**Q1.**

(a)  Explain **five** properties that make water important for organisms.

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**(5)**

(b)  Describe the biochemical tests you would use to confirm the presence of lipid, non-reducing sugar and amylase in a sample.

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**(5)**

(c)  Describe the chemical reactions involved in the conversion of polymers to monomers and monomers to polymers.

Give **two** named examples of polymers and their associated monomers to illustrate your answer.

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**(5)**

**(Total 15 marks)**

**Q2.**

(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)**

**Q3.**

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

Lactose + water   galactose + monosaccharide **X**

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

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**(1)**

(ii)     Name monosaccharide **X**.

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**(1)**

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

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**(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.

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**(1)**

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

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**(2)**

**(Total 7 marks)**

**Q4.**

(a)     (i)      The equation shows the reaction catalysed by the enzyme lactase. Complete this equation.

Lactose + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Glucose + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

(ii)     Name the type of chemical reaction shown in this equation.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(b)     Lactase is an enzyme. Lactose is a reducing sugar.

(i)      Describe how you could use the biuret test to distinguish a solution of the enzyme, lactase from a solution of lactose.

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**(1)**

(ii)     Explain the result you would expect with the enzyme.

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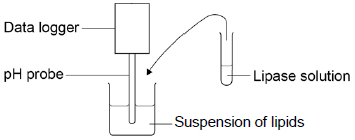
**(1)**

**(Total 5 marks)**

**Q5.**

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.

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**(1)**

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

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2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

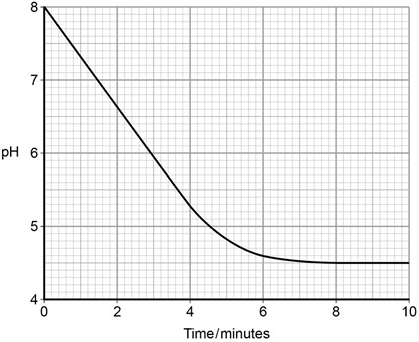
(c)     Give the suitable control for this investigation.

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**(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.

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**(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.

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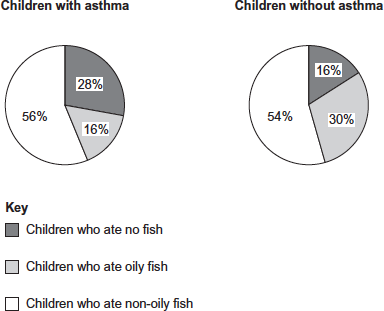
**(3)**

**(Total 11 marks)**

**Q6.**

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?

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**(3)**

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

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**(3)**

**(Total 6 marks)**

**Q7.**

(a)     Describe the difference between the structure of a triglyceride molecule and the structure of a phospholipid molecule.

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**(1)**

(b)     Describe how you would test for the presence of a lipid in a sample of food.

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**(2)**

(c)     Animal fats contain triglycerides with a high proportion of saturated fatty acids. If people have too much fat in their diet, absorption of the products of fat digestion can increase the risk of obesity. To help people lose weight, fat substitutes can be used to replace triglycerides in food.

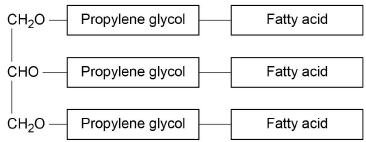
Describe how a saturated fatty acid is different from an unsaturated fatty acid.

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**(1)**

The diagram shows the structure of a fat substitute.



(d)     This fat substitute **cannot** be digested in the gut by lipase.

Suggest why.

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**(2)**

(e)     This fat substitute is a lipid. Despite being a lipid, it cannot cross the cell-surface membranes of cells lining the gut.

Suggest why it **cannot** cross cell-surface membranes.

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**(1)**

**(Total 7 marks)**

Mark schemes

**Q1.**

(a)  1.   A metabolite **in** condensation/hydrolysis/ photosynthesis/respiration;

2.   A solvent **so** (metabolic) reactions can occur

**OR**

A solvent **so** allowing transport of substances;

3.   High heat capacity **so** buffers changes in temperature;

*For ‘buffer’ accept ‘resist’.*

4.   Large latent heat of vaporisation **so** provides a cooling effect (through evaporation);

5.   Cohesion (between water molecules) **so** supports columns of water (in plants);

*For ‘columns of water’ accept ‘transpiration stream’.*

*Do not credit ‘transpiration’ alone but accept description of ‘stream’.*

*For ‘columns of water’ accept ‘cohesion-tension (theory)’.*

*For cohesion accept hydrogen bonding*

6.   Cohesion (between water molecules) **so** produces surface tension supporting (small) organisms;

*For cohesion accept hydrogen bonding*

*Ignore reference to pH.*

*Allow other suitable properties but must have a valid explanation.*

*For example*

*•   ice floating* ***so*** *maintaining aquatic habitat beneath*

*•   water transparent* ***so*** *allowing light penetration for photosynthesis*

**5 max**

(b)

*4 max if marks gained from only 2 substance tests.*

Lipid

1.   Add ethanol/alcohol **then** add water **and** shake/mix

**OR**

Add ethanol/alcohol **and** shake/mix **then** pour into/add water;

*Reject heating emulsion test.*

*Accept ‘Add Sudan III and mix’.*

2.   White/milky emulsion

**OR**

emulsion test turns white/milky;

*Ignore cloudy.*

*Reject precipitate.*

*Accept (for Sudan III) top (layer) red.*

Non-reducing sugar

3.   Do Benedict’s test **and** stays blue/negative;

*Ignore details of method for Benedict’s test for this mp.*

4.   Boil with acid **then** neutralise with alkali;

*Accept named examples of acids/alkalis.*

5.   Heat with Benedict’s **and** becomes red/orange (precipitate);

*Do not credit mp5 if no attempt at mp4.*

*For ‘heat’ ignore ‘warm’/’heat gently’/’put in a water bath’ but accept stated temperatures ≥ 60°C.*

*Heat must be stated again, do not accept using residual heat from mp4.*

*Accept ‘do the Benedict’s test’* ***if*** *full correct method given elsewhere.*

*Accept ‘sodium carbonate, sodium citrate and copper sulfate solution’ for Benedict’s but must have all three if term ‘Benedict’s’ not used.*

Amylase

6.   Add biuret (reagent) **and** becomes purple/violet/mauve/lilac;

*Accept ‘sodium or potassium hydroxide and copper sulfate solution’ for ‘biuret’.*

*Reject heating biuret test.*

7.   Add starch, (leave for a time), test for reducing sugar/absence of starch;

**5 max**

(c)

*Ignore reference to dimers.*

1.   A condensation reaction joins monomers together **and** forms a (chemical) bond **and** releases water;

2.   A hydrolysis reaction breaks a (chemical) bond between monomers **and** uses water;

3.   A suitable example of polymers and the monomers from which they are made;

*3. and 4. Polymers must contain many monomers.*

*3. and 4: suitable examples include*

*•   amino acid* ***and*** *polypeptide, protein, enzyme, antibody or specific*

*example*

*•   nucleotide* ***and*** *polynucleotide, DNA or RNA*

*•   Alpha glucose* ***and*** *starch/glycogen*

*•   Beta glucose* ***and*** *cellulose.*

*If neither specific carbohydrate example is given, allow monosaccharide/glucose and polysaccharide.*

*3. and 4. Reject (once) reference to triglycerides.*

4.   A second suitable example of polymers and the monomers from which they are made;

5.   Reference to a correct bond within a named polymer;

*Reject reference to ester bond.*

**5**

**[15]**

**Q2.**

(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]**

**Q3.**

(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) and 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* ***two***

*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 to lactose / both complementary;

*Q Reject: Same shape / structure*

2.      (Inhibitor / Galactose) fits into / enters / binds with active site (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]**

**Q4.**

(a)     (i)      (Lactose +) Water; → (Glucose +) Galactose;

*Accept: H2O for water*

**2**

(ii)     Hydrolysis;

*Accept: if phonetically correct*

**1**

(b)     (i)      (Add Biuret reagent to both solutions) – no mark;

*Neutral: positive / negative result*

         Lactase / enzyme will give purple / lilac / mauve;

*Neutral: incorrect reference to the method*

**OR**

Lactose / reducing sugar will not give purple / lilac / mauve / will remain blue;

**1**

(ii)     Lactase / enzyme is a protein;

*Accept: lactase / enzyme contains peptide bonds*

**1**

**[5]**

**Q5.**

(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]**

**Q6.**

(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]**

**Q7.**

(a)     1.      In phospholipid, one fatty acid replaced by a phosphate;

*Ignore references to saturated and unsaturated*

*Accept *

*Reject P/Phosphorus*

*Accept annotated diagrams*

**1**

(b)     1.      Add ethanol, then add water;

*Reject ethanal/ethonal*

*Accept ‘Alcohol/named alcohol’*

2.      White (emulsion shows lipid);

*Accept milky – Ignore ‘cloudy’*

*Sequence must be correct*

*If heated then DQ point 1*

*Reject precipitate*

**2**

(c)     Saturated single/no double bonds (between carbons)

**OR**

Unsaturated has (at least one) double bond (between carbons);

*Accept hydrocarbon chain/R group for ‘between carbons’ for either*

*Accept Sat = max number of H atoms bound*

*‘It’ refers to saturated*

**1**

(d)     1.      (Fat substitute) is a different/wrong shape/not complementary;

**OR**

Bond between glycerol/fatty acid and propylene glycol different   
(to that between glycerol and fatty acid)/no ester bond;

2.      Unable to fit/bind to (active site of) lipase/no ES complex formed;

*If wrong bond name given (e.g. peptide/glycosidic), then penalise once*

**2**

(e)     It is hydrophilic/is polar/is too large/is too big;

*Ignore ‘Is not lipid soluble’*

**1**

**[7]**