EXAM PAPERS PRACTICE

Proteins and enzymes 2

Level: CIE AS 9700
Subject: Biology
Exam Board: Suitable for all boards
Topic: Proteins and enzymes 2
Type: Mark Scheme

To be used by all students preparing for CIE AS Biology 9700 foundation or higher tier but also suitable for students of other boards.

Mark schemes

1

(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]

2

(a) Quaternary (structure);

Accept phonetic spelling eg quarternary/quarternery /4°

Award no mark for quaternary as part of a list

1

(b) 423;

1

(c) 1. Oxyhaemoglobin formed/ haemoglobin is loaded/ uptakes/associates/binds with oxygen in area of higher ppO_2 / in gas exchange surface/lungs/gills;

Reference to "react with" = max 1

Accept: reversible interaction with oxygen

Ignore: haemoglobin is carried / contained in red blood cells

2. (oxygen) unloaded/dissociates from/released (in area of lower ppO_2 / in capillaries/to cells/tissues);

2

(d) (i) 56(%);

Accept responses in the range 54-58(%)

1

(ii) 1. (Anaemia curve shifted to right) haemoglobin has lower affinity for oxygen / binds less tightly;

Assume reference is to haemoglobin of anaemia unless stated

2. releases more oxygen / oxygen is released quicker / oxygen dissociates/ unloads more readily to muscles/tissues/cells;

3. (For) respiration;

Accept: even with a lower haemoglobin concentration / meet demand for ATP/energy;

3

[8]

3

(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 "malt ose"

3. To form enzyme substrate complex.

Accept E−S complex

3

[5]

4

(a) Lactose intolerance in babies/babies don't make/have lactase;
Lactose (in milk) causes colic/crying/discomfort;
Lactase breaks down lactose/milk sugar;

2 max

(b) To avoid prejudice/bias from mother (when recording crying);

Accept for mother she/they/their

Accept to avoid mothers being concerned that their child has lactose intolerance.

Q - Reject vague ref. to fair test/avoid bias with no ref. to mothers.

1

(c) **One** variable; with explanation;
Example,
Type of milk used;
So same concentration of lactose;

Same age of children;
Change in enzyme production with age;

Same age of children;
Change in milk consumption with age;

Same volume of milk (per kg baby);

So same dosage (of lactose);

Accept ref. to controlling other factors in diet

Reject time in the context of duration of investigation, given in stem

Accept e.g. time of feeding each day

Accept temperature of milk, related to action of lactase enzyme

2 max

(d) There is a decrease in crying;
Could be other causes/symptoms of colic;
Babies might cry for reasons besides colic/might have colic and not cry/can't be sure they have colic, they can't talk;
Don't know number of babies in trial/need a larger study;
So don't know how reliable mean is;
Standard deviation not given/spread of data;
So don't know whether difference is significant;
Babies still crying (for 1.43 hours);
Recording by mothers might not be reliable;
Longer running study to make sure effect (of lactase) lasts;

3 max

[8]

5

(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]

6

(a)
1. Helicase;
2. Breaks hydrogen bonds;
3. Only one DNA strand acts as template;
4. RNA nucleotides attracted to exposed bases;
5. (Attraction) according to base pairing rule;
6. RNA polymerase joins (RNA) nucleotides together;
7. Pre-mRNA spliced to remove introns.

6 max

(b)
1. Polymer of amino acids;
2. Joined by peptide bonds;
3. Formed by condensation;
4. Primary structure is order of amino acids;
5. Secondary structure is folding of polypeptide chain due to hydrogen bonding;

Accept alpha helix / pleated sheet

6. Tertiary structure is 3-D folding due to hydrogen bonding and ionic / disulfide bonds;
7. Quaternary structure is two or more polypeptide chains.

5 max

(c)
1. Hydrolysis of peptide bonds;
2. Endopeptidases break polypeptides into smaller peptide chains;
3. Exopeptidases remove terminal amino acids;
4. Dipeptidases hydrolyse / break down dipeptides into amino acids.

4

[15]

7

(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]

8 (a) Amylase;

(Starch) to maltose:

Maltase;

Maltose to glucose;

Hydrolysis;

(Of) glycosidic bond;

Q *Do not penalise incorrect site for digestion or incorrect site of enzyme production.*

5 max

(b) Glucose moves in with sodium (into epithelial cell);

Via (carrier / channel) protein / symport;

Sodium removed (from epithelial cell) by active transport / sodium- potassium pump;

Into blood;

Maintaining low concentration of sodium (in epithelial cell) / maintaining sodium concentration gradient (between lumen and epithelial cell);

Glucose moves into blood;

By (facilitated) diffusion;

Q *Only allow diffusion mark in context of movement of glucose into the blood.*

5 max

[10]

9

(a) (i) Hydrolysis;

1

(ii) Water enters fungus (by osmosis) which increases pressure inside fungus;
Cell wall no longer strong enough / present so cannot withstand this;

2

(iii) Cell wall (of plant) not made of chitin / made of cellulose;
Enzyme is specific to chitin / will not break down cellulose;

1

(b) Way in which the whole protein / polypeptide is folded / shape adopted by whole protein molecule / further folding of 2° structure;

Do not credit unqualified reference to three-dimensional shape.
Reject third level / third sort.

1

(c) (i) More (kinetic) energy;
Bonds / specified bonds (holding tertiary structure) break;

2

(ii) Change amino acids;
Allowing formation of more hydrogen bonds / disulphide bridges;

2

(d)
1. Sequence of amino acids gives shape;
2. This is tertiary structure;
3. Has similar shape to substrate;
4. Fits / competes for active site;
5. Fits at site other than active site;
6. Distorting active site;
7. Therefore substrate will not fit (active site);

max 6

[15]

10 (a) 1. Sodium ions actively transported from ileum cell to blood;

2. Maintains / forms diffusion gradient for sodium to enter cells from gut (and with it, glucose);

3. Glucose enters by facilitated diffusion with sodium ions;

3

(b)

Biochemical test	Liquid from beaker	Liquid inside Visking tubing
Biuret reagent		✓
I_2/KI		✓ or blank
Benedict's	✓	✓

1 mark for each correct row

3

(c) 1. Biuret: protein molecules too large to pass through tubing;

Neutral: enzyme molecules

2. Iodine in potassium iodide solution: starch molecules too large to pass through tubing;

If no tick in 04.2, allow no starch hydrolysed

3. Benedict's: starch hydrolysed to maltose, which is able to pass through tubing.

Reject: glucose

3

[9]

11 (a) 1. IV on x axis and DV on y axis **and** both axes on linear scales;

2. Axes labelled clearly and with correct units separated from variable by solidus or in brackets;

3. All rates calculated correctly;

4. Points plotted correctly **and** joined by ruled lines and no extrapolation;

4

(b) Yes:

1. Expect optimum temperature of enzyme to be same

OR

Similar to temperature where bacterium lives;

2. Optimum temperature for enzyme (appears to be around) 15 °C;

No:

3. Need data from more temperatures (between 10 °C and 20 °C);

4. Data for only isolated enzyme

OR

Isolation may affect activity;

4

(c) 1. Initial / starting substrate concentration

2. Enzyme concentration

3. pH.

*Any **2** for **1** mark*

1 max

[9]

12

(a) 1. (before reaction) active site not complementary to/does not fit substrate;

2. Shape of active site changes as substrate binds/as enzyme-substrate complex forms;

Note. Points 1 and 2 may be made in one statement and 'complementary' introduced at any point.

Points 1&2 – active site mentioned once applies for both points

Point 2 – Ignore references to how shape change is caused

3. Stressing/distorting/bending bonds (in substrate leading to reaction);

2 max

(b) 1. Tangent to curve drawn;

Tangent drawn at about 10 minutes

2. Value in range of 8 to 11;

1 mark only for correct answer

2

(c) 1. (Rate of) increase in concentration of maltose slows as substrate/starch is used up
OR
High initial rate as plenty of starch/substrate/more E-S complexes;

Reject ref. to amylase being used up

2. No increase after 25 minutes/at end/levels off because no substrate/starch left;

Accept 'little'

Ignore references to substrate a limiting factor

2

(d) 1. Make/use maltose solutions of known/different concentrations (and carry out quantitative Benedict's test on each);
2. (Use colorimeter to) measure colour/colorimeter value of each solution and plot calibration curve/graph described;

Axes must be correct if axes mentioned, concentration on x-axis and colorimeter reading on y-axis

3. Find concentration of sample from calibration curve;

3

[9]

13 (a) Any **one** from:

1. Numerical readings / not subjective / colour change subjective / gives quantitative data / not qualitative / gives continuous data;
2. Greater accuracy;

Accept greater precision

1 max

(b) Fatty acids produced;

1

(c) 1. No more (fatty) acids produced;
2. All triglycerides/fat//lipids/substrate used up / enzyme denatured;

2

(d) 1. Line starting at same point and falling above original line;
2. Levels off at same pH, but later;

Accept the line still falling at 4 minutes

Do not credit if levels off at higher pH

2

[6]

14 (a) 1. Add Benedict's;

Hydrolyse with acid negates mp1

2. Heat;

Accept warm, but not an unqualified reference to water bath

3. Red / orange / yellow / green (shows reducing sugar present);

Accept brown

3

(b) (i) 1. Starch hydrolysed / broken down / glucose / maltose produced;
Neutral: Sugar produced

2. Lower water potential;

3. Water enters by osmosis;

3

(ii) Only 2 pHs studied / more pHs need to be tested;
Accept: different amylase may have a different optimum pH

1

[7]

15 (a) ***EITHER***

Answer either based on

1. Molecules move at slower speeds;
2 diffusion or

2. Decreases rate of diffusion;
4 enzymes.

OR

3. Molecules move at slower speed;

4. Fewer collisions between enzymes and substrates / fewer enzyme-substrate complexes formed;
Accept converse answers if clearly in context of "If it stayed at 30 °C".

2 max

(b) (i) 1. Allows comparison;
2. Different amounts of fungus added / fungus is different size at start;

2

(ii) Two marks for correct answer in range 1.7 : 1 to 1.3 : 1;;
Answer must be expressed this way round and must give the diameter of the fungus as 1.

One mark for unsimplified answer in range 29 : 19 to 27 : 21;
Calculations are based on tolerance limits for measurements of ± 1 mm. If the actual measurements are other than 28 and 20, marking guidelines should be adjusted accordingly.

2

(c) 1. Colourless zone around fungus / colourless zone outside fungus;

2. No fungus growing here / must be enzyme here;
Accept any alternative wording clearly relating to colourless zone.

2

[8]

16 (a) (Most of) bromelain is digested / not absorbed / broken down in blood;

1

(b) Total volume of blood;

1

[2]

17 (a) (i) Increase to 30 °C / 31 °C and then decreases / optimum or max rate at 30 °C / 31 °C;

Accept: peak at 30 °C / 31 °C

1

(ii) 1. Enzyme denatured / hydrogen bonds / bonds holding tertiary structure broken / tertiary structure changed;

2. Change in shape of active site (of enzymes);

3. Substrate / protein no longer fits / binds (into active site) / few or no ES complexes;

1. Reject: Peptide bonds broken

Denatures active site = 2 marks for mp 1 and 2

2. Q Only allow second point if active site is used correctly

Accept: active site no longer complementary

3. Accept: Substrate cannot bind to enzyme

3

(b) (i) Use buffer / test pH (at end / at intervals);

Accept a method of measuring pH.

Reject litmus.

1

(ii) (30 °C / 31 °C) Maximum rate / optimum temperature;

Accept other valid answers e.g. temp below 30 °C as enzyme not denatured.

1

(iii) Works best at pH 6 / at higher pH activity decreases;

Accept converse

Insufficient: pH 6 had largest clear area

1

[7]

18 (a) (i) (Grinding) breaks open cells / increases surface area (of liver);
Releases catalase / enzyme / more catalase / allows more hydrogen peroxide into liver;

2

(ii) Heating causes bonds (maintaining tertiary structure) to break;
Denatures / changes tertiary structure so active site changed;
Substrate no longer fits / ES complex not formed;

3

(b) (Control) to show that sand did not affect reaction (with ground liver);

1

(c) (i) Lower activation energy / less energy required to bring about reaction;

1

(ii) Energy in products / water and oxygen less than energy in substrate / reactants / hydrogen peroxide;
(Difference) given out as heat / exothermic;

2

[9]

19

(a) (i) (Molecule) made up of many identical / similar molecules / monomers / subunits;
Not necessary to refer to similarity with monomers.

1

(ii) Cellulose / glycogen / nucleic acid / DNA / RNA;

1

(b) (i) To keep pH constant;
A change in pH will slow the rate of the reaction / denature the amylase / optimum for reaction;

2

(ii) Purple / lilac / mauve / violet;
Do not allow blue or pink.

1

(iii) Protein present / the enzyme / amylase is a protein;
Not used up in the reaction / still present at the end of the reaction;

2

[7]

20

(a) (i) Curve rising and levelling out;

1

(ii) Substrate becomes limiting / falls / gets less;
Fewer collisions / complexes formed;

2

(b) To keep pH the same / optimum pH / so change in pH does not affect reaction;

1

(c) (i) For temperature up to 40 – 50 °C has no effect;
Over temperature (of 40 – 50 °C) reduces rate of reaction;

Note. Award one mark for general statement about the longer the incubation time, the slower the rate of reaction.

2

(ii) Bonds (holding tertiary structure) broken;
More enzyme denatured / tertiary structure destroyed / active sites lose shape / no longer fit;
Fewer enzyme-substrate complexes formed;

Note. Award marks if clearly in the context of more denaturation. Allow credit here for converse relating to exposure for 5 minutes.

3

(d) <u>Competitive</u>
2 Similarity of shape of inhibitor and substrate;
3 Inhibitor can enter / bind with active site (of enzyme);

<u>Non-competitive</u>
4 Affect / bind to enzyme other than at active site;
5 Distorts shape of active site;

<u>Inhibitors</u>
6 Prevent entry of / binding of substrate to active site;
7 Therefore fewer / no enzyme-substrate complexes formed;

6

[15]

21 (a) urea diffused into / entered the tubing and was hydrolysed / broken down (inside tubing);
ammonia increases pH / makes (solution) more alkaline and indicator turns blue as pH above 8 / due to alkalinity / due to ammonia;
idea that outside stays yellow because urease does not pass out;

3

(b) (i) add biuret solution / add sodium hydroxide + copper sulphate (solution);

(disqualify heat / boil, but accept warm)

violet / lilac / purple colour;

2

(ii) inside: protein present, as enzyme is protein;
outside: no protein, as urease / enzyme / protein unable to pass through membrane / out;

(accept correct result of biuret test as indicator of protein)

2

(c) method to maintain range of temperatures, e.g. water baths;
method to measure rate of activity - e.g. time taken to turn indicator blue;

(principle - measure rate of activity over range of temperatures = 1 mark, if neither point)

other conditions kept constant / named examples,
e.g. volumes of solutions,
starting pH, sample time;
method of refining optimum, e.g. repeats at narrower range;

3 max

[10]

22 (a) colour results from starch-iodine reaction;
decrease due to breakdown of starch by carbohydrase / enzyme;

2

(b) (i) curve drawn below curve on graph and starting at same point;

1

(ii) curve drawn above curve on graph and starting at same point but finishing above;

(allow curve or horizontal line)

(allow alternative curve for pH if explanation in (ii) is consistent)

1

(c) (i) 1. increase in temperature increases kinetic energy;
2. increases collisions (between enzyme / active site and substrate) / increases formation of enzyme / substrate complexes;
3. increases rate of breakdown of starch / rate of reaction / carbohydrase activity;

(ii) 4. (decrease in pH) increases H^+ ions / protons which attach / attracted to amino acids;
5. hydrogen / ionic bonds disrupted / broken which denatures enzyme / changes tertiary structure;
6. changes <u>shape / charge</u> of active site so active site / enzyme unable to combine / fit with starch / enzyme-substrate complex no longer able to form;
7. decreases rate of breakdown of starch / rate of reaction / carbohydrase activity;

(allow alternative explanation for pH if consistent with line drawn in (ii))

7

[11]

23 (a) C_{12} ; $H_{22}O_{11}$;

2

(b) (i) heat with Benedict's;
yellow / brown / orange / red;

2

(ii) (yes)

(may appear on second line)

more precipitate in sample **B**;
both sugars are reducing sugars / give a positive test;

2

[6]

24 (a) Hydrolysis;

Accept breaking of peptide bonds

1

(b) Adding fluorine changes shape/different shape from other proteins;
Do not fit active site (of protease);
Induced fit not produced;

2 max

(c) (i) Suitable example;
e.g. Flaming spreader/ use lid of Petri dish as umbrella/ clean bench with disinfectant/ sterilise agar in autoclave;

Ignore references to wearing gloves, unless suitably qualified and unqualified references to 'clean'

1

(ii) All the AMPs killed/inhibited the bacteria/AMPs with fluorine more effective than frog AMP;
Not All fluorine AMPs are equally effective;
Diameter/area of clear zone indicates effectiveness;
Only used one kind of bacterium/need to repeat using other bacteria;
Need to repeat the investigation/only one plate used;
Credit suitable measurements or calculations;

3 max

[7]

25 (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]

26

(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]

27

(a) Translation.

1

(b) Transfer RNA / tRNA.

1

(c) TAC;

UAC.

2

(d) Have different R group.

Accept in diagram

1

(e) 1. Substitution would result in CCA / CCC / CCU;
2. (All) code for same amino acid / proline;
3. Deletion would cause frame shift / change in all following codons / change next codon from UAC to ACC.

3

[8]

28

(a) Box around single nucleotide.

1

(b)

DNA strand	Percentage of each base			
	A	C	G	T
Strand **1**	(16)	**34**	**21**	**29**
Strand **2**	**29**	(21)	(34)	**16**

2 rows correct = 2 marks;
1 row correct = 1 mark.

2

(c) 1. Reference to DNA polymerase;
2. (Which is) specific;
3. Only complementary with / binds to 5' end (of strand);

Reject hydrogen bonds / base pairing

4. Shapes of 5' end and 3' end are different / description of how different.

4

[7]

29

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

Ignore references to saturated and unsaturated

Accept Pi/PO_4^{3-} / (P)

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]

30

(a) 1. Change in DNA base/nucleotide (sequence);

Accept: mutation in DNA base (sequence).

Accept: deletion/substitution/addition of a DNA base/nucleotide.

2. Change in amino acid (sequence)/primary structure;

Reject: different amino acid formed.

Ignore: change in code for amino acid.

3. Alters (position of) hydrogen/ionic/disulfide bonds;

4. Change in tertiary structure (of receptor);

Reject: any reference to active site.

Ignore: 3°.

4

(b) 1. (Receptor) is not complementary
OR
(HIV) cannot bind/attach and enter/infect (helper) T cell;

Accept: 'complimentary'.

Accept: invade as alternative to infect.

2. No replication (of virus)
OR
No destruction of (helper) T cell;

Accept: reproduction (of virus).

2

(c) 1. Low/lower exposure to HIV (in Europe)
OR
Low/lower number of HIV/AIDS (infections/cases);

Accept: converse.

2. (HIV) has only been present for a short time period
OR
(HIV relatively) recently evolved;

3. Mutation/CCR5 has been around for many years;

Accept: frequency of mutation has always been high.

4. Mutation/CCR5 is advantageous (for something else);

2 max

[8]

31

(a) maximum rate at which enzyme can combine with substrate / form enzyme-substrate complexes / substrate no longer limiting / enzyme is a limiting factor;
(active site of) enzyme saturated with substrate (*disqualify active sites / enzymes' used up*);

2

(b) inhibitor attaches to enzyme away from the active site;
changes shape of active site and prevents formation of enzyme-substrate complex;

2

(c) $\frac{7.6 - 5.6}{7.6} \times 100$;

= 26.32%; *(accept 26% or 26.3%)*

(correct answer = 2 marks)

(principle – $\frac{decrease\ in\ rate}{max\ rate} \times 100$ *= 1 mark)* **2**

(d) curve below top curve (without inhibitor) joining to top curve / continues to increase to end of *x*-axis
(*must not exceed or level out below 'without inhibitor curve' and must start from origin*);

1

[7]

32

(a) (i) fall in deaths due to rise in number of people with immunity / better care / targeting vaccination at vulnerable;

1

(ii) mutation of virus / new strain;
mutant form not recognised by memory cells (*allow antibodies*);

2 max

(b) (i) T lymphocyte receptors recognise shape of haemagglutinin / neuraminidase / viral antigen;
clone (*once only*);
destroy virus;

2 max

(ii) clone (*once only*);
produce antibodies;
effect of antibody e.g. stimulation of phagocytosis / precipitation of toxins;

2

(c) alter shape of active site of neuraminidase / block active site;
virus unable to leave host cells;

2

[9]

33 (a) To keep concentrations of gelatine constant;

Accept 'to keep concentration constant' for / mark if points 1 and 2 not made

To keep concentration of pineapple extract constant;
Tube 2 had HCl added / to give same volume as B;

2 max

(b) Tube A

Enzyme (in pineapple) has digested gelatine;

Allow enzyme 'breaks down' gelatine

So no gelatine / protein to form a jelly;

Tube B

Enzyme denatured / inhibited / reference to hydrogen bonds / change of tertiary structure;
By HCl / change of pH;

4

(c) For comparison / as a control;
To show that it is an <u>enzyme</u> in pineapple that digested gelatine / stopped gelatine setting in tube 1;
Boiling denatures enzyme / Can be described but must be permanent change;
Other components of pineapple still present;

3 max

[9]