M1.(a) C.

Ignore name of organ

1

(b) E.

Ignore name of organ

1

(c) 1. Active site (of enzyme) has (specific) shape / tertiary structure / active site complementary to substrate / maltose;

Reject active site on substrate.
Must have idea of shape
Assume "it" = maltase
Accept (specific) 3D active site
Reject has same shape

2. (Only) maltose can bind / fit;

Accept "substrate" for "maltose"

3. To form enzyme substrate complex.

Accept E−S complex

3

[5]

M2.(a) Accept **three** suitable suggestions:

1. (Lactase / beads) can be reused / not washed away;

1. Accept lactase / beads not wasted
1. Less lactase used is insufficient

2. No need to remove from milk;

2. Accept lactase not present in milk.

3. Allows continuous process;
4. The enzyme is more stable;
5. Avoid end-product inhibition.

Ignore ref to SA

3 max

(b) 1. (Lactose hydrolysed to) galactose and glucose;
2. (So) more sugar molecules;
*2. Idea of **more** sugars essential*

3. (So) more / different receptors stimulated / sugars produced are sweeter (than lactose).

2 max

[5]

M3.(a) 1. Large / dense / heavy cells;
2. Form pellet / move to bottom of tube (when centrifuged);
3. Liquid / supernatant can be removed.
Must refer to whole cells.

3

(b) Break down cells / cell parts / toxins.
Idea of 'break down / digestion' needed, not just damage

1

(c) 1. To stop / reduce them being damaged / destroyed / killed;
Reject (to stop) bacteria being denatured.

2. By stomach acid.
Must be in context of stomach.

2

(d) 1. More cell damage when both present / A;

2. Some cell damage when either there on their own / some cell damage in B <u>and</u> C;
MP1 and MP2 − figures given from the graph are insufficient.

3. Standard deviation does not overlap for A with B <u>and</u> C <u>so</u> difference is real;
*MP3 and MP4 **both** aspects needed to gain mark.*

4. Standard deviations do overlap between B and C <u>so</u> no real difference.

MP3 and MP4 accept reference to significance / chance for 'real difference'

3 max

(e) 1. Enzyme (a protein) is broken down (so no enzyme activity);
Accept hydrolyse / digested for 'broken down'.

2. No toxin (as a result of protein-digesting enzyme activity);
Must be in the correct context.

3. (So) toxin is protein.
This must be stated, not inferred from use of 'protein−digesting enzyme'.

3

[12]

M4.(Maintaining constant pH to avoid)

1. Named protein / enzyme (in blood) sensitive to / affected by change in pH;
Accept converse for MP2 and MP3.
Named example should be a protein that might be affected (by change in pH) eg haemoglobin, carrier protein in plasma membrane.
Accept 'change in H^+ concentration' for 'change in pH'.

2. (Resultant) change of charge / shape / tertiary structure;
The change in charge idea relates to the enzyme / protein and not the blood (plasma) or red blood cells.
'Denaturation' alone is insufficient.

3. Described effect on named protein or enzyme.
e.g. less oxygen binds with haemoglobin / less transport across membranes / fewer substrates can fit active site / fewer enzyme-substrate complexes.
Idea of 'less' or 'fewer' required. Ignore suggestion of 'no' or 'none'.

[3]

M5.(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 <u>active site</u> (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]

M6.(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]

M7.(a) Deoxyribose.

1

(b) 1. Thymine 18 (%);
2. Guanine 32 (%).

2

(c) DNA polymerase.

1

(d) 1. (**Figure 1** shows) DNA has antiparallel strands / described;
2. (**Figure 1** shows) shape of the nucleotides is different / nucleotides aligned differently;
3. Enzymes have active sites with specific shape;
4. Only substrates with complementary shape / only the 3' end can bind with active site of enzyme / active site of DNA polymerase.

4

[8]