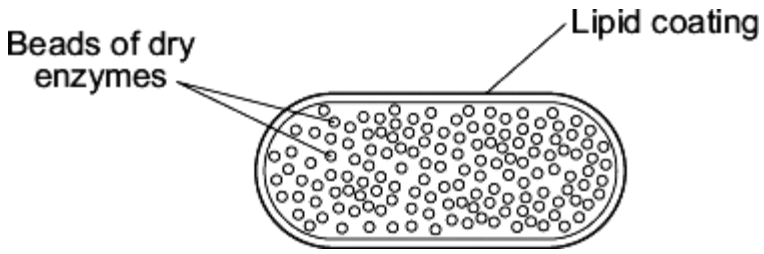
1 A patient has a disease. The disease damages his pancreas.

A doctor prescribes a course of treatment for the patient:
'Take one capsule with each meal.'

Each capsule contains hundreds of small, dry beads.

The beads are made of enzymes. The pancreas normally produces these enzymes.

The outer coating of the capsule is made of lipid.



(a) One enzyme in the beads is lipase.

In a healthy person, lipase is made in the pancreas.

Name **two** other enzymes made in the pancreas of a healthy person.

1. _____

2. _____

(2)

(b) The lipid coating on the capsule makes sure that the enzymes are not released until the capsule reaches the small intestine.

Explain how.

_____

_____

_____

_____

_____

(2)

(c) The lipase in the beads does **not** digest the lipid coating around the capsule.

Suggest why.

_____

_____

(1)

(Total 5 marks)

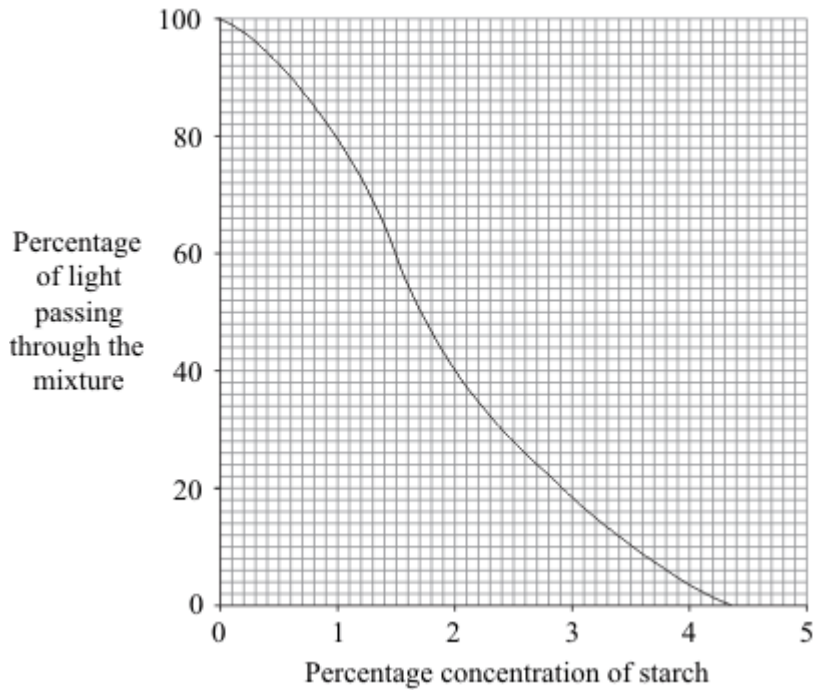
2 A manufacturer of slimming foods is investigating the effectiveness of carbohydrases from different microorganisms.

Iodine solution is a pale golden brown, transparent solution. Starch reacts with iodine to form a dark blue mixture.

Known concentrations of starch are added to iodine solution. The mixture is placed in a colorimeter which measures the percentage of light passing through the mixture.

Graph 1 shows the results.

Graph 1



(a) Explain why less light passes through the mixture when the starch is more concentrated.

_____

_____

_____

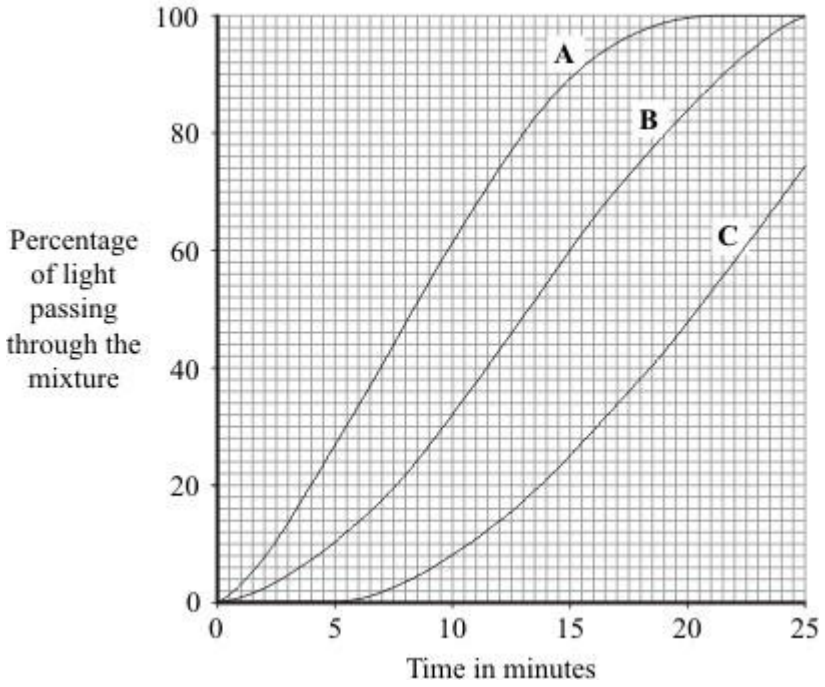
(1)

(b) The manufacturer adds carbohydrase from each of three different microorganisms, **A**, **B** and **C**, to starch in flasks at 40 °C.

Every minute a sample of the mixture is added to iodine solution and placed in the colorimeter.

Graph 2 shows these results.

Graph 2



(i) When the concentration of starch reaches 2 %, digestion is considered to be sufficient for the next stage in the manufacture of the slimming food.

How long does this take for the most effective carbohydrase?

Show clearly how you work out your answer.

_____

_____

_____minutes

(2)

(ii) Explain why the manufacturer carried out the investigation at 40 °C.

_____

_____

_____

_____

_____

(2)

(c) Carbohydrases convert starch into glucose. To complete the manufacture of the slimming food the glucose should be converted into fructose.

(i) Name the enzyme which would be used to convert glucose into fructose.

_____

(1)

(ii) Explain why fructose, rather than glucose, is used in slimming foods.

_____

_____

_____

_____

_____

(2)

(Total 8 marks)

3 (a) (i) What name is given to an enzyme which catalyses the breakdown of protein?

_____

(1)

(ii) What product is formed when protein is broken down by the enzyme?

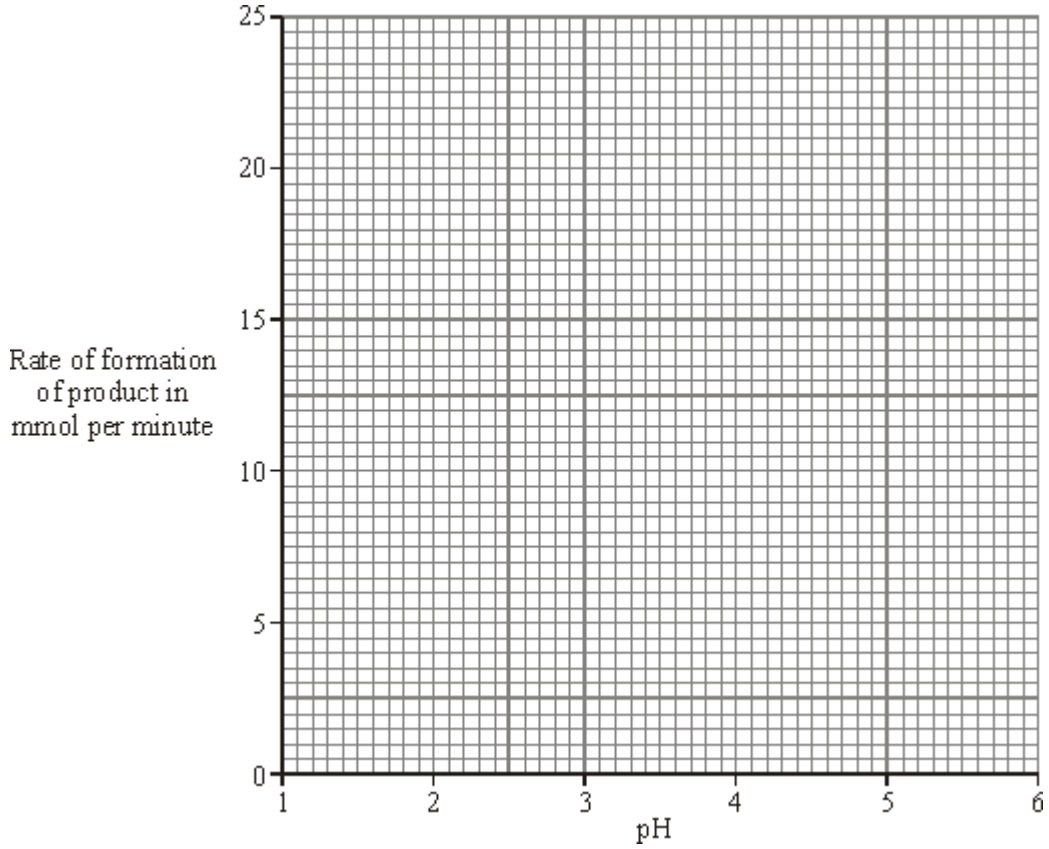
_____

(1)

The table shows the effect of pH on the activity of an enzyme which catalyses the breakdown of protein.

pH	1.0	2.0	3.0	4.0	5.0
Rate of formation of product in mmol per minute	10.5	23.0	10.5	2.5	0.0

(b) Draw a graph of the data in the table.



(3)

(c) The enzyme is produced by the human digestive system.

(i) At what pH does this enzyme work best? _____

(1)

(ii) Suggest which part of the digestive system produces this enzyme.

_____

(1)

(d) Why is it necessary to break down proteins in the digestive system?

_____

_____

_____

_____

_____

_____

(3)

(Total 10 marks)

4 Enzymes are used in biological detergents.

(a) Name the type of enzyme that digests stains containing fats.

_____

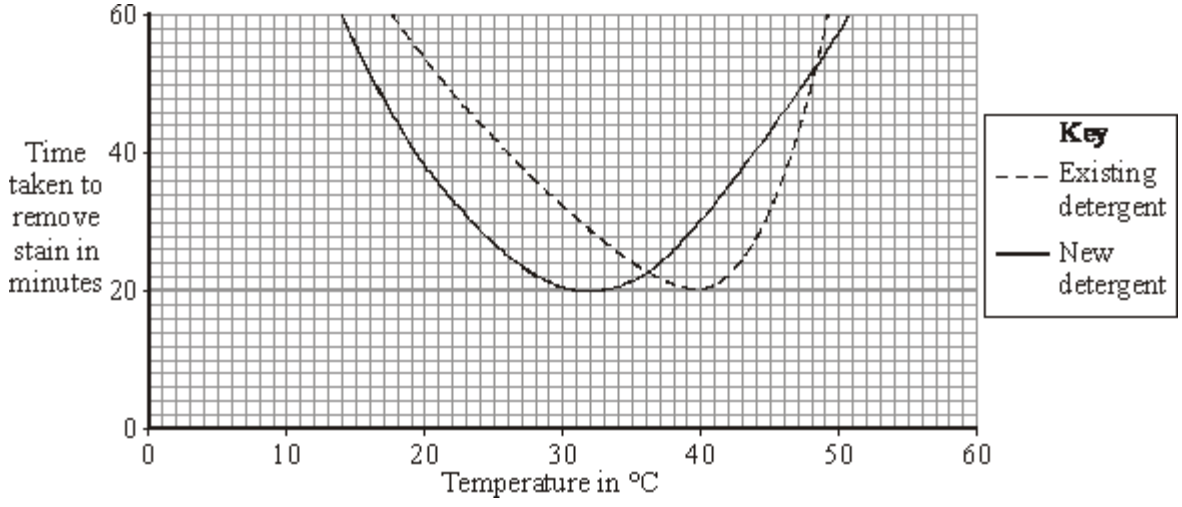
(1)

(b) A new detergent is marketed as being 'environmentally-friendly'.

Scientists compared the performance of this new detergent with an existing detergent.

They measured the time taken by the two detergents to remove a fat stain at different temperatures.

The graph shows their results.



(i) Describe the effect of increasing the temperature on the time taken by the existing detergent to remove the stain.

_____

_____

_____

_____

(2)

(ii) The new detergent works at a lower temperature than the existing one.

Is the new detergent likely to be more 'environmentally-friendly' than the existing detergent?

Draw a ring around your answer. **Yes / No**

Explain the reason for your answer.

_____

_____

_____

_____

(2)

(c) Neither detergent works well at 60 °C.

Explain why.

_____

_____

_____

_____

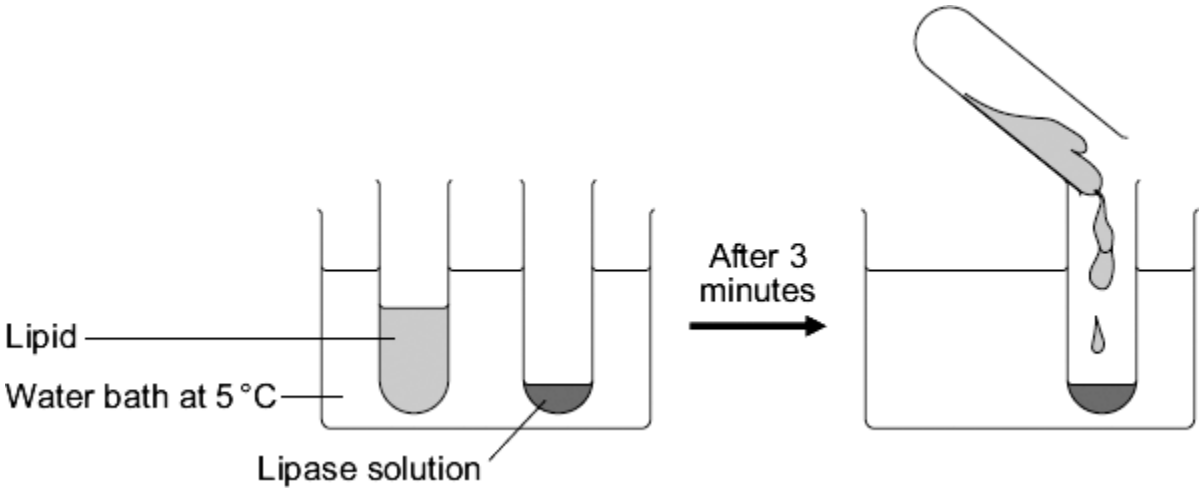
(2)

(Total 7 marks)

5 A group of students investigated the effect of temperature on the action of the enzyme lipase.

The students:

- put 1 cm^3 of lipase solution into a test tube
- put 5 cm^3 of lipid into a different test tube
- put both tubes in a water bath at 5 °C for 3 minutes
- mixed the lipid with the lipase solution.



Every five minutes the students tested a sample of the mixture for lipid, until no lipid remained. The students repeated the experiment at different temperatures.

(a) To make their investigation fair the students needed to control some variables.

Give **one** variable the students controlled in their investigation.

_____

(1)

(b) The tubes of lipase solution and lipid were kept separately in the water bath for 3 minutes before mixing. Why?

Tick (✓) **one** box.

So that the lipase broke down the lipid quickly ☐

So that the lipase and the lipid reached the right temperature ☐

To give enough time for the lipase to break down the lipid ☐

To give enough time for the water bath to heat up ☐

(1)

The table shows the students' results.

Temperature in °C	**Time taken until no lipid remained in minutes**
5	40
20	15
35	5
50	30
95	lipid still there after 120 minutes

(c) Describe the effect on the breakdown of the lipid of increasing the temperature from 5 °C to 50 °C.

_____

_____

_____

_____

(2)

(d) Suggest **two** ways in which the students could have improved their investigation.

Use information from the students' method and the results table to help you.

1. _____

_____

_____

2. _____

_____

_____

(2)

(e) (i) The lipase did **not** break down the lipid at 95 °C.

Why?

_____

_____

(1)

(ii) At 35 °C the lipase broke down the lipid after 5 minutes.

What new substances will be in the tube?

Draw a ring around **one** answer.

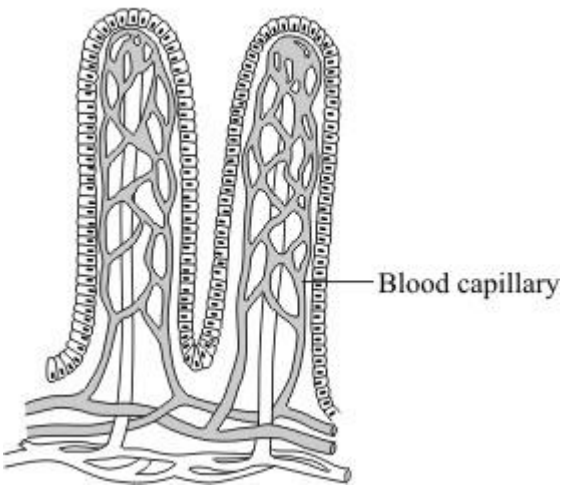
amino acids **fatty acids and glycerol** **sugars**

(1)

(Total 8 marks)

6 **Diagram 1** shows two villi in the small intestine of a healthy person.

Diagram 1



(a) Describe **two** features of the villi which help the small intestine to function.

1. _____

_____

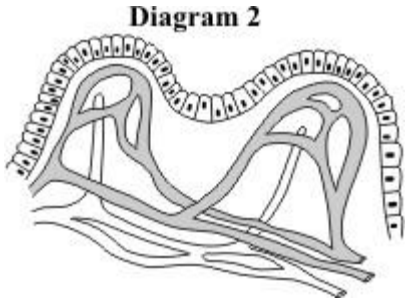
2. _____

_____

(2)

(b) **Diagram 2** shows two villi in the small intestine of a person with coeliac disease.

Diagram 2



(i) How do the villi of the person with coeliac disease differ from those of a healthy person?

_____

_____

(1)

(ii) Suggest how this difference might affect how well the small intestine functions.

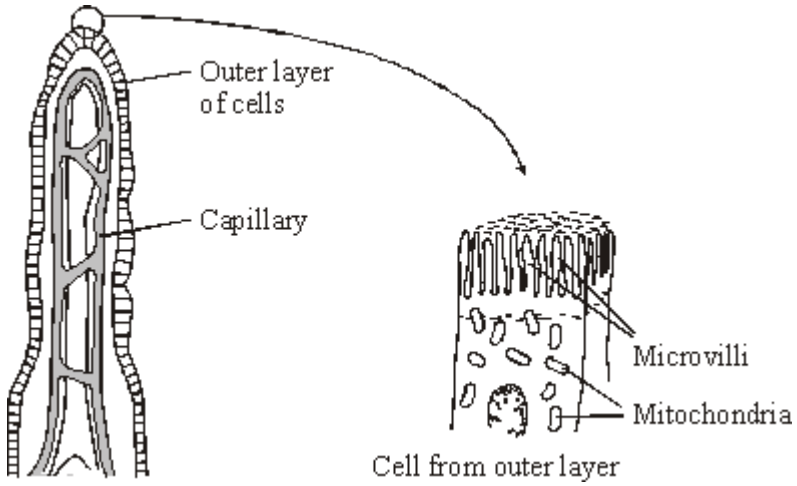
_____

_____

(1)

(Total 4 marks)

7 The small intestine is lined with millions of villi.
The diagram shows the structure of a villus.



In the small intestine, some of the products of digestion are absorbed into the blood by *active transport*.

(a) Explain what is meant by *active transport*.

_____

_____

_____

_____

(2)

(b) How do microvilli and mitochondria help in the active transport of the products of digestion from the small intestine into the blood?

Microvilli _____

_____

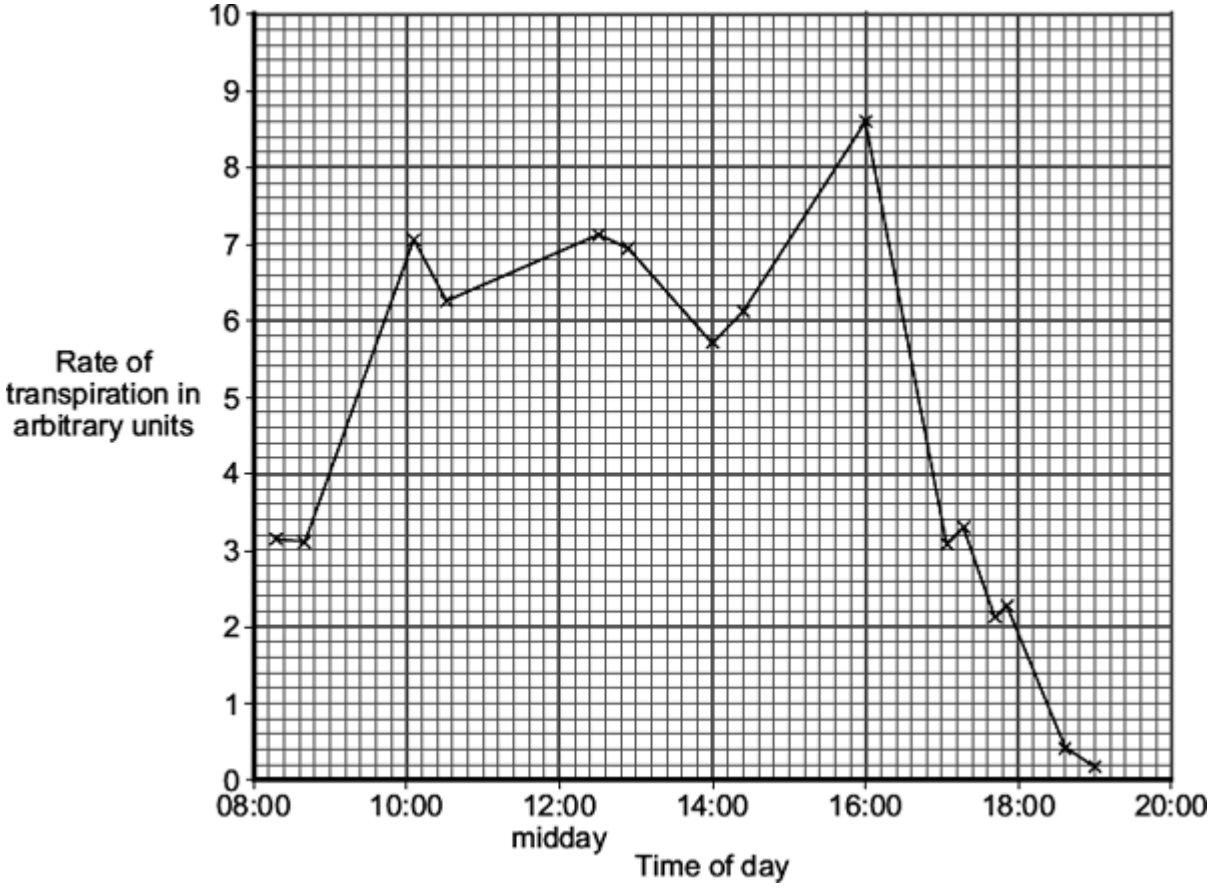
Mitochondria _____

_____

(2)

(Total 4 marks)

8 The graph shows the rate of transpiration from a plant at different times of the day.



Transpiration occurs mainly in the leaves of a plant.

(a) (i) What is *transpiration*?

_____

_____

_____

_____

(2)

(ii) Through which part of a leaf does most transpiration occur?

_____

(1)

(b) In this investigation, the rate of transpiration decreases between 16:00 hours and 19:00 hours.

(i) Calculate the average rate of decrease per hour in the rate of transpiration over this time.

Show clearly how you work out your answer.

Rate = _____ arbitrary units per hour

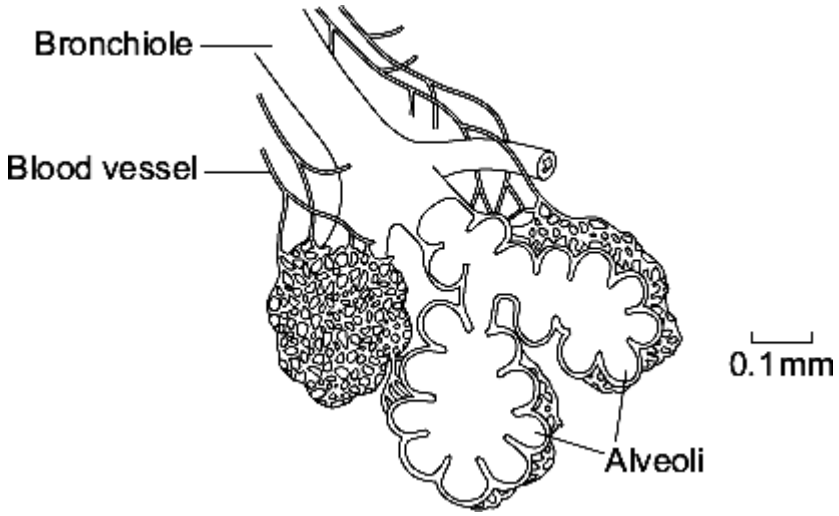
(2)

(ii) Suggest **one** explanation for the decrease in the rate of transpiration between 16:00 hours and 19:00 hours.

(2)

(Total 7 marks)

9 The human lung has about 80 million alveoli.
The diagram shows some alveoli in a human lung.



(a) Give **three** features of the alveoli that allow large amounts of oxygen to enter the blood.

1. _____

_____

2. _____

_____

3. _____

_____

(3)

(b) (i) Name the process by which oxygen passes from the air into the blood.

_____

(1)

(ii) Breathing allows large amounts of oxygen to enter the blood.

Explain how breathing does this.

_____

_____

_____

_____

(2)

(Total 6 marks)

Mark schemes

1 (a) protease

allow trypsin / peptidase

*do **not** allow pepsin*

1

carbohydrase / amylase

*do **not** allow sucrase / maltase / lactase*

1

(b) no lipase produced / found

1

in stomach / mouth / before small intestine

OR

accept lipase <u>only</u> produced / found (1)

in small intestine / pancreas (1)

*if no other mark is awarded lipid is not broken down in the stomach **or** lipid is digested in small intestine gains **1** mark*

1

(c) enzymes only work in solution / when dissolved

or

because enzyme / lipase / it is dry

*allow enzymes only work in presence of water **or** enzymes do not work when dry*

ignore other physical conditions

1

[5]

2 (a) opaque / less transparent / blue

allow mixture becomes dark / black

ignore thicker

1

(b) (i) 7 (minutes) **or** in range 6.7 to 7

*award **2** marks for correct answer*

if answer is incorrect evidence of selection of 40(% light intensity) either in working **or** in graph 2 for **1** mark

2

(ii) any **two** from:

- slower / takes longer at lower temperatures
- (40 ^{o}C is) optimum / best temperature
  allow near to 37^{o}C / body temperature where enzymes work best
- enzyme denatured / destroyed / damaged at higher temperatures
  allow description of denaturation

2

(c) (i) isomerase
allow phonetic spelling

1

(ii) fructose is sweeter than glucose
needed in smallerquantities **or** less is needed

2

[8]

3

(a) (i) protease
*accept peptidase **or** named protease*
e.g. pepsin / trypsin
allow 'proteinase'

1

(ii) amino acids
accept peptides / polypeptides / peptones

1

(b) points plotted accurately

± $\frac{1}{2}$ *square*

*deduct **1** mark per error*

2

best fit curve **or** ruled point-to-point

if double line within $\frac{1}{2}$ *square*
allow sharp apex
*do **not** allow single straight line*
if no points line defines points
*if (5,0) not plotted only penalise **1** mark*
*bar graph wide bars – **no** marks*

bar graph **±** $\frac{1}{2}$ *square max **2** for points*

1

(c) (i) 2 **or** correct from candidate's graph

± $\frac{1}{2}$ *square*

1

(ii) stomach

1

(d) proteins are large / product is small

1

proteins (may be) insoluble / product is soluble

1

cannot be absorbed / cannot enter blood **or** cannot pass through gut lining

accept reverse referring to product

1

[10]

4 (a) lipase

allow phonetic spelling

allow lipidase

1

(b) (i) fall **then** rise owtte eg down **then** up

*allow faster **then** slower*

ignore explanations

1

minimum / least / fastest / best / optimum at 39–41(°C)

allow it falls to 40(°C)

*if no other marks gained, 'falls to an optimum' gains **1** mark*

1

(ii) (yes)

there is no mark for circling 'yes'

*maximum **1** mark if No is circled*

any **two** from:

- less heat / energy / electricity / power required / used / wasted

  ignore lower temperature

- conserves fuel supplies
  or less fuel used

- less pollution from power stations
  owtte

  accept less global warming

  or

  less CO_2 / carbon emissions / greenhouse gases

  or

  less SO_2 / acid rain

  ***NB** only direct effects*

  less pollution only is not enough

2

(c) any **two** from:

*max **1** mark for reference to cell*

- enzyme / lipase

  accept any named enzyme

- destroyed / denatured

  allow damaged / broken down

  ***not** 'killed'*

- reference to (specific) shape changed

  ignore detergent / it

2

[7]

5 (a) any **one** from:

*ignore reference to recording results every 5 minutes **or** concentrations of lipid / lipase*

- (same) volume / amount / 1 cm^3 lipase
  allow amount of solution
- (same) volume / amount / 5 cm^3 lipid
  allow keep same volumes in the test tubes
- mixed after 3 minutes / same time before mixing
  *do **not** accept temperature*

1

(b) so that the lipase and the lipid reached the right temperature

1

(c) any **two** from

ignore explanations

- decrease in time **or** faster (breakdown)
- then increase in time **or** then slower (breakdown)
- fastest / least time / optimum at 35°C

2

(d) any **two** from:

ignore 'test at more temperatures' unqualified

- test more regularly eg test every minute
  any interval < 5min
- test at smaller temperature intervals
  any value <15°C
  allow test more temperatures in the range
- test between 50 (°C) and 95 (°C)
  any value in range, eg test at 70
- repeat at same temperatures
  or repeat the investigation
  or compare results with others
  *allow do **it** again*

2

(e) (i) (lipase / it) denatured / destroyed / changed shape

allow damaged / deformed

*do **not** accept killed*

ignore broken (down)

1

(ii) fatty acids and glycerol

1

[8]

6 (a) any **two** from:

- large surface / area **or** many villi **or** have microvilli

  accept big surface / area

- thin surface **or** thin wall **or** surface 1-cell thick **or** capillaries near surface **or** permeable **or** partially permeable

  accept they are thin

  *do **not** allow thin **cell** wall*

- many blood vessels **or** many capillaries **or** capillary network **or** good blood supply

  ignore 'constant blood flow' owtte

  ignore extras eg moist or reference to gases

- have enzymes

  ignore release enzymes

  - *accept reference to lacteal as 5th point*
  - *allow reference to having mitochondria*

2

(b) (i) small(er) (surface area) / flat(ter) / short(er) **or** not as folded **or** fewer capillaries owtte

allow small(er) lacteal

ignore references to wide / thick / spread out etc

1

(ii) less absorption (of digested food) / less digestion / diffusion

accept slower for less

accept description of less digestion

accept less food can get in

*do **not** allow zero absorption*

*do **not** allow 'collection' of nutrients*

1

[4]

7 (a) any **two** from:

- transport up / against concentration gradient / low to high concentration
- uses energy
- use of protein / carrier

2

(b) microvilli – large(r) surface area

accept have carriers

1

mitochondria – release energy **or** make ATP

*do **not** accept 'makes energy'*

1

[4]

8 (a) (i) water <u>loss</u>

extra substance(s) cancel

*if transpiration stream described max **1** mark*

1

as a vapour / by evaporation

ignore stomata

1

(ii) stomata / stoma / guard cells

ignore epidermis

1

(b) (i) 2.8

*correct answer with or without working gains **2** marks*

if answer incorrect:

*allow **1** mark for (8.6 - 0.2) ÷ 3 **or** 8.4 ÷ 3*

2

(ii) warmer at 16:00 / gets cooler

***or** reverse argument for 19.00*

1

faster diffusion / evaporation

accept sun setting as equivalent to heat or light marking points

or

lighter at 16:00 / gets darker (1)

if no environmental factor still allow reason mark

stomata open / more open (1)

eg 'stomata close later in the day'

or

(more) windy at 16:00 / gets less windy (1)

removal of (more) water vapour / steeper gradient (1)

or

air is less humid at 16.00 (1)

allow rain at 19.00

faster diffusion or steeper gradient (1)

1

[7]

9 (a) large surface / large area

1

thin / short distance (from air to blood) / one cell thick / two cells thick

1

good blood supply / many capillaries / capillary network / many blood vessels

ignore moist surface

1

(b) (i) diffusion

ignore gaseous exchange

1

(ii) brings (more) oxygen / air into the lungs / alveoli

1

keeps O_2 level high in alveoli

or

maintains concentration difference (between alveoli and blood) / keeps O_2 concentration in alveoli > O_2 concentration in blood gains **2** marks

1

[6]