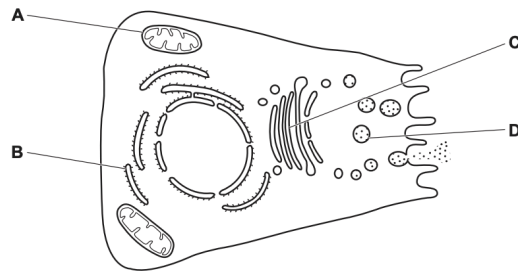
- A Cell wall**
B Cytoplasm
C Nucleus
D Plasmid

Your answer ☐

[1]

Q5. (2018)

- 7 This is a cell.



Where does cellular respiration occur?

Your answer ☐

[1]

Q6. (2018)

- 12 The surface area of a single red blood cell is $1.5 \times 10^{-4} \text{ mm}^2$.

The volume is $1 \times 10^{-7} \text{ mm}^3$.

What is the surface area to volume ratio of a red blood cell?

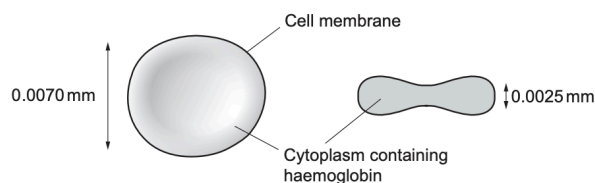
- A 0.0015 : 1**
B 0.7 : 1
C 1.5 : 1
D 1500 : 1

Your answer ☐

[1]

Q7. (2018)

13 The diagram shows a red blood cell.



	Distance oxygen travels to get to haemoglobin from blood plasma	Surface area to volume ratio	Nucleus present
A	Large	Small	Yes
B	Short	Large	Yes
C	Short	Large	No
D	Large	Large	No

Which row in the table shows how red blood cells are adapted for transport of oxygen?

Your answer

[1]

Q8. (2018)

14 Which is a function of carrier proteins in a cell membrane?

- A Transfer impulses across a synapse
- B Transfer molecules by active transport
- C Transport amino acids in protein synthesis
- D Transport molecules around the blood

Your answer

[1]

Q9. (2018)

16 Students investigate how to extract DNA from peas.

Stage 1:

- Chill 10 cm³ of ethanol. Keep it on ice throughout the method for use in stage 2.
- Make a thick 'soup' by blending 100 cm³ of peas with salt and cold water. Blend for 15 seconds in an electric blender.
- Strain the 'soup' through a mesh strainer and collect the liquid part in a beaker.
- Add 30 cm³ of washing-up liquid and swirl to mix.
- Let the mixture settle for 5–10 minutes in a water bath at 60 °C.

A)

- (a) One group of students made a water bath using a beaker of water, thermometer and Bunsen burner. Another group used an electric water bath.

Write down **two** advantages of using an electric water bath.

1

.....

2.....

.....

[2]

B)

- (b) Low temperatures protect DNA by slowing down the activity of enzymes that destroy DNA. High temperatures break down membranes in the cell.

To extract DNA, some methods use a water bath at 60°C but other methods do not use an increased temperature.

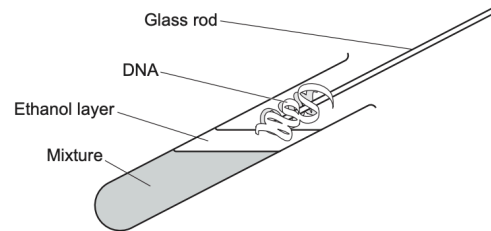
Suggest **two** reasons for the different methods.

.....

 [2]

C)

Stage 2 isolates the DNA.



- Pour the mixture collected from stage 1 into a test tube until a third full. Add protease enzymes to the test tube.
- Slowly pour cold ethanol at an angle of 45° into the tube. Ethanol will float on top.
- DNA is soluble in water, but salted DNA does not dissolve in ethanol and will form white clumps where the water and ethanol layers meet.
- Twirl a glass rod and the DNA will collect on the rod.
- Dry the sample on a pre-weighed filter paper and measure the mass of product.

- (c) Suggest **two** safety precautions which should be taken at stage 2.

Explain why each safety precaution is needed.

1 Safety precaution:

Explanation:

2 Safety precaution:

Explanation: [2]

D)

- (d) Look at the table. It shows the results from the two groups of students in the investigation.

Type of water bath used	Mass of DNA collected (mg)			
	Test 1	Test 2	Test 3	Mean
Beaker of water and Bunsen burner				22.9
Electric	33.6	32.3	33.3	

- (i) Calculate the mean mass collected in the investigation using the electric water bath.

Give your answer to **1** decimal place.

Answer = mg [2]

E)

- (ii) The range of the three test readings for the beaker of water and Bunsen burner was 3.4.

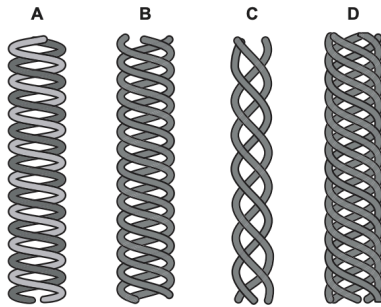
Does the evidence support using an electric water bath instead of a beaker of water and Bunsen burner?

Explain your answer.

.....
.....
..... [2]

Q10. (2019)

- 3 Which structure most closely resembles DNA?

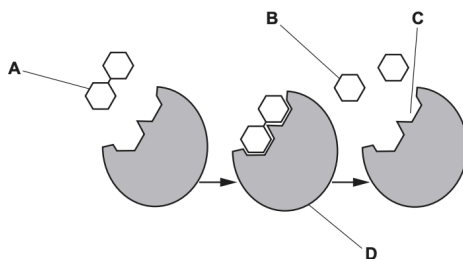


Your answer

[1]

Q11. (2019)

- 4 Look at the model of enzyme activity.



Which label represents the active site of an enzyme?

Your answer

[1]

Q12. (2019)

- 5 Which biological molecule is **not** a polymer?

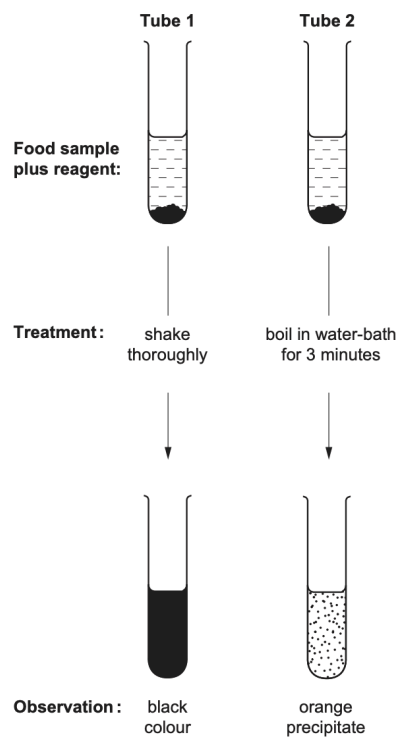
- A Amylase
- B DNA
- C Nucleotide
- D Starch

Your answer

[1]

Q13. (2019)

- 8 The diagram shows positive results in two different food tests.



What do the results show in each tube?

	Tube 1	Tube 2
A	sugar	lipid
B	starch	sugar
C	protein	sugar
D	starch	protein

Your answer

[1]

Q14. (2019)

- 11 A cell structure measures 1 micrometre in diameter.

What is the diameter of the cell structure in metres?

- A 1×10^{-3} metres
- B 1×10^{-6} metres
- C 1×10^{-9} metres
- D 1×10^{-12} metres

Your answer

[1]

Q15. (2019)

- 12 A human cell has 10 000 mitochondria and a yeast cell has 10.

By how many orders of magnitude are there more mitochondria in a human cell than in a yeast cell?

- A 2
B 3
C 10
D 1000

Your answer

[1]

Q16. (2019)

A)

- 17 Yeast cells can respire anaerobically.

(a) Complete the word equation for **anaerobic** respiration in yeast.

glucose $\longrightarrow$ + [1]

B)

(b) Write down **two** ways in which anaerobic respiration in yeast cells is different from anaerobic respiration in human muscle cells.

1

.....

2

..... [2]

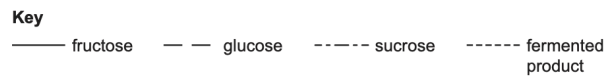
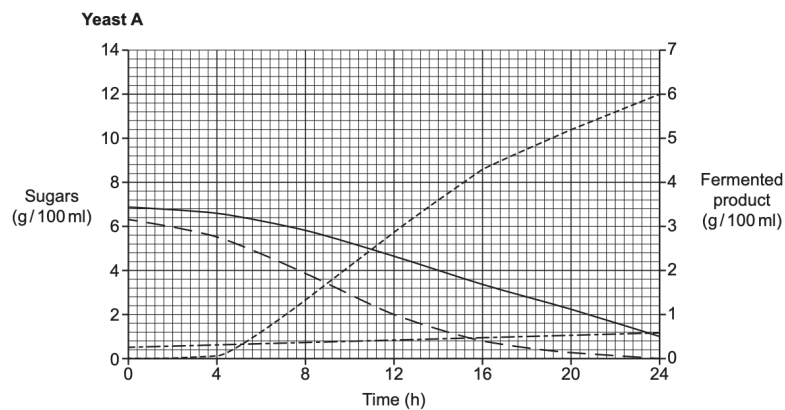
C)

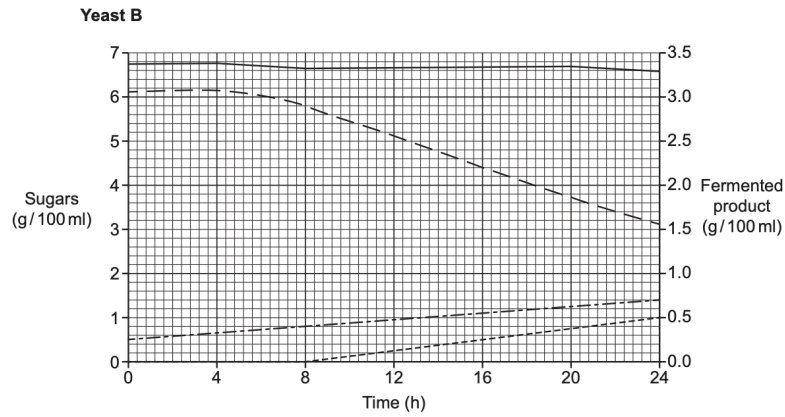
(c) Date fruits contain three different sugars, fructose, glucose and sucrose.

Different strains of yeast can ferment different sugars to produce a fermented product.

Scientists investigate how two different strains of yeast, **A** and **B**, ferment sugars inside date fruits.

Look at their results.





- (i) Which sugar is **not** fermented by either strain of yeast?

Tick (✓) **one** box.

Fructose	☐
Glucose	☐
Sucrose	☐

[1]

D)

- (ii) After 24 hours, how many times higher is the fermented product yield of yeast **A** compared to yeast **B**?

Number of times higher = [2]

E)

- (iii) Which sugar would increase fermentation the **most** if added to either yeast **A** or yeast **B**?

Tick (✓) **one** box.

Fructose	☐
Glucose	☐
Sucrose	☐

[1]

F)

- (iv) Fermented dates are used to supply both fructose and fermented product.

Explain why it would be best to use yeast **B** to ferment dates to supply both fructose and fermented product.

.....

.....

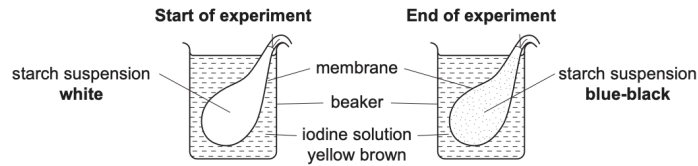
.....

..... [2]

Q17. (2019)

- 18 (a) An experiment is set up to investigate how substances move into and out of cells.

Look at the results.



Explain the results of this experiment.
Use ideas about molecules in your answer.

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.....

..... [3]

Q18. (2019)

- 20 A scientist clones a cauliflower plant.



He uses small pieces of the cauliflower plant called explants.

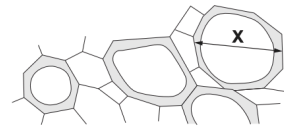
This is the method the scientist uses to get the explants:

- Place the equipment in a beaker of bleach and swab the bench with 70% alcohol.
- Collect a small piece of cauliflower and place on a white tile.
- Using a scalpel cut the piece of cauliflower lengthways into small 3–5mm pieces called explants.
- Measure the mass of the explants.

A)

- (c) The scientist observes some of the tissues of the growing explants using a light microscope.

The diagram shows some of the plant cells.



The diameter of X has been magnified 500 $\times$.

What is the actual diameter of X?

Give your answer in **standard form**.

Diameter = mm [2]

B)

- (d) Transmission **electron** microscopes (TEM) work by passing a beam of electrons through a very thin slice of an object.

Suggest **one** advantage and **one** disadvantage of using TEM rather than a light microscope to look at cells.

advantage

.....

disadvantage

..... [2]

Q19. (2019)

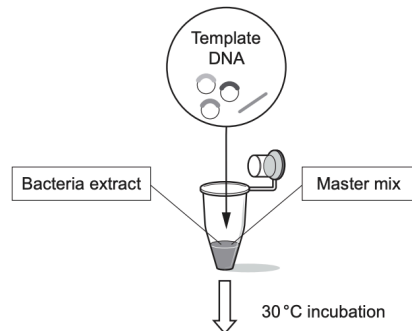
- 22 Scientists can make the proteins they need outside of living cells (*in vitro*).

To do this they use cell free protein synthesis kits.

The kit includes three different parts:

- A template DNA molecule
- An extract from bacteria containing mRNA and tRNA nucleotides
- A master mix containing amino acids, energy sources, enzymes and ribosomes.

To make a protein the three different parts are mixed together and incubated for 3 hours at 30 °C.



A)

- (a) (i) Describe the role of the DNA template and mRNA nucleotides in the production of the protein.

.....

.....

.....

..... [2]

B)

- (ii) Describe the role of the tRNA nucleotides and ribosomes in the production of the protein.

.....

.....

.....

..... [2]

Q20. (2020)

- 4 A student models the process of mitosis using cookies and sprinkles.



Mitosis is part of the cell cycle.

Which process in the cell cycle has the student modelled?

- A Cell division
- B Chromosome movement
- C DNA replication
- D Growth of cell

Your answer

[1]

Q21. (2020)

- 8 In a sample of DNA, 23% of the bases are cytosine.

What percentage of the bases are adenine?

- A 23%
- B 27%
- C 46%
- D 54%

Your answer

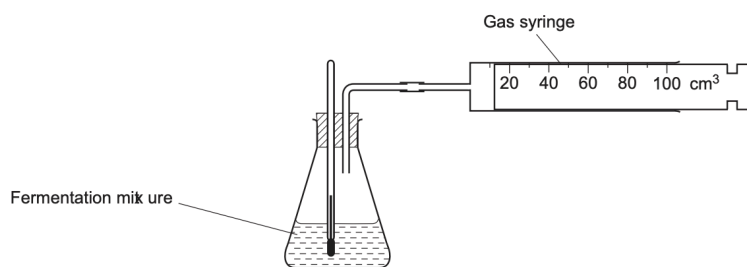
[1]

Q22. (2020)

- 18 Fermentation involves enzymes that break down sugar releasing carbon dioxide gas.

The volume of carbon dioxide released can be used to measure how fast these enzymes are working.

A student investigates if fermentation works faster at 25 °C or 30 °C.
She measures the volume of carbon dioxide released in 10 minutes.
The diagram shows the apparatus she uses.



A)

- (a) The student could have measured the volume of carbon dioxide by collecting the gas over water in a measuring cylinder.

Why is it better to use a gas syringe?

..... [1]

(b) The student's results are shown in the table.

Temperature (°C)	Volume of carbon dioxide gas (cm ³) released in 10 minutes		
	Trial 1	Trial 2	Trial 3
25	23	25	22
30	34	27	33

Give your answer to 1 decimal place.

C)

Use ideas about enzymes to explain why.

[3]

Suggest how phenols inhibit enzymes.

[2]

A)

Use terms from the list in your answer.

amino acids	DNA	mRNA	transcription
translation	ribosome		

[4]

B)

(b) ADH is a protein hormone made up of amino acids.

(i) Complete the sentences to explain the link between amino acids and proteins.

Large molecules, like proteins, made of smaller molecules are called

The smaller molecules, or amino acids, are called

[2]

Q24. (2021)

5 Which statement describes why iodine solution is added to onion epidermis cells before viewing under a microscope?

A To colour any protein in the cell.

B To kill the cells.

C To prevent osmosis.

D To stain starch.

Your answer

☐

[1]

Q25. (2021)

7 Which statement describes DNA?

A A monomer of one strand that forms a single helix.

B A monomer of two strands that form a double helix.

C A polymer of two strands that form a double helix.

D A polymer of two strands that form a single helix.

Your answer

☐

[1]

Q26. (2021)

16 Polymenorrhea is a condition which affects the menstrual cycle.

Symptoms of the condition include the time between ovulation and the next period being shorter than usual.

(b) Stem cells can be obtained from embryos. Stem cells can also be extracted from menstrual blood. These two types of cells are different.

A)

(i) Embryo stem cells can be used to treat a wider range of disorders than menstrual blood stem cells.

Explain why.

.....
.....
..... [2]

B)

(ii) The time it takes for a population to double in size is called the **doubling time**. For menstrual blood stem cells, doubling time is 19.4 hours.

Starting with 1 stem cell, assuming a constant growth rate, it is possible to work out how long a population takes to grow.

Calculate the time it takes for the population to reach 16 cells.

Time to reach 16 cells = hours [2]

C)

- (iii) The doubling time for umbilical cord stem cells is 48 hours.

How many times faster is the growth of menstrual blood stem cells?

..... [1]

D)

- (iv) Discuss why scientists think menstrual blood stem cell extraction is a positive development.

.....

.....

.....

..... [2]

Q27. (2021)

A)

- 22 (a) (i) Fig. 22.1 shows the cell cycle. The letters represent different stages.

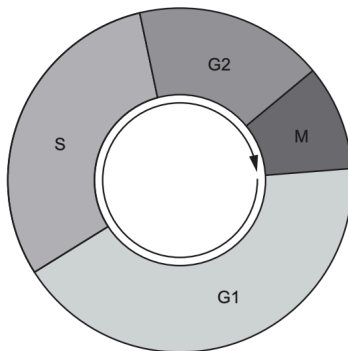


Fig. 22.1

Which processes happen during stage **S** and stage **M**?

Write your answers in the table.

Stage	Process
G1	Growth
S	
G2	Growth and preparation for cell division
M	

[2]

B)

- (ii) Cells can become specialised.

Give **one** reason why this is important for organisms.

.....

..... [1]

..... [6]

[2]

9

[1]

9

[1]

Q30. (2022)

- 12 In a sample of DNA, 37% of the bases are thymine (T).

What will be the percentage of the other bases in this sample?

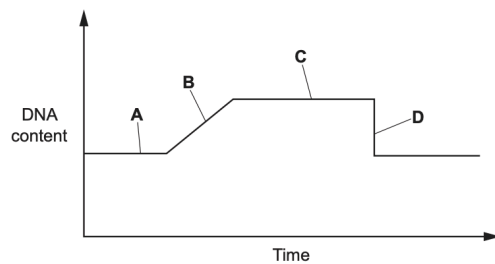
- A Adenine (A) 13%, Cytosine (C) 13%, Guanine (G) 37%
- B Adenine (A) 37%, Cytosine (C) 13%, Guanine (G) 13%
- C Adenine (A) 0%, Cytosine (C) 37%, Guanine (G) 26%
- D Adenine (A) 21%, Cytosine (C) 21%, Guanine (G) 21%

Your answer

[1]

Q31. (2022)

- 13 The graph shows how the DNA content of a cell changes during the cell cycle.



Which part of the graph A, B, C or D represents DNA replication?

Your answer

[1]

Q32. (2022)

- 14 The cell cycle consists of the following stages:

1. Cell growth
2. Movement of chromosomes
3. DNA replication

Which is the correct order of the stages in one cell cycle?

- A 1, 2, 3, 2
- B 1, 3, 1, 2
- C 2, 1, 3, 1
- D 2, 3, 1, 3

Your answer

[1]

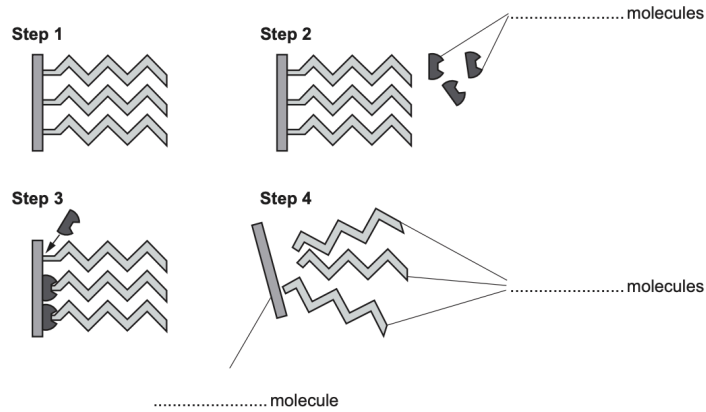
Q33. (2022)

A)

16 Lipase is an enzyme produced in the human digestive system. It breaks down lipids.

(a) Fig. 16.1 shows the steps in lipid digestion.

Fig. 16.1



(i) Complete the labels in Fig. 16.1.

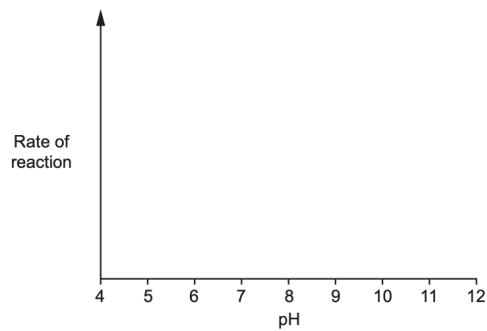
[3]

B)

(ii) Lipase is found in the small intestine where the pH is alkaline.

Draw a curve on Fig. 16.2 to show the effect the pH will have on the rate of reaction for the digestion of lipids by lipase.

Fig. 16.2



[2]

C)

- (b) Phenolphthalein is an indicator that turns pink in an alkaline solution of pH 10.

When lipase breaks down lipids, the indicator goes colourless.

A group of students investigate how temperature affects the enzymes that break down lipids found in milk.

Describe an experiment that the students could use to investigate the effect of temperature on the breakdown of the lipids found in milk.

In your description include:

- how the independent variable could be changed
- the observations that should be made
- **two** variables that need to be controlled.

To change the independent variable, I will

.....

The observations I make will be to

.....

I will need to control

.....

[5]

Q34. (2022)

A)

- 23 (a) The statements **A–E** describe parts of the process of protein synthesis. They are **not** in the correct order.

- A** A copy of DNA is formed during transcription; this is a molecule called mRNA.
B Amino acids are joined in the correct order during translation.
C DNA unzips and unwinds.
D The mRNA attaches to a ribosome in the cytoplasm.
E The mRNA leaves the nucleus.

Write **A, B, C, D** or **E** in each box to show their correct order in protein synthesis.

One letter has been done for you.

		E		
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[2]

B)

- (b) Describe how the triplet code determines the structure of a protein.

.....

 [2]

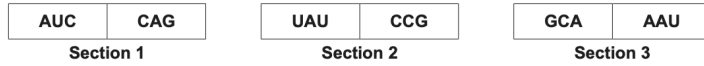
C)

- (c) Scientists used to think that one gene coded for only one protein.

They have now discovered that one gene can code for more than one protein.

The diagram below shows the order of three sections of RNA.

(In RNA the base T is replaced with the base U.)



The order of these sections in a molecule of RNA made by transcription can be changed.

- (i) Use the diagram to explain how changing the order of the sections would produce a different protein.

.....

.....

.....

..... [2]

D)

- (ii) Write down how many different proteins could be made from the three sections of RNA.

Number of proteins = [1]

E)

- (d) Compare the DNA found in eukaryotic and in prokaryotic cells.

.....

.....

.....

.....

..... [3]

24 Fig. 24.1 shows how stem cells in bone marrow differentiate into red blood cells.

Fig. 24.1



The graph illustrates the relationship between the concentration of RNA and Haemoglobin and the area of the nucleus. The y-axis represents 'Concentration (%)' from 0 to 100. The x-axis represents 'Area of nucleus (μm^2)' from 80 to 0. The RNA curve starts at 100% for 80 μm^2 and decreases to 0% at 0 μm^2 . The Haemoglobin curve is constant at 10% from 80 μm^2 to 30 μm^2 , then increases to 100% at 0 μm^2 .

Area of nucleus (μm^2)	RNA Concentration (%)	Haemoglobin Concentration (%)
80	100	10
60	80	10
40	35	10
30	20	10
20	15	15
10	5	40
0	0	100

[6]

Q36. (2023)

- 9 A cell divides by mitosis every 20 minutes.
How many cells will there be after 3 hours?

A 9
B 18
C 60
D 512

Your answer

[1]

Q37. (2023)

- 10 A drug is used to treat cancer. The drug stops the formation of microtubules that move chromosomes in cells.

Which statement explains how the drug stops more cancer cells being made?

A Chromosomes will be replicated but the chromosomes will not separate in mitosis.
B Dividing cells will not replicate their chromosomes.
C Four cells will be produced at the end of mitosis.
D New cells formed will only have half the number of chromosomes.

Your answer

[1]

Q38. (2023)

- 13 Which molecules are all polymers?

A DNA, amino acids and starch
B Fatty acids, glycerol and amino acids
C RNA, glucose and fatty acids
D Starch, protein and DNA

Your answer

[1]

Q39. (2023)

A)

- 16 (a) The contents of sub-cellular structures found in eukaryotic cells enable the structure to perform its function.

Draw lines to connect each **sub-cellular structure** to its **contents**.
Then draw lines to join each of the **contents** to its correct **function** within the cell.

Sub-cellular structure	Contents	Function
cell membrane	chlorophyll	allows communication with other cells
chloroplast	enzymes	catalyses reactions in aerobic respiration
mitochondria	receptors	needed for photosynthesis

[4]

B)

(b) The image is of a mitochondrion.



(i) Draw the mitochondrion in the box. Your drawing should be a scientific drawing.

--

[2]

C)

(ii) What type of microscope was used to create the image of the mitochondrion?

Explain your answer.

Type of microscope

Reason

[2]

D)

(c) Name **one** structure found in both an animal cell and a prokaryotic cell.

..... [1]

Q40. (2023)

20 A student makes pineapple jelly using two different methods. Both methods use a protein called gelatin which causes the jelly to set.

Tinned pineapple is fresh pineapple which has been treated with heat.

Method 1	Method 2
Fresh pineapple is added to the gelatin.	Tinned pineapple is added to the gelatin.
It is left for 2 hours.	It is left for 2 hours.
The jelly does not set.	The jelly sets.

Pineapple contains an enzyme called bromelain. Bromelain digests proteins.

A)

(a) Explain why the jelly made with fresh pineapple does **not** set but the jelly made with tinned pineapple does set.

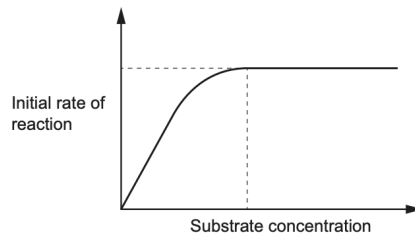
Use your knowledge of enzymes.

[4]

[4]

B)

- (b) The graph shows the rate of an enzyme catalysed reaction as the concentration of substrate is changed.



Draw an **X** on the graph to show where approximately 50% of the enzymes' active sites are occupied with substrate.

Explain your decision.

.....

 [2]

Q41. (2023)

- 24 (a) * Beta thalassaemia is a genetic disorder caused by a mutation in DNA.

In this mutation, some bases are inserted into the gene that codes for the production of the haemoglobin protein.

Explain how this mutation causes a different haemoglobin protein to be produced.

Use your knowledge of DNA and protein synthesis.

.....

 [6]

Q42. (2023) – 24c

- (c) Beta thalassaemia can be treated with stem cells.
 Stem cells are taken from a donor and placed in the vein of the patient.

Explain why using stem cells from a donor can be used as a treatment for this disease.

.....

 [2]

Q43. (2024)

- 1 Cellulose is a complex carbohydrate.

Which monomers is cellulose made from?

- A Amino acids
- B Fatty acids
- C Glycerol
- D Simple sugars

Your answer

☐

[1]

Q44. (2024)

- 6 A section of DNA is analysed to find the percentage of each of the four bases present. 16% of the DNA is guanine.

What is the percentage of the other bases in this section of DNA?

- A 16% Adenine, 16% Cytosine, 52% Thymine
- B 16% Adenine, 34% Cytosine, 34% Thymine
- C 34% Adenine, 16% Cytosine, 34% Thymine
- D 34% Adenine, 34% Cytosine, 16% Thymine

Your answer

☐

[1]

Q45. (2024)

- 7 Which statement about DNA is correct?

- A DNA codes for the production of amino acids.
- B DNA contains specific sequences of amino acids and bases.
- C DNA is a polymer made of three different nucleotides.
- D DNA nucleotides consist of a base, a sugar and a phosphate.

Your answer

☐

[1]

Q46. (2024)

- 8 What is the correct sequence of events in one cell cycle?

- A Growth of the cell, DNA replication, movement of the chromosomes
- B Growth of the cell, movement of the chromosomes, DNA replication
- C Movement of the chromosomes, DNA replication, growth of the cell
- D Movement of the chromosomes, growth of the cell, DNA replication

Your answer

☐

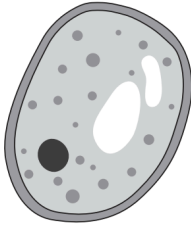
[1]

Q47. (2024)

A)

21 Yeast is a fungus.

(a) The diagram shows a yeast cell.



(i) Name **two** sub-cellular structures the yeast cell has in common with both animal and plant cells.

1

2 [2]

B)

(ii) Yeast is classified as a fungus and not as a plant or animal.

Explain why fungi are **not** classified as plants or as animals.

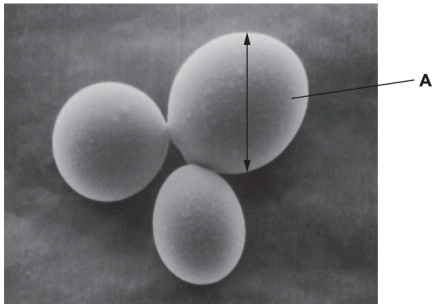
Use the diagram.

.....

..... [1]

C)

(b) The image is of some yeast cells taken using an electron microscope.



The actual diameter of the yeast cell labelled **A** is $2.8\text{ }\mu\text{m}$.

($1\text{ mm} = 1000\text{ }\mu\text{m}$)

Calculate the magnification used to produce this image.

Give your answer to **3** significant figures.

Magnification = [4]

D)

(c) The cells in the image are baker's yeast.

Baker's yeast is used to make bread. The yeast respires anaerobically.

Which product of this process will help the bread rise?

..... [1]

24 Glycogen storage disease is caused by a mutation in the DNA that codes for an enzyme (a protein) that converts glycogen into glucose.

(a)* Describe how a change to the triplet codes in the DNA can prevent the enzyme working and how this can affect the person's blood glucose level.

[6]