Biological molecules revision pack 128 minutes 91 marks

Q1.

(a) Some seeds contain lipids. Describe how you could use the emulsion test to show that a seed contains lipids.

_____

_____

_____

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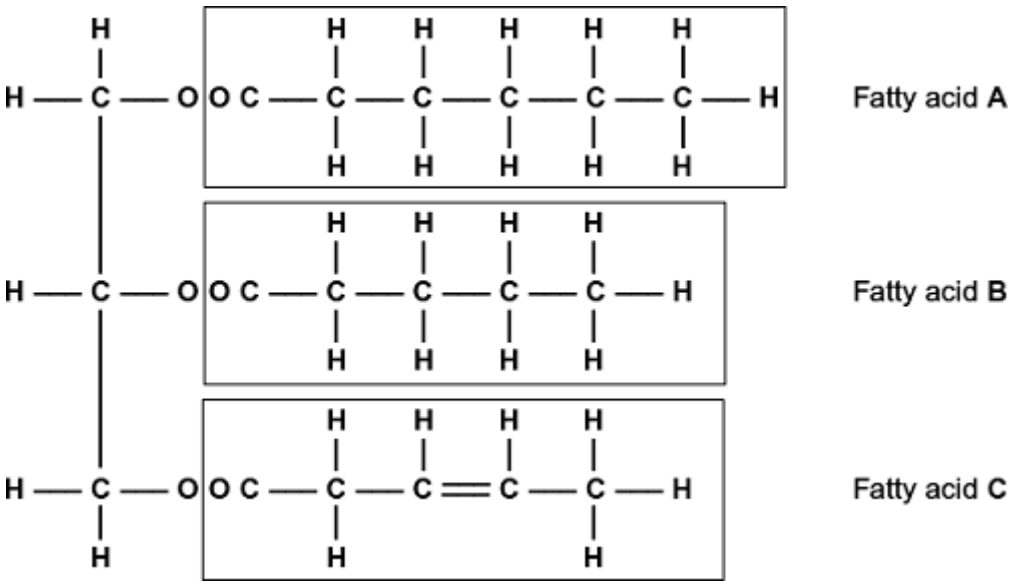
_____

_____

_____

(3)

(b) A triglyceride is one type of lipid. The diagram shows the structure of a triglyceride molecule.



(i) A triglyceride molecule is formed by condensation. From how many molecules is this triglyceride formed?

(1)

(ii) The structure of a phospholipid molecule is different from that of a triglyceride. Describe how a phospholipid is different.

_____

_____

_____

_____

_____

(2)

(iii) Use the diagram to explain what is meant by an unsaturated fatty acid.

_____

_____

_____

_____

_____

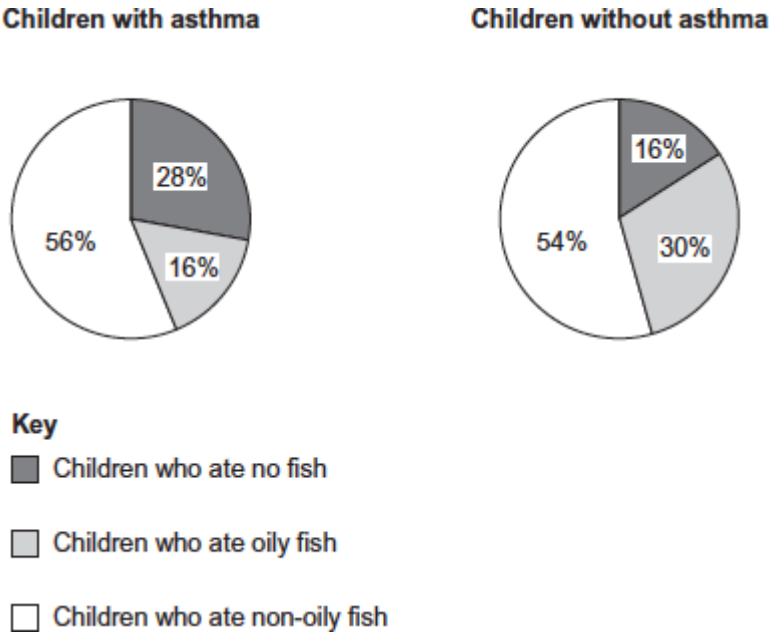
(2)

(Total 8 marks)

Q2.

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?

_____

_____

_____

_____

_____

_____

_____

_____

(3)

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

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 6 marks)

Q3.

(a) The table shows some statements about three carbohydrates. Complete the table with a tick in each box if the statement is true.

Statement	Starch	Cellulose	Glycogen
Found in plant cells			
Contains glycosidic bonds			
Contains β-glucose			

(3)

(b) Name the type of reaction that would break down these carbohydrates into their monomers.

_____

(1)

(c) Give **one** feature of starch and explain how this feature enables it to act as a storage substance.

Feature _____

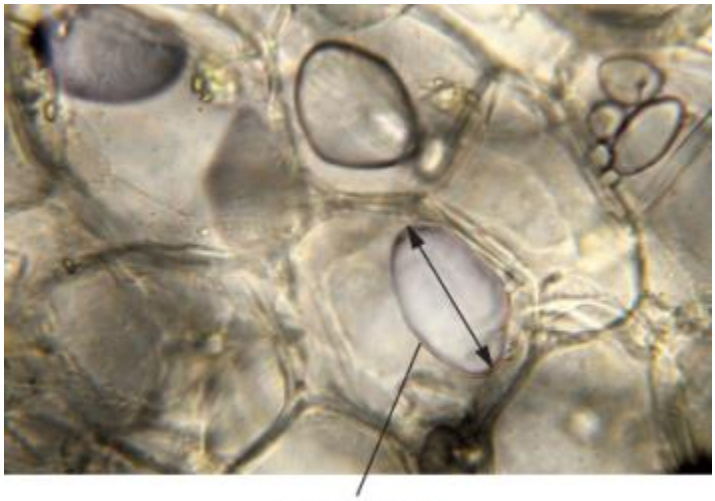
Explanation _____

_____

_____

(2)

(d) The picture shows starch grains as seen with an optical microscope. The actual length of starch grain **A** is 48 µm. Use this information and the arrow line to calculate the magnification of the picture. Show your working.



Magnification _____ times

(2)

(Total 8 marks)

Q4.

The equation shows the breakdown of lactose by the enzyme lactase.

Lactose + water $\xrightarrow{\text{lactase}}$ galactose + monosaccharide **X**

(a) (i) Name the type of reaction catalysed by the enzyme lactase.

_____

(1)

(ii) Name monosaccharide **X**.

_____

(1)

(b) (i) Describe how you would use a biochemical test to show that a reducing sugar is present.

_____

_____

_____

_____

_____

(2)

(ii) Lactose, galactose and monosaccharide **X** are all reducing sugars. After the lactose has been broken down there is a higher concentration of reducing sugar. Explain why.

_____

(1)

(c) A high concentration of galactose slows down the breakdown of lactose by lactase. Use your knowledge of competitive inhibition to suggest why.

_____

_____

_____

_____

_____

(2)

(Total 7 marks)

Q5.

Read the following passage.

Aspirin is a very useful drug. One of its uses is to reduce fever and inflammation. Aspirin does this by preventing cells from producing substances called prostaglandins. Prostaglandins are produced by an enzyme-controlled pathway. Aspirin works by inhibiting one of the enzymes in this pathway. Aspirin attaches permanently to a chemical group on one of the monomers that make up the active site of this enzyme. 5

The enzyme that is involved in the pathway leading to the production of prostaglandins is also involved in the pathway leading to the production of thromboxane. This is a substance that promotes blood clotting. A small daily dose of aspirin may reduce the risk of myocardial infarction (heart attack). 10

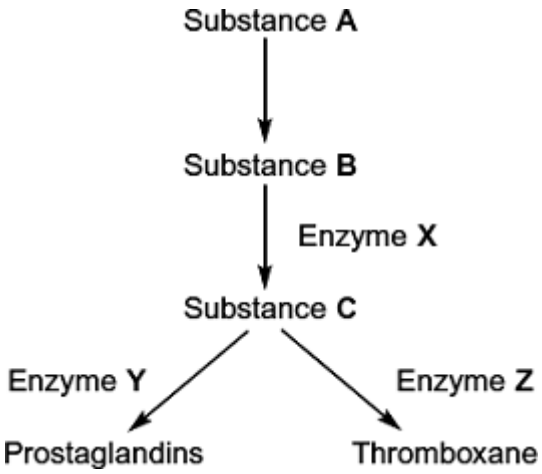
Use information from the passage and your own knowledge to answer the following questions.

(a) Name the monomers that make up the active site of the enzyme (lines 6 – 7).

_____

(1)

(b) The diagram shows the pathways by which prostaglandins and thromboxane are formed.



(i) Aspirin only affects one of the enzymes in this pathway. Use information in lines 5 - 7 to explain why aspirin does **not** affect the other enzymes.

_____

_____

_____

_____

_____

(2)

(ii) Which enzyme, **X**, **Y** or **Z**, is inhibited by aspirin? Explain the evidence from the passage that supports your answer.

Enzyme _____

Explanation _____

_____

_____

(2)

(c) Aspirin is an enzyme inhibitor. Explain how aspirin prevents substrate molecules being converted to product molecules.

_____

_____

_____

_____

_____

(2)

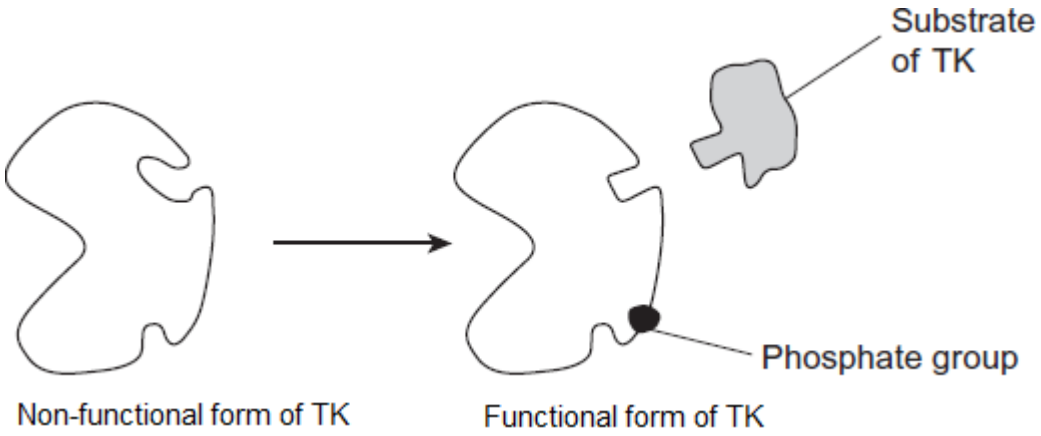
(Total 7 marks)

Q6.

The enzyme tyrosine kinase (TK) is found in human cells. TK can exist in a non-functional and a functional form. The functional form of TK is only produced when a phosphate group is added to TK.

This is shown in **Figure 1.**

Figure 1



(a) Addition of a phosphate group to the non-functional form of TK leads to production of the functional form of TK.

Explain how.

_____

_____

_____

_____

_____

(2)

(b) The binding of the functional form of TK to its substrate leads to cell division. Chronic myeloid leukaemia is a cancer caused by a faulty form of TK. Cancer involves uncontrolled cell division.

Figure 2 shows the faulty form of TK.

Figure 2

Faulty form of TK

Suggest how faulty TK leads to chronic myeloid leukaemia.

_____

_____

_____

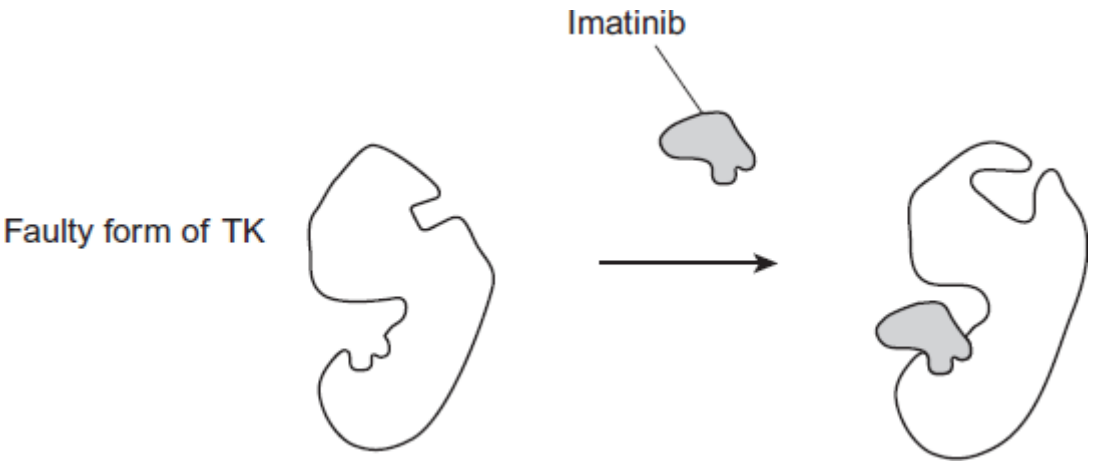
_____

_____

(2)

(c) Imatinib is a drug used to treat chronic myeloid leukaemia. **Figure 3** shows how imatinib inhibits faulty TK.

Figure 3



Using all of the information, describe how imatinib stops the development of chronic myeloid leukaemia.

_____

_____

_____

_____

_____

(2)

(Total 6 marks)

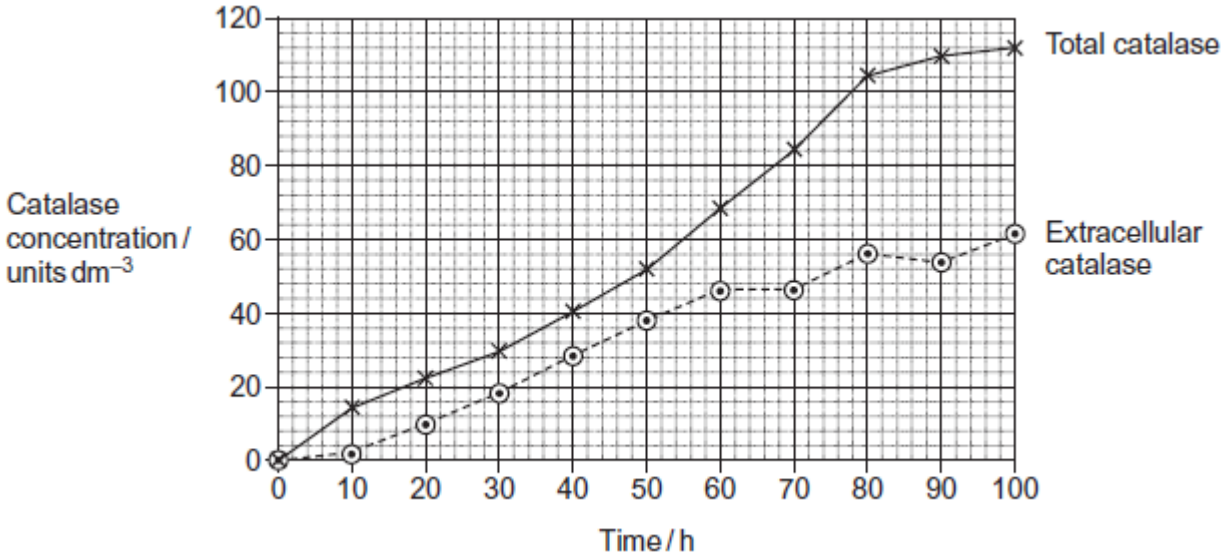
Q7.

Some of the catalase produced by *Aspergillus niger* is intracellular and some is extracellular.
Intracellular enzymes stay inside the cells that produce them. Extracellular enzymes are secreted from the cells that produce them.

Another group of scientists grew a different strain of *A. niger*.

- *A. niger* grows from tiny structures called spores. The scientists kept the spores in an isotonic medium at a low temperature until they needed them.
- They put spores of *A. niger* into a 500 cm^3 flask containing a sterile medium. The medium contained starch.
- They measured the total amount of catalase and the amount of extracellular catalase produced by the fungus over a period of 100 hours.

The graph shows their results.



(a) (i) The scientists kept the spores in an isotonic medium until they were needed. Suggest why it was important that the medium was isotonic.

_____

_____

_____

_____

_____

(2)

(ii) The scientists kept the spores at a low temperature until they were needed. Suggest why.

_____

_____

_____

(1)

(b) Starch is a source of carbon, hydrogen and oxygen for the fungus. Name one other chemical element that must be in the culture medium before *A. niger* can synthesise catalase. Give the reason for your answer.

Chemical element _____

Reason _____

_____

_____

_____

(2)

(c) To get reliable results in this investigation, the medium must be sterile.
Explain why.

_____

_____

_____

_____

_____

(2)

(d) (i) At what time was the concentration of intracellular catalase highest?

_____

(1)

(ii) Between what times was the rate of total catalase production highest?

_____

(1)

(e) Technologists prefer to manufacture extracellular enzymes rather than intracellular enzymes. This is because intracellular enzymes are more expensive to purify than extracellular enzymes. Suggest why intracellular enzymes are more expensive to purify.

_____

_____

_____

_____

_____

(2)

(Total 11 marks)

Q8.

(a) (i) Describe the role of DNA polymerase in DNA replication.

_____

_____

(1)

(ii) Other than being smaller, give **two** ways in which prokaryotic DNA is different from eukaryotic DNA.

1. _____

2. _____

(2)

(b) The table shows the percentage of each base in the DNA from three different organisms.

Organism	**Percentage of each base in DNA**			
	Adenine	Guanine	Thymine	Cytosine
Human	30.9	19.9	29.4	19.8
Grasshopper	29.4	20.5	29.4	20.7
Virus	24.0	23.3	21.5	31.2

(i) Humans and grasshoppers have very similar percentages of each base in their DNA but they are very different organisms.

Use your knowledge of DNA structure and function to explain how this is possible.

_____

_____

_____

_____

_____

(2)

(ii) The DNA of the virus is different from that of other organisms. Use the table above and your knowledge of DNA to suggest what this difference is. Explain your answer.

_____

_____

_____

_____

_____

(2)

(Total 7 marks)

Q9.

(a) Name the monosaccharides of which the following disaccharides are composed.

(i) Sucrose

monosaccharides_____and_____

(1)

(ii) Lactose

monosaccharides_____and_____

(1)

(b) Amylase and maltase are involved in the digestion of starch in the small intestine.

Complete the table by identifying where these enzymes are produced and the product of the reaction they catalyse.

Name of enzyme	Where the enzyme is produced	Product of the reaction catalysed by the enzyme
Amylase		
Maltase		

(2)

(Total 4 marks)

Q10.

(a) An enzyme catalyses only one reaction. Explain why.

_____

_____

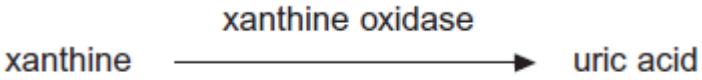
_____

_____

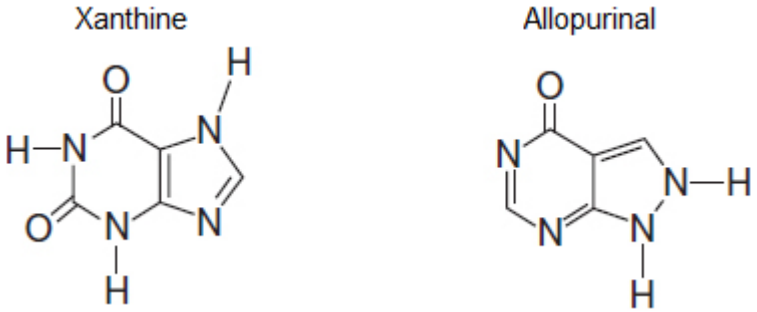
_____

(2)

(b) Gout is a disease caused by the build-up of uric acid crystals in joints. Uric acid is produced from xanthine in a reaction catalysed by the enzyme xanthine oxidase.



Allopurinol is a drug used to treat gout. The diagram shows the structures of xanthine and allopurinol.



Use this information to suggest how allopurinol can be used to treat gout.

_____

_____

_____

_____

_____

_____

(3)

(Total 5 marks)

Q11.

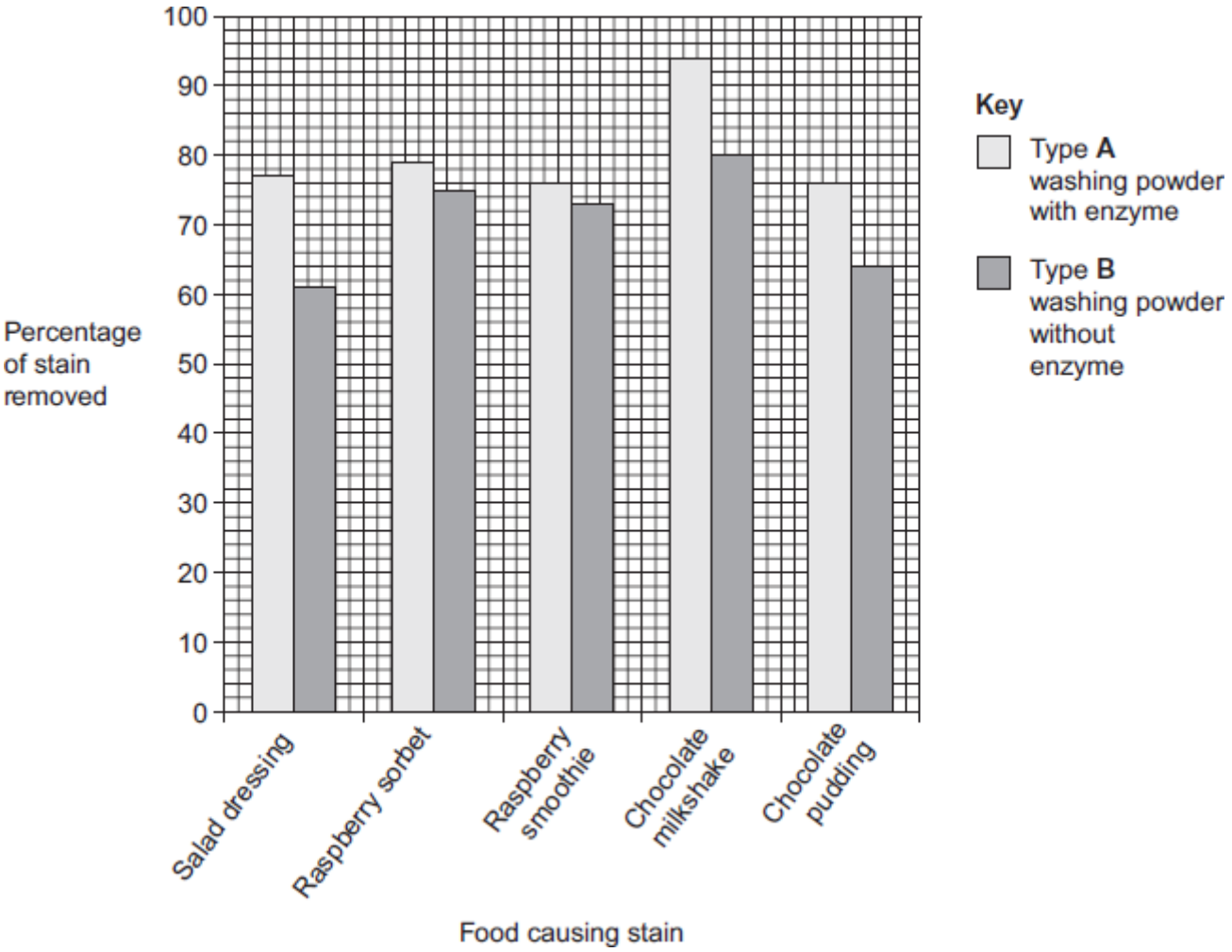
Biological washing powders contain enzymes which hydrolyse substances that cause stains on clothes.

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.

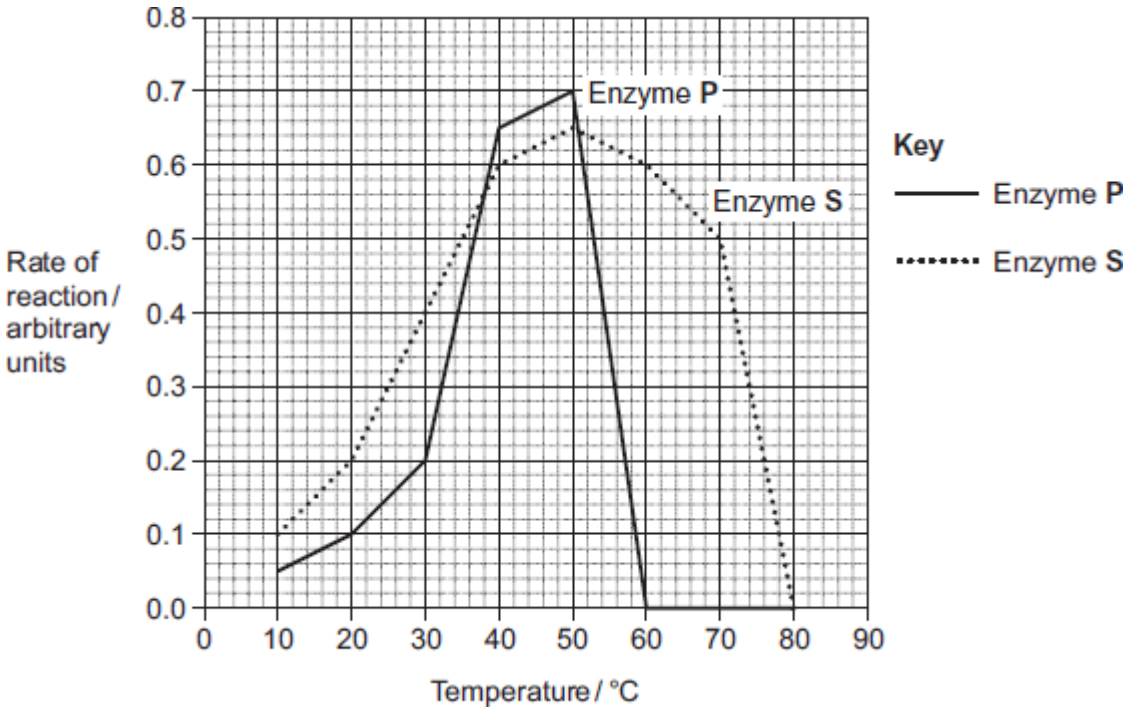
Figure 1



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.

(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.

(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)

Q12.

(a) In humans, the enzyme maltase breaks down maltose to glucose.
This takes place at normal body temperature.

Explain why maltase:

- only breaks down maltose
- allows this reaction to take place at normal body temperature.

(5)

(b) Scientists have investigated the effects of competitive and non-competitive inhibitors of the enzyme maltase.

Describe competitive and non-competitive inhibition of an enzyme.

(5)
(Total 10 marks)

Q1.

(a) 1. Crush / grind;

2. With ethanol / alcohol;

3. Then add water / then add to water;
2. Water must be added <u>after</u> ethanol for third mark.

4. Forms emulsion / goes white / cloudy;
4. Do not accept carry out emulsion test.

3

(b) (i) 4 / four;

1

(ii) 1. Phosphate / PO_4;
"It" refers to phospholipid.

2. Instead of one of the fatty acids / and two fatty acids;
1. Accept minor errors in formula. Do not accept phosphorus / phosphorus group.

2

(iii) 1. Double bonds (present) / some / two carbons with only one hydrogen / (double bonds) between carbon atoms / not saturated with hydrogen;
Answer refers to unsaturated unless otherwise clearly indicated.
May be shown in appropriate diagram.

2. In (fatty acid) **C** / 3;

2

[8]

Q2.

(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]

Q3.

(a)

Statement	Starch	Cellulose	Glycogen
Found in plant cells	✓	✓	
Contains glycosidic bonds	✓	✓	✓
Contains β-glucose		✓	

One mark for each correct row

3

(b) Hydrolysis;

Accept: if phonetically correct

Do not accept: 'hydration'

1

(c) 1. Coiled / helical / spiral;

Feature = one mark

Explanation = one mark

Note: these are independent marking points

These must be related for <u>both</u> marks but can be in reverse order

2. (So) compact / tightly packed / can fit (lots) into a small space;

3. Insoluble;

4. (So) no osmotic effect / does not leave cell / does not affect <u>water potential</u>;

Accept: prevents osmosis

5. Large molecule / long chain;

6. (So) does not leave cell / contains large number of glucose units;

4. and 6. Accept: can' t cross membranes

7. Branched chains;

8. (So) easy to remove glucose;

2 max

(d) Two marks for correct answer of 479 - 521;

Accept: measured and actual lengths in different but correct units for 1 mark

One mark for incorrect answers in which candidate clearly divides measured length by actual length;

The actual range is 23 - 25mm, If they just divide this by 48 they gain 1 mark

Just writing the formula is insufficient, numbers must be used

2

[8]

Q4.

(a) (i) Hydrolysis;

Accept phonetic spelling.

Ignore reaction.

1

(ii) (Alpha) glucose;

Accept α glucose.

Reject β glucose / beta glucose

1

(b) (i) Add Benedict's (reagent) <u>and</u> heat / warm;

Red / orange / yellow / green (colour);

Reject Add HCl

Accept brown, reject other colours

2

(ii) 2 products / 2 sugars produced;

*Look for idea of **<u>two</u>***

Accept named monosaccharides produced.

"More" insufficient for mark

Neutral if incorrect products named

Neutral "lactose is a polysaccharide"

Neutral "lactose is not a reducing sugar"

Neutral: Reference to surface area.

1

(c) 1. Galactose is a similar shape / structure <u>to lactose</u> / both complementary;

Q Reject: <u>Same</u> shape / structure

2. (Inhibitor / Galactose) fits into / enters / binds with <u>active site</u> (of enzyme);

Accept blocks active site

3. Prevents / less substrate fitting into / binding with (active site) / fewer or no E-S complexes;

Look for principles:

1. Shape

2. Binding to active site

3. Consequence

2 max

[7]

Q5.

(a) Amino acid / amino acids ;

If anything else is given as well do not award mark.

1

(b) (i) 1. Affects one monomer / amino acid;

i.e. What is affected

2. Not found in all active sites;

i.e. Where it is found.

2. Must relate to active site. Enzyme is insufficient.

2

(ii) 1. **X**;

2. Enzyme in both pathways;

2. Award independently

2

(c) 1. Occupies / blocks / binds to active site;

i.e. What it does in terms of the active site.

2. Substrate will not fit / does not bind / no longer complementary to / enzyme-substrate complex not formed;

1. Ignore references to change in shape and shape of aspirin molecule.

Ignore reference to competitive inhibitor i.e. Consequence required

2

[7]

Q6.

(a) 1. (Phosphate) changes shape of TK / changes shape of enzyme / changes the active site;

It = phosphate

Accept 'alters' for changes

Reject that phosphate is an inhibitor

Accept adding energy / affecting charged / affects polar groups (on amino acids)

2. Active site forms / becomes the right shape / can bind to substrate / complementary to substrate / E-S complex can form;

Reject similar / same shape as substrate

2

(b) 1. Faulty TK has functional active site without phosphate;

Accept 'works without phosphate'

2. (So, faulty) TK functional all the time / TK not controlled (by phosphate);

2

(c) 1. Non-competitive inhibitor / binds to site other than active site;

Accept allosteric site

Do not accept 'changes shape' unqualified

2. Causes TK to be in non-functional form / active site not formed / wrong shape / E-S complex not formed;

3. So, (uncontrolled) cell division stopped / slowed / controlled;

2 max

[6]

Q7.

(a) (i) 1. Water potential same (inside and outside) / no water potential gradient;

Accept symbol Ψ or abbreviation WP as alternatives to water potential.

2. Water does not enter / leave spores;

3. By osmosis / prevents osmotic damage;

Answer must refer to osmosis.

2 max

(ii) Prevents growth (before ready) / stops growth of (other) microorganisms / slows enzyme action / prevents enzymes being denatured;

1

(b) 1. Nitrogen / N / sulfur / S;

2. Catalase is a protein / catalase is made up of amino acids / enzymes are proteins / enzymes are made up of amino acids;

Specific reference needed to proteins or amino acids.

2

(c) 1. Prevents contamination by (other) microorganisms;

Accept alternatives such as microbes, bacteria, other fungi.

2. Which also produce the enzyme / catalase / which would produce substances that affect catalase;

2

(d) (i) 90 hours;

Hours must be specified in answer to (c)

1

(ii) 70 – 80 (hours);

Allow with no reference to units.

Incorrect units negates answer.

1

(e) 1. Extra steps (with intracellular enzymes);

2. Cells have to be broken open;

3. Cell walls / bits of cells have to be removed / separated from enzyme;

4. Needs to be separated from all the other enzymes in the cell;

2 max

[11]

Q8.

(a) (i) Joins nucleotides (to form new strand).

Accept: joins sugar and phosphate / forms sugar-phosphate backbone

Reject: (DNA polymerase) forms base pairs / hydrogen bonds

1

(ii) (Prokaryotic DNA)

1. Circular / non-linear (DNA);

Accept converse for eukaryotic DNA

Ignore: references to nucleus, binary fission, strands and plasmids

2. Not (associated) with proteins / histones;

Accept does not form chromosomes / chromatin

3. No introns / no non-coding DNA.

Accept only exons

***Q** Neutral: no 'junk' DNA*

2 max

(b) (i) 1. Have different genes;

Reject: different alleles

2. (Sobases / triplets) are in a different sequence / order;

Accept: base sequence that matters, not percentage

3. (So) different amino acid (sequence / coded for) / different protein / different polypeptide / different enzyme.

Unqualified 'different amino acids' does not gain a mark

Reject: references to different amino acids formed

Ignore: references to mutations / exons / non-coding / introns

2 max

(ii) (Virus DNA)

1. A does not equal T / G does not equal C;

Accept: similar for equal

Accept: virus has more C than G / has more A than T

2. (So) no base pairing;
3. (So) DNA is not double stranded / is single stranded.

2 max

[7]

Q9.

(a) (i) Glucose and fructose;

Ignore reference to alpha and beta

Either way around

1

(ii) Glucose and galactose;

Ignore reference to alpha and beta

Either way around

1

(b) 1. (Amylase) pancreas, produces maltose;

Place and product = 1 mark

(mark horizontally)

2. (Maltase) in / on epithelium (of small intestine), produces glucose;

Ignore references to salivary glands or saliva

Accept wall / lining of small intestine

Ignore reference to cells alone

Ignore reference to ribosomes / rER

2

[4]

Q10.

(a) 1. (Enzyme has) active site;

1. Reject active site is same shape as substrate

1. Reject active site is on the substrate

1. Accept active site forms during induced fit

2. Only substrate fits (the active site);

2. Accept converse statement

2

(b) Assume "it" = allopurinol

1. (Allopurinol) is a similar shape to xanthine;

1. Reject same shape. Accept similar structure

2. (Allopurinol) enters active site / is a competitive inhibitor;

2. Ignore e-s complexes in relation to inhibitor

2. Reject non-competitive inhibitor in the context of binding to the active site

2. Ignore complementary / fits

3. Less xanthine binds / fewer e-s complexes / fewer uric acid crystals formed / less uric acid formed;

3. Reject no e-s complexes / xanthine cannot enter active site, no uric acid

3. Can award in context of non-competitive inhibition

3

[5]

Q11.

(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]

Q12.

(a) 1. Tertiary structure / 3D shape of enzyme (means);

Accept references to active site

2. Active site complementary to maltose / substrate / maltose fits into active site / active site and substrate fit like a lock and key;

Idea of shapes fitting together

3. Description of induced fit;

4. Enzyme is a catalyst / lowers activation energy / energy required for reaction;

Accept "provides alternative pathway for the reaction at a lower energy level"

5. By forming enzyme-substrate complex;

Accept idea that binding stresses the bonds so more easily broken

Do not award point 5 simply for any reference to E-S complex

5

(b) 1. Inhibitors reduce binding of enzyme to substrate / prevent formation of ES complex;

Max 3 if only one type of inhibition dealt with. Accept maltase and maltose as examples of enzyme and substrate (and others)

Only once, for either inhibitor

(Competitive inhibition),

2. Inhibitor similar shape (idea) to substrate;

3. (Binds) in to active site (of enzyme);

Accept allows max rate of reaction to be reached / max product will eventually be formed

Accept complementary to active site

4. (Inhibition) can be overcome by more substrate;

(Non-competitive inhibition),

5. Inhibitor binds to site on enzyme other than active site;

6. Prevents formation of active site / changes (shape of) active site;

Accept does not allow max rate of reaction to be reached / max product will not be formed

7. Cannot be overcome by adding more substrate;

5 max

[10]