St Mary's Science Department

A level Biology

Independent Work Book

Biological Molecules 1

Name: _____

Class: _____

Teacher : _____

Q1.

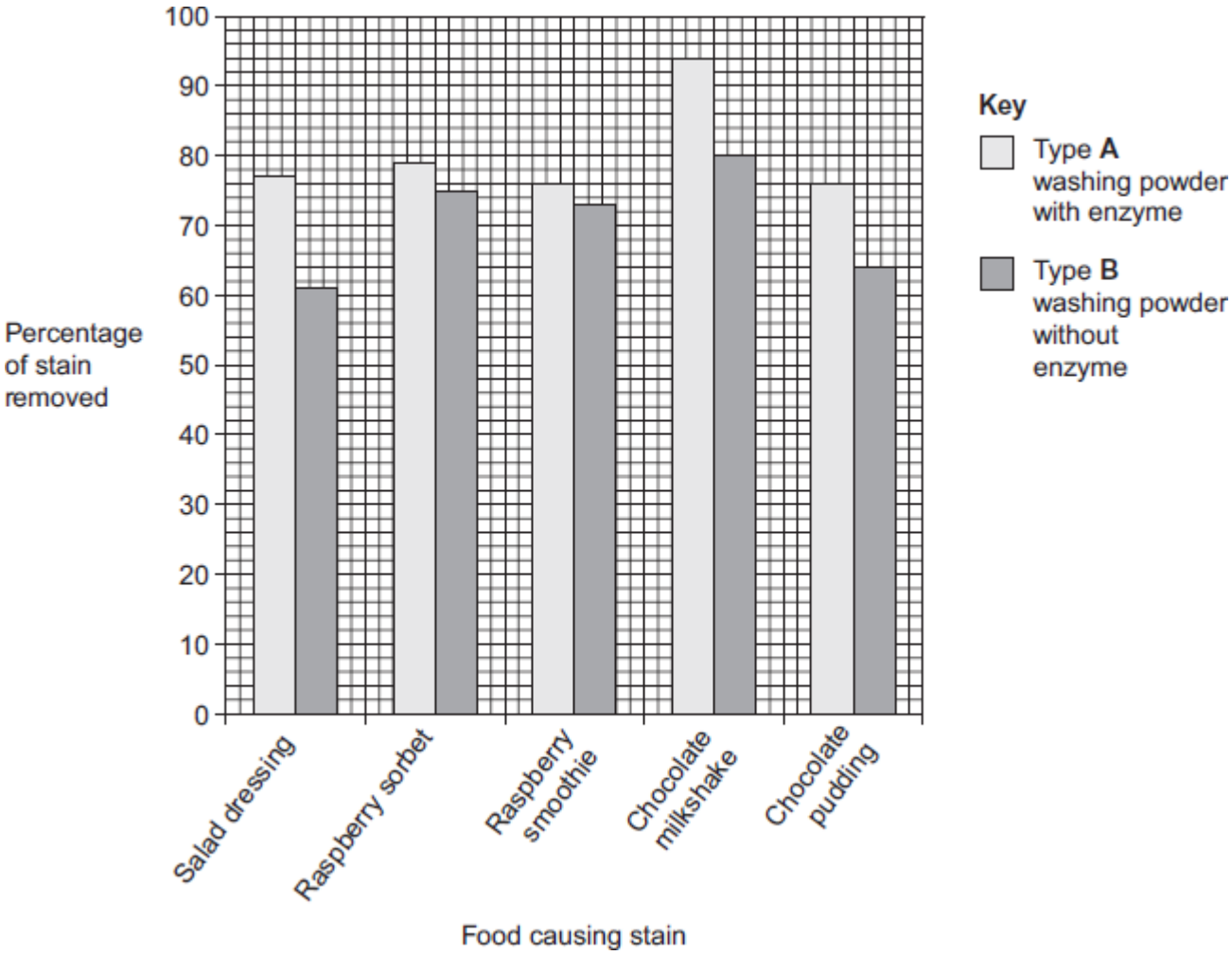
Biological washing powders contain enzymes which hydrolyse substances that cause stains on clothes.

A manufacturer tested the ability of two types of the same brand of washing powder to remove different food substances that stain clothes.

- Type **A** contained an enzyme.
- Type **B** was identical to **A** except it did **not** contain the enzyme.

Figure 1 shows the results.

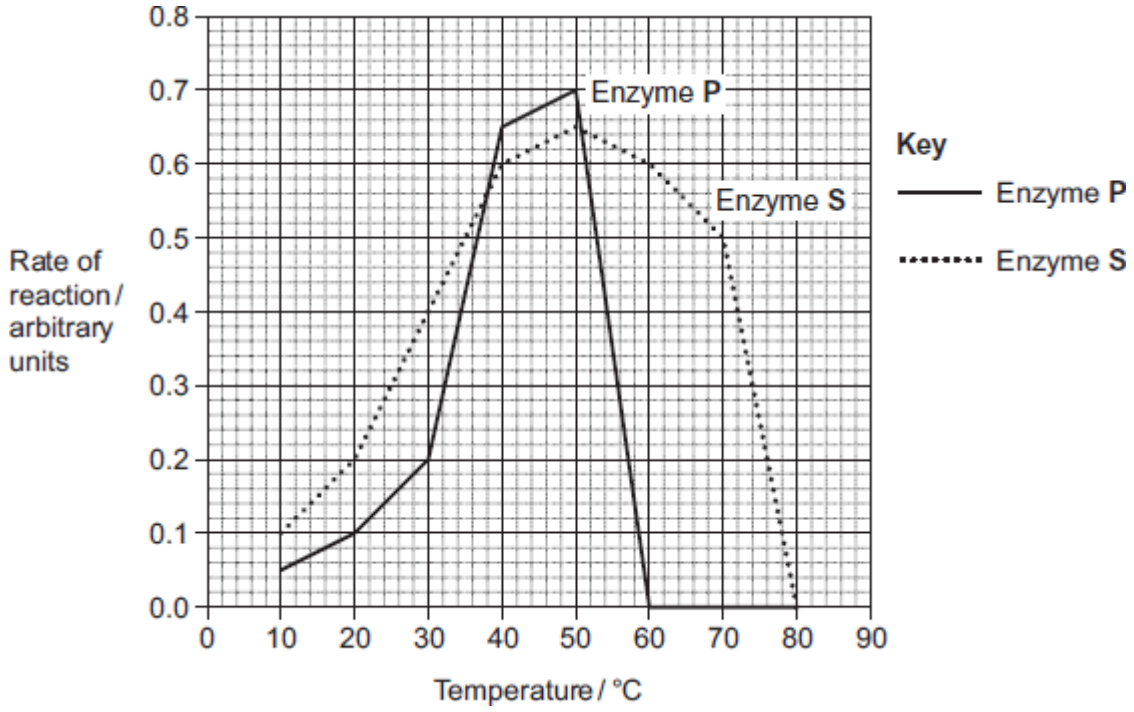
Figure 1



A scientist worked for a company that wanted to develop a biological washing powder that was effective over a range of temperatures. He investigated the effect of temperature on the rates of the reaction catalysed by two enzymes, **P** and **S** used in biological washing powders.

Figure 2 shows his results.

Figure 2



(a) Many of the substances causing the food stains are large, insoluble proteins. Suggest how a biological washing powder removes this type of stain.

(2)

(b) The manufacturer of type **A** and type **B** washing powder claimed that these results showed that biological washing powders are better at removing stains from clothes.

Use the information in **Figure 1** to evaluate this claim.

(Extra space)

(4)

(c) Most customers want a washing powder which removes stains from clothes over a range of temperatures. After obtaining the results shown in **Figure 2**, which enzyme should the scientist recommend for use in a biological powder?

Give reasons for your answer.

(Extra space)

(3)

(d) Biological washing powders often contain a number of different enzymes. This enables them to remove a wider range of stains from clothes.
Explain why a number of enzymes are required to remove a wider range of stains.

(3)
(Total 12 marks)

Q2.

Cyanide is poisonous. Cyanide binds to cytochrome oxidase, which is an enzyme in the electron transport chain in mitochondria. This stops the movement of electrons to oxygen. As a result, ATP cannot be made via aerobic respiration. If a person or animal is exposed to cyanide, a substance that acts as an antidote can reduce or prevent poisoning. This substance binds to cyanide.

Scientists investigated the effect of cyanide on the rate of respiration of cells in different animal organs and in organs from different animals. They extracted organs from animals that had just been killed. For each animal organ they set up 3 dishes. Each dish contained:

- phosphate solution
- saline (sodium chloride) solution
- cyanide solution of known concentration.

They measured the mean amount of oxygen used by the slices of organs in one hour. Their results are shown in **Table 1**.

Table 1

Trial	Animal organ	Mean amount of oxygen used, in the absence or presence of cyanide, per hour / arbitrary units		
		No cyanide	10^{-4} mol dm^{-3} cyanide	10^{-2} mol dm^{-3} cyanide
A	Sheep liver	2.7	2.5	0.7
B	Sheep kidney	14.1	9.9	1.9
C	Ox liver	1.9	1.5	0.8
D	Rat kidney	20.7	18.8	2.3
E	Rat liver	10.5	10.0	1.9
F	Guinea pig kidney	16.8	14.4	1.9

(a) Suggest how binding of cyanide to cytochrome oxidase affects the enzyme.

(3)

(b) Suggest how the antidote can reduce poisoning by cyanide.

_____

_____

_____

(1)

(c) **Table 1** shows the scientists' results for different trials. The trials could be put into groups to allow comparisons to be made within each group.

(i) As an example of how trials could be grouped, **Group 1** has been completed in **Table 2** below. Complete **Table 2** to show **three** other possible ways that the scientists' trials could be grouped.

Table 2

Group	Trials allowing comparisons to be made
1	**A** with **B**
2	
3	
4	

(2)

(ii) What is the effect of cyanide on **Group 1** trials in **Table 2**? Use evidence from **Table 1** to support your answer.

_____

_____

_____

_____

_____

_____

(3)

(iii) Calculate the percentage difference in oxygen use for 'rat liver' (**Trial E**) between a cyanide concentration of 10^{-4} and 10^{-2} mol dm^{-3}.

Percentage difference = _____

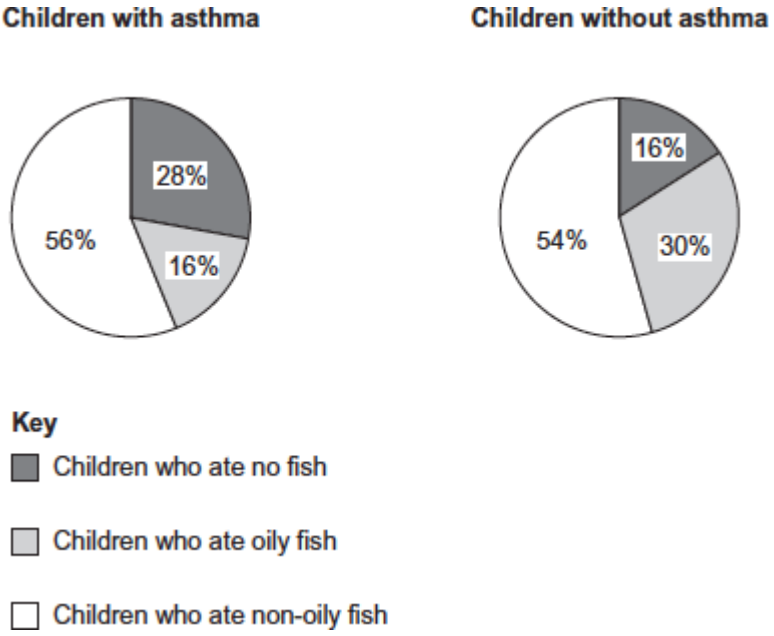
(2)

(Total 11 marks)

Q3.

Nutritionists investigated the relationship between eating oily and non-oily fish and the incidence of asthma. They analysed the diets of children with asthma and the diets of children without asthma.

The pie charts show the results.



(a) What conclusions can you make from the data?

[Extra space]

(3)

(b) Describe how you could use the emulsion test to show the presence of oil in a sample of fish.

[Extra space]

(3)

(Total 6 marks)

Q4.

Trypsin is a protease. It is produced in an inactive form inside some of the cells of the pancreas.

(a) Name the part of a pancreatic cell that produces the inactive form of trypsin.

(1)

(b) Suggest the advantage of producing trypsin in an inactive form inside cells in the pancreas.

(2)

(c) After the inactive form of trypsin enters the small intestine, another enzyme removes a short chain of amino acids from the end of the inactive trypsin molecules. This leads to the formation of the active form of trypsin.

(i) Name the type of bond hydrolysed when the short chain of amino acids is removed.

_____

(1)

(ii) Sometimes trypsin can become activated inside a pancreatic cell. A competitive inhibitor in the cell then binds to the trypsin and stops it working. Explain how the competitive inhibitor stops trypsin working.

_____

_____

_____

_____

_____

_____

_____

_____

_____

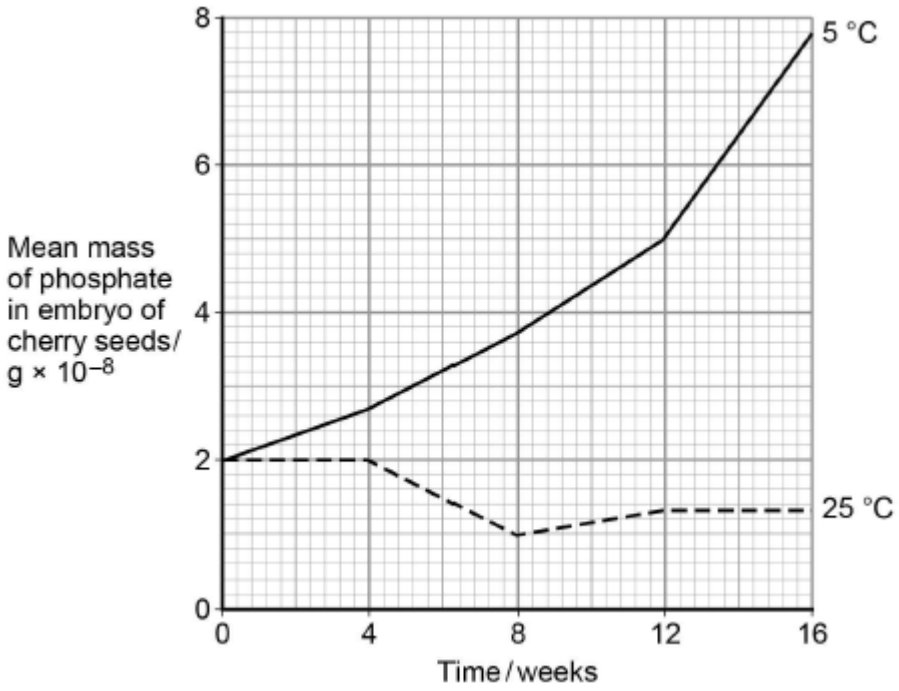
(3)

(Total 7 marks)

Q5.

The seeds of some plant species require chilling (exposure to low temperatures) before the embryos they contain grow into plants. During chilling, storage molecules in the seed that contain phosphate are broken down and phosphates are transported to the embryo. Scientists investigated the change in the mass of phosphate in the embryos of cherry seeds exposed to two different temperatures for 16 weeks.

The following graph shows their results.



(a) Phospholipids are one of the storage molecules found in cherry seeds.

Name the type of reaction used to break down phospholipids to release phosphate.

_____

(1)

(b) The scientists concluded that an increase in phosphate in the embryo was linked to growth of the embryo.

Suggest **two** reasons why an increase in phosphate can be linked to growth of the embryo.

1. _____

_____

_____

2. _____

_____

_____

(2)

(c) Calculate the ratio of the mean mass of phosphate found at 5 °C to the mean mass of phosphate found at 25 °C after 9 weeks of chilling.

Ratio = _____

(1)

(d) The chilling requirement of seeds of certain plant species is considered to be an adaptation for survival in countries with seasonal changes in environmental conditions.

Suggest how this adaptation may enable these plant species to survive and respond to seasonal changes.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 7 marks)

Q6.

Scientists investigated the hydrolysis of sucrose in growing plant cells by an enzyme called SPS.

(a) Name the products of the hydrolysis of sucrose.

1. _____

2. _____

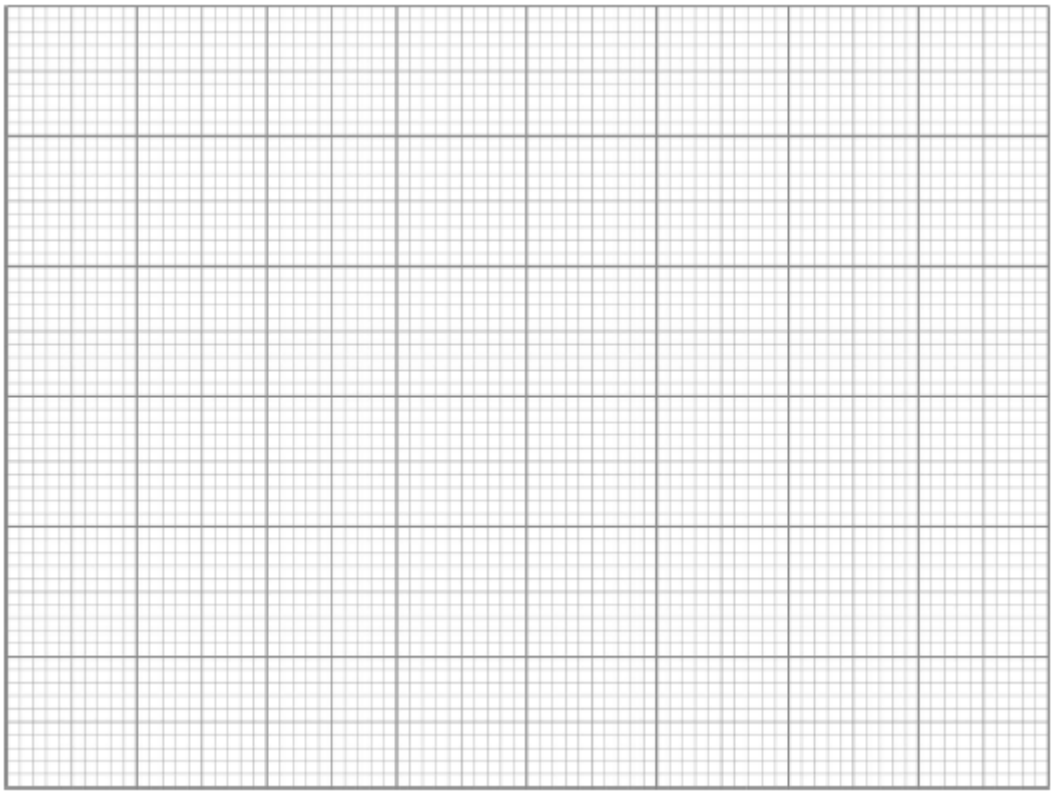
(2)

(b) The scientists grew plant cells in a culture for 12 days. At the start, there were only a few cells in the culture. Each day, they determined the mass of sucrose hydrolysed by SPS in the plant cells in **1 hour**.

The following table shows their results.

Day	**Mass of sucrose hydrolysed by SPS in 1 hour / µg**	**Rate of hydrolysis of sucrose by SPS**
0	0.07	
2	0.09	
4	0.11	
6	0.15	
8	0.20	
10	0.24	
12	0.24	

For each day, calculate the rate **per minute** of the reaction catalysed by SPS. Record the rates in standard form and plot a suitable graph of your processed data.



(3)

(c) What can you conclude about the growth of the plant cells from these data? Explain how you reached your conclusions.

(3)

(Total 8 marks)

Q7.

Newborn babies can be fed with breast milk or with formula milk. Both types of milk contain carbohydrates, lipids and proteins.

- Human breast milk also contains a bile-activated lipase. This enzyme is thought to be inactive in milk but activated by bile in the small intestine of the newborn baby.
- Formula milk does not contain a bile-activated lipase.

Scientists investigated the benefits of breast milk compared with formula milk.

(a) The scientists used kittens (newborn cats) as model organisms in their laboratory investigation.

Other than ethical reasons, suggest **two** reasons why they chose to use cats as model organisms.

1. _____

_____

2. _____

_____

(2)

(b) Before starting their experiments, the scientists confirmed that, like human breast milk, cat's milk also contained bile-activated lipase.

To do this, they added bile to cat's milk and monitored the pH of the mixture.

Explain why monitoring the pH of the mixture could show whether the cat's milk contained lipase.

_____

_____

_____

_____

(2)

The scientists then took 18 kittens. Each kitten had been breastfed by its mother for the previous 48 hours.

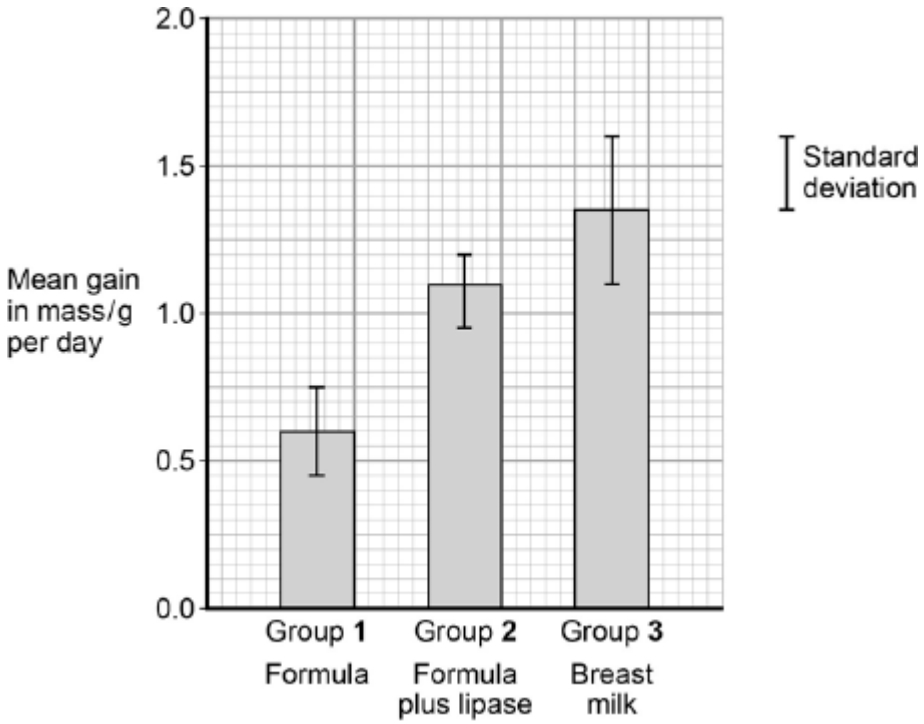
The scientists divided the kittens randomly into three groups of six.

- The kittens in group **1** were fed formula milk.
- The kittens in group **2** were fed formula milk plus a supplement containing bile-activated lipase.
- The kittens in group **3** were fed breast milk taken from their mothers.

Each kitten was fed 2 cm^3 of milk each hour for 5 days.

The scientists weighed the kittens at the start of the investigation and on each day for 5 days.

The figure below shows the scientists' results.



(c) What can you conclude from the figure about the importance of bile-activated lipase in breast milk?

_____

_____

_____

_____

_____

_____

(Extra space) _____

_____

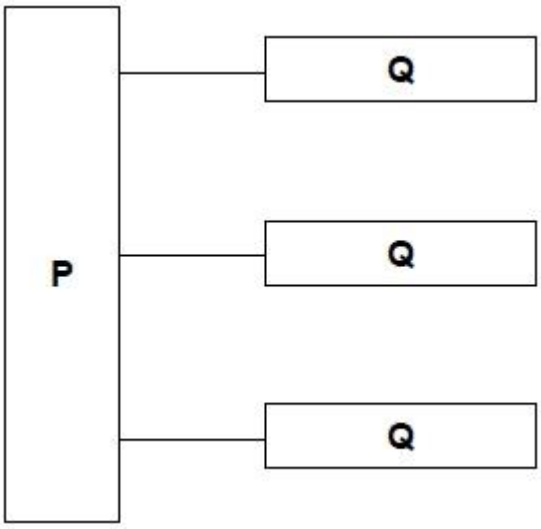
_____

(3)

(Total 7 marks)

Q8.

The diagram represents a triglyceride.



(a) Name the molecules represented in the diagram by:

Box **P** _____

Box **Q** _____

(2)

(b) Name the type of bond between **P** and **Q** in he diagram.

_____

(1)

(c) Describe how you would test a liquid sample for the presence of lipid **and** how you would recognise a positive result.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

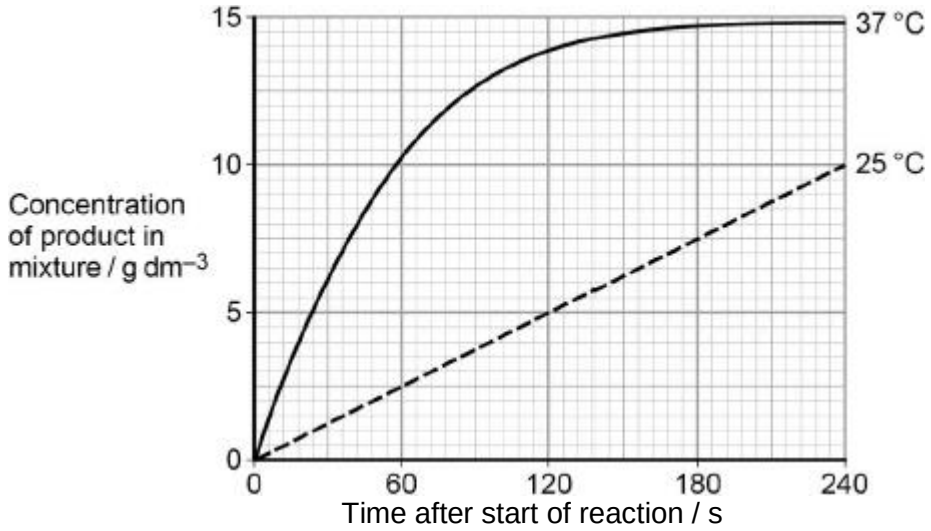
(2)

(Total 5 marks)

Q9.

A technician investigated the effect of temperature on the rate of an enzyme-controlled reaction. At each temperature, he started the reaction using the same volume of substrate solution and the same volume of enzyme solution.

The figure below shows his results.



(a) Give **one** other factor the technician would have controlled.

_____

_____

(1)

(b) Calculate the rate of reaction at 25 °C.

Answer _____

(2)

(c) Describe and explain the differences between the two curves.

(5)

(Total 8 marks)

Q10.

(a) Name the monomers from which a maltose molecule is made.

_____

(1)

(b) Name the type of chemical bond that joins the **two** monomers to form maltose.

_____

(1)

A student wanted to produce a dilution series of a maltose solution so he could plot a calibration curve. He had a stock solution of maltose of concentration 0.6 mol dm^{-3} and distilled water. He made a series of dilutions from 0.1 to 0.6 mol dm^{-3}.

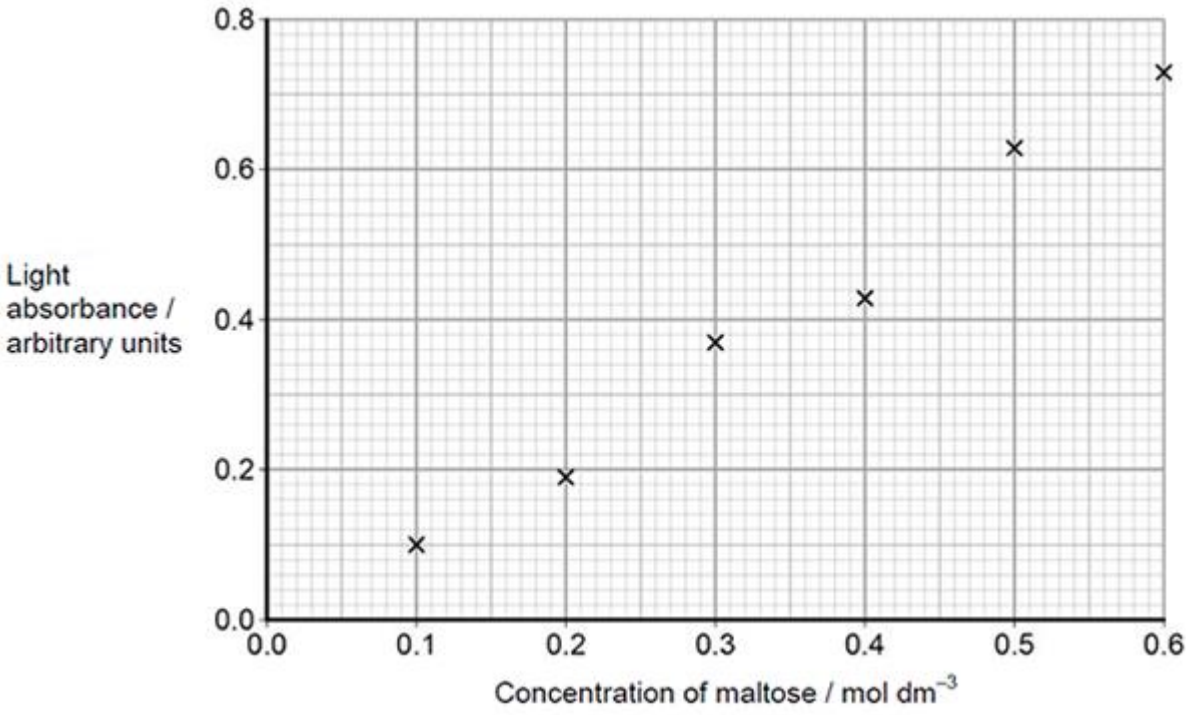
(c) Complete the table below by giving all headings, units and the concentration of the maltose solution produced.

Concentration of maltose solution / _____	**Volume of 0.6 mol dm^{-3} maltose solution / cm^3**	**_____ / _____**
_____	5	10

(2)

The student performed the Benedict's test on six maltose solutions ranging from 0.1 mol dm^{-3} to 0.6 mol dm^{-3}. He placed a sample of each solution in a colorimeter and recorded the light absorbance.

His results are shown in the graph below.



(d) Explain how you would use the graph to determine the maltose concentration with a light absorbance of 0.45 arbitrary units.

_____

_____

_____

_____

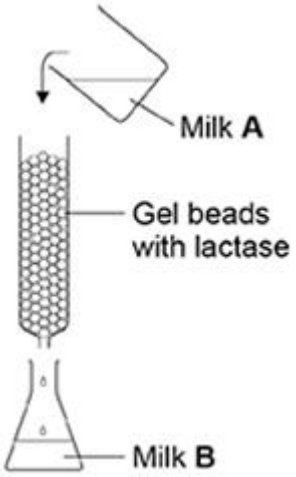
_____

(2)

(Total 6 marks)

Q11.

Many humans are unable to digest lactose. A scientist investigated the production of lactose-free milk. He produced gel beads containing the enzyme lactase and placed the beads in a column. He poured milk (Milk **A**) into the column and collected the milk (Milk **B**) after it had moved through the column over the beads. This is shown in the diagram below.



(a) Milk **A** contains no glucose. Milk **B** contains glucose. Explain why Milk **B** contains glucose.

_____

_____

_____

(1)

(b) The enzyme was trapped within the gel beads. Suggest **one** advantage of trapping the enzyme within the gel beads.

_____

_____

_____

(1)

The scientist varied the flow rate of the milk through the column. The effect of flow rate on the concentration of glucose in Milk **B** is shown in the table below.

Flow rate of milk through the column / cm^3 $minute^{-1}$	**Concentration of glucose in Milk B / arbitrary units**
50	45
100	6

(c) Explain the difference in the results in the table.

_____

_____

_____

(1)

(d) The gel beads were all similar sizes. Use the formula below to calculate the volume of one of the beads with a 3.0 mm diameter.

Volume of sphere = $\frac{4}{3}\pi r^3$

Volume = _____ mm^3

(1)

(e) Galactose has a similar structure to part of the lactose molecule.
Explain how galactose inhibits lactase.

_____

_____

_____

_____

_____

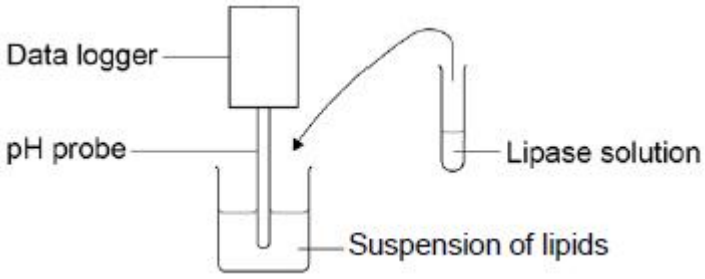
(2)

(Total 6 marks)

Q12.

A student investigated the effect of lipase concentration on the hydrolysis of lipids.

He took a beaker containing a suspension of lipids. He placed a pH probe attached to a data logger into the beaker. After 5 minutes, he added the lipase solution. The data logger recorded the pH. The apparatus used is shown in the diagram below.



(a) The student did **not** add a buffer to the lipase solution.

Explain why.

_____

_____

_____

(1)

(b) Give **two** variables the student would have controlled in this investigation.

1. _____

2. _____

(2)

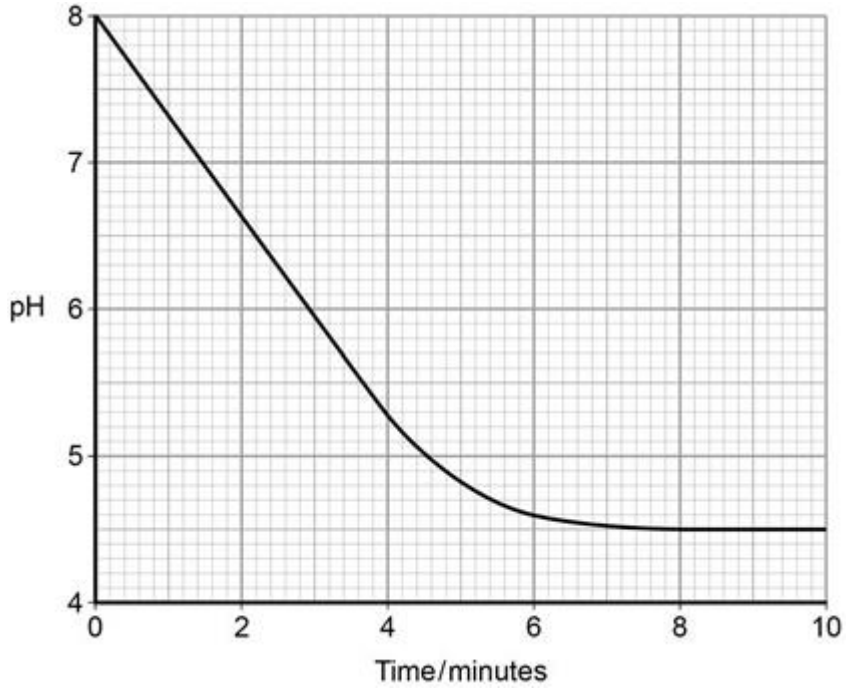
(c) Give the suitable control for this investigation.

_____

_____

(1)

The data logger recorded the pH. The graph below shows what happened after he added the lipase solution.



(d) Draw a tangent on the graph and use it to calculate the rate of change at 5 minutes.

Rate of change at 5 minutes = _____ pH minute^{-1}

(2)

(e) Explain the results shown in the graph.

_____

_____

_____

_____

_____

(2)

(f) The student repeated the experiment with a higher concentration of lipase solution. Describe and explain the results you would expect him to get.

_____

_____

_____

_____

_____

(3)

(Total 11 marks)

Q13.

(a) Glycogen and cellulose are both carbohydrates.
Describe **two** differences between the structure of a cellulose molecule and a glycogen molecule.

1. _____

_____

_____

2. _____

_____

_____

(2)

(b) Starch is a carbohydrate often stored in plant cells.
Describe and explain **two** features of starch that make it a good storage molecule.

1. _____

_____

_____

2. _____

_____

_____

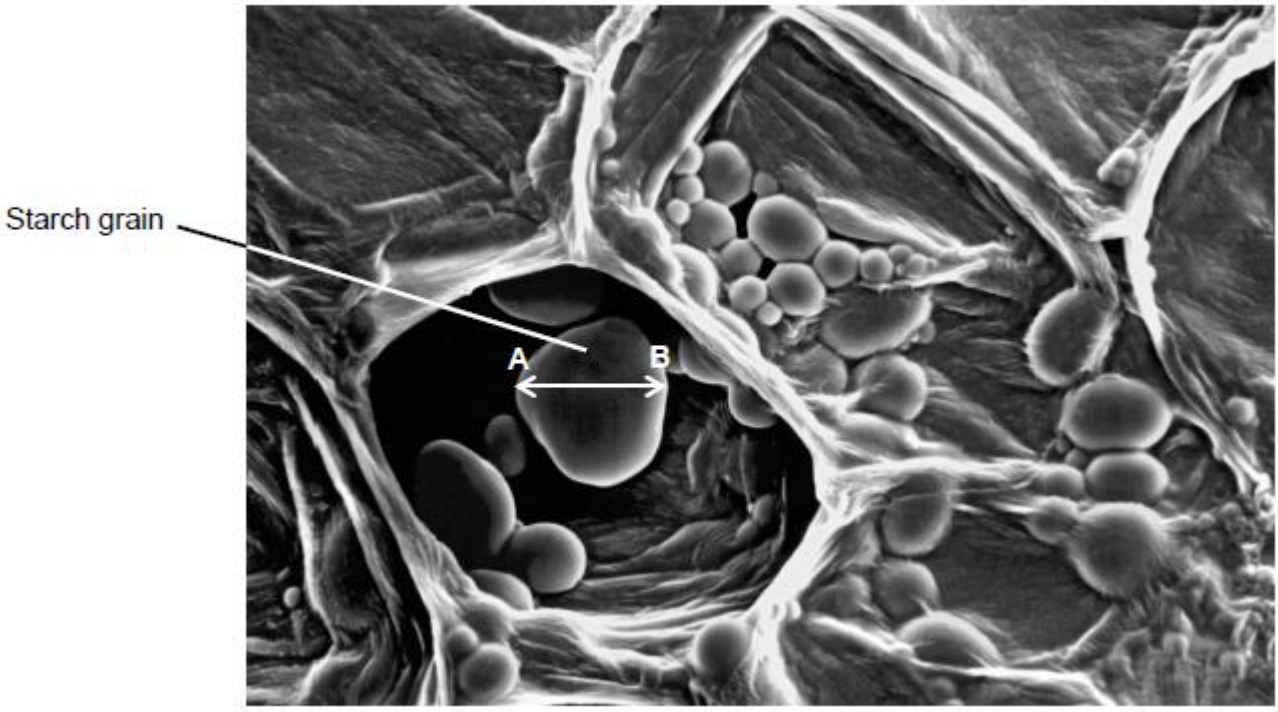
(2)

(c) Tick (✓) the box that identifies the test which would be used to show the presence of starch.

Acid hydrolysis test	☐
Benedict's test	☐
Emulsion test	☐
Iodine/potassium iodide test	☐

(1)

(d) The diagram shows a section through a plant tissue at a magnification of ×500.



Calculate the actual diameter of the starch grain between points **A** and **B**.

Answer = _____ µm

(2)

(e) What type of microscope was used to obtain the image shown in the diagram above?

Give **one** piece of evidence to support your answer.

Type of microscope _____

Evidence _____

(2)

(Total 9 marks)

Q1.

(a) 1. Enzyme hydrolyses / breaks down protein to amino acids;

2. Products are soluble / can be washed away;

2

(b) **Arguments for biological washing powder:**

3 max if only arguments against biological washing powder are referred to

1. More effective with all stains;

Accept different ways of expressing 'effective' e.g. higher % of stain removed

2. Greater improvement with salad dressing / chocolate milkshake / chocolate pudding;

Arguments against biological washing powder:

3. Little / less improvement with raspberry sorbet / raspberry smoothie;

4. Only tested 5 / a small number of stains;

5. Only chose stains that would work / didn't select stains that wouldn't work;

6. Only included results that did work / didn't show results that didn't work;

7. Only one set of results / not repeated;

8. Only compared against one washing powder / may not be true for other washing powders;

Ignore references to unknown masses of powder, temperature of washes or other aspects of technique or different fabrics

4 max

(c) 1. Enzyme **S** effective across a wider range of temperatures;

2. Enzyme **S** *more* active above 50 °C / active up to 80 °C / active above 60 °C;

3. Enzyme **S** more active below (about) 37 °C temperature;

4. (Although) Enzyme **P** has higher rate of reaction at optimum / 40 – 50 °C;

5. Enzyme **P** denatured above 50 °C;

*Answers should be in the context of choosing enzyme **S** but, if **P** is chosen, points 4 and 5 may still be awarded, if described*

In points 2 and 3, a temperature must be stated. Allow ± 5 degrees of values shown

3 max

(d) 1. Stains caused by different substances;

2. Enzymes are specific;

3. Active site specific to substrate / other substrates cannot fit active site;

This could be expressed in other ways e.g. 'other substrates are not complementary to the active site'

3

[12]

Q2.

(a) 1. Inhibition;

Accept either competitive or non-competitive inhibition or a description of either.

2. Changes tertiary structure (of enzyme);
3. Changes shape of / blocks active site (of enzyme);

The active site must be in the context of the enzyme / cytochrome oxidase.

4. Enzyme cannot bind to its substrate / no enzyme-substrate complex formed.

Accept 'ES'. Accept 'substrate cannot attach to enzyme'.

3 max

(b) (Antidote reacts with / binds to cyanide) *so* cyanide cannot bind to enzyme / cytochrome oxidase
OR
(Antidote reacts with / binds to cyanide) *so* causing cyanide to be released from the enzyme / cytochrome oxidase.

Key idea is how the antidote affects the cyanide.

1

(c) (i) 1. **A** + **C** + **E** / all liver (trials)
2. **B** + **D** + **F** / all kidney (trials)
3. **D** + **E** / all rat (trials);;

Accept a description of any trial letter.

All 3 groups correct = 2 marks.

Any 2 groups correct = 1 mark.

1 group / no groups correct = 0 mark.

2 max

(ii) 1. Cyanide reduces oxygen use / rate of respiration in **A** and **B** / in both
OR
as concentration of cyanide increases, the use of oxygen decreases in both;

*Accept use of letters or description of the animal **and** organ*

Reference to 'both', in some way, is required.

2. Greater effect of cyanide (on oxygen use) on sheep kidney / **B** than on sheep liver / **A**;

Comparison required in the statement. The statement should not be inferred from MP3.

3. Appropriate calculations of mean oxygen use from the data
E.g. 1 liver falls by 74% whereas kidney falls by 87%
OR
liver falls to 0.26 / to 26% whereas kidney falls to 0.13 / to 13%
E.g. 2 liver falls by 2.0(au) whereas kidney falls by 12.2(au);
Check correct calculations using the data but a comparison must be shown. Accept other calculations using the data.

3

(iii) 81(%);
Correct answer = 2 marks.
Allow 1 mark for either:
Showing 8.1 divided by 10 or answer of 19(%).
Ignore '+' or '−' in showing the difference.

2

[11]

Q3.

(a) 1. Fewer children / less likely that children with asthma eat fish;
Accept converse.

2. Fewer children / less likely that children with asthma eat oily fish;
MP1 and 2 − Allow use of numbers.

3. Little / only 2% / no difference in (children with or without asthma who eat) non-oily fish.
Do not accept arguments related to amount of fish eaten

3

(b) 1. (Shake with) ethanol / alcohol;
1. Accept named alcohol

2. Then add (to) water;
2. Order must be correct

3. White / milky / cloudy (layer indicates oil).
3. Ignore forms emulsion as in stem
3. Ignore precipitate

3

[6]

Q4.

(a) Ribosome/rough endoplasmic reticulum;
Ignore RER or endoplasmic reticulum unqualified

1

(b) 1. Does not digest protein inside cells;
Accept named examples
2. So (pancreatic) cell/tissue/function not destroyed/damaged;

2

(c) (i) Peptide (bond);

1

(ii) 1. Inhibitor is a similar shape to the substrate;
2. (Inhibitor) blocks active site/is complementary to the active site/binds to the active site (of trypsin);
3. Substrate can't bind to active site / no/fewer ES complexes formed;

3

[7]

Q5.

(a) Hydrolysis (reaction);

1

(b) 1. (Phosphate required) to make RNA;
2. (Phosphate required) to make DNA;

1 and 2. If neither DNA or RNA are named allow one mark for nucleotide/nucleic acid/phosphodiester bonds/sugar-phosphate backbone.

3. (Phosphate required) to make ATP/ADP;
4. (Phosphate required) to make membranes;

Ignore: phospholipids without reference to membranes.

5. (Phosphates required) for phosphorylation;

Accept: as additional mark points any named biological molecule containing phosphate e.g. NADP, AMP, RuBP.

2 max

(c) Accept answer in range from 3.7 : 1 to 4.1 : 1;

Reject any ratio not : 1.

1

(d) 1. Seeds/embryo remain dormant/inactive in winter/cold
OR
Growth/development of seed/embryo during winter/cold;

Ignore: hibernate.

Accept: 'seed survives winter/cold'.

Reject: plant develops or seed germinates during winter/cold.

2. Seeds/plants develop in spring/summer
OR
Seeds/plants develop when temperature/light increases;

Accept: seeds/plants develop when more light or when temperature is higher.

Accept: seed germinates/'sprouts' during spring/summer or when temp/light increases.

3. Plant photosynthesise (in spring/when warm);
4. Produce (more) seeds/offspring in spring/growing season;

3 max

[7]

Q6.

(a) 1. Glucose;

2. Fructose;

Accept answers in either order

Ignore α and β glucose

2

(b) 1. Line graph with rate on y axis and days/time in days on x axis and linear scales;

Correct answers × 10^{-3} 1.17, 1.50, 1.83, 2.50, 3.33, 4.00, 4.00 (accept to 1DP)

2. Correct units of μg min^{-1}/per minute/$minute^{-1}$ × 10^{-3};

Reject m^{-1}

Reject if put 10^{-3} on axis for each point

'/' means separating units from what goes before i.e. accept sucrose hydrolysis per min / μgx10^{-3}

3. Rates correctly calculated and plotted, with line connecting points/line of best fit and no extrapolation;

*Do not accept a ruled **straight line** of best fit*

Accept y axis starting at 1

3

(c) 1. Sucrose hydrolysis linked to some aspect of growth;

Accept 'breakdown

2. Greater the rate of/faster hydrolysis/more SPS activity as plant grows/cells divide (up to 8/10 days);

Accept 'breakdown

Accept converse of greater rate of growth, greater rate of hydrolysis

Reject 'sucrose broken down'

3. Growth/division remains the same/slows after 8/10 days (because SPS activity is levelling off);

Accept after 8 days/at 10 days growth rate maximum/growth stops

3

[8]

Q7.

(a) **Two** suitable suggestions;

E.g.

1. (Are mammals so) likely to have same physiology / reactions as humans;
2. Small enough to keep in laboratory / produce enough milk to extract;
3. (Can use a) large number.

Ignore references to ethical issues

2 max

(b) 1. Hydrolysis of lipids produces fatty acids;

2. Which lower pH of mixture.

2

(c) 1. (Bile-activated lipase / it) increases growth rate (of kittens);

2. Results for formula with lipase not (significantly) different from breast milk / are (significantly) different from formula milk alone;

3. Showing addition of (bile-activated) lipase is the likely cause (of increased growth);

4. Lipase increases rate of digestion of lipids / absorption of fatty acids.

3 max

[7]

Q8.

(a) P – glycerol
Q – fatty acid (chains)
Accept phonetic spelling

2

(b) Ester (bond);

1

(c) 1. (Mix / shake sample) with ethanol, then water;
Sequence is important

2. White / milky (emulsion);
Ignore cloudy
Reject precipitate

2

[5]

Q9.

(a) Concentration of substrate solution / of enzyme solution / pH.

1

(b) 1. 2.5 / 0.04;
1 mark for correct value

2. g dm^{-3} $minute^{-1}$ / g dm^{-3} s^{-1};
1 mark for related unit

2

(c) 1. Initial rate of reaction faster at 37 °C;
2. Because more kinetic energy;
3. So more E–S collisions / more E–S complexes formed;
4. Graph reaches plateau at 37 °C;
5. Because all substrate used up.
Allow converse for correct descriptions and explanations for curve at 25 °C

5

[8]

Q10.

(a) Glucose (and glucose);

1

(b) (α1,4) Glycosidic;

1

(c) 1. Headings correct – mol dm^{-3} **and** volume of water / cm^3;

2. Concentration correct. ie 0.2;

2

(d) Line of best fit drawn;

Read off value at 0.45.

2

[6]

Q11.

(a) Lactase hydrolyses lactose in to glucose (and galactose);

1

(b) No lactase in the milk
OR
Enzyme can be reused.

1

(c) 100 cm^3 $minute^{-1}$ is too fast to bind to active site / converse for 50 cm^3 $minute^{-1}$;

1

(d) 14.1(4);

1

(e) 1. Galactose is a competitive inhibitor / attaches to the active site (of lactase);

2. Fewer enzyme substrate complexes formed.

2

[6]

Q12.

(a) Student was measuring change in pH
OR
Buffer would maintain a constant pH.

1 max

(b) 1. Volume of suspension of lipids;

2. Concentration of suspension of lipids;

3. Volume of lipase solution;

4. Temperature;

2 max

(c) Boiled lipase solution;

1

(d) –0.34 = 2 marks

0.34 = 1 mark

2

(e) 1. Fatty acids produced;

2. Curve levels off as all substrate used up.
accept the lower pH inactivates / denatures the enzyme

2

(f) 1. Faster fall in pH **and** levels off at same point;

2. More enzyme = substrate complexes formed;

3. Same amount of fatty acids produced / product

3

[11]

Q13.

(a) 1. Cellulose is made up of β-glucose (monomers) **and** glycogen is made up of α-glucose (monomers);
2. Cellulose molecule has straight chain **and** glycogen is branched;
3. Cellulose molecule has straight chain **and** glycogen is coiled;
4. glycogen has 1,4- and 1,6- glycosidic bonds **and** cellulose has only 1,4-glycosidic bonds;

Ignore ref. to H bonds / microfibrils

2 max

(b) Any **two** from:
1. Insoluble (in water), so doesn't affect water potential;
2. Branched / coiled / (α-)helix, so makes molecule compact;
OR
Branched / coiled / (α-)helix so can fit many (molecules) in small area;
3. Polymer of (α-)glucose so provides glucose for respiration;
4. Branched / more ends for fast breakdown / enzyme action;
5. Large (molecule), so can't cross the cell membrane

*Require feature **and** explanation for 1 mark*

1. Accept Ψ or WP

1. Accept Insoluble so doesn't affect osmosis

*1. Do **not** allow ref to 'doesn't affect water leaving cells*

4. Ignore 'surface area'

4. Accept 'branched so glucose readily released'

2 max

(c) Iodine/potassium iodide;

1

(d) For correct answer of 40 (µm) award 2 marks;
Evidence of division by 500: award 1 mark

Allow tolerance of 0.5mm i.e. 20±0.5mm

2

(e) 1. Scanning electron (microscope);
2. 3D (image);

Accept SE(M)

2. Ignore any other correct features

2

[9]