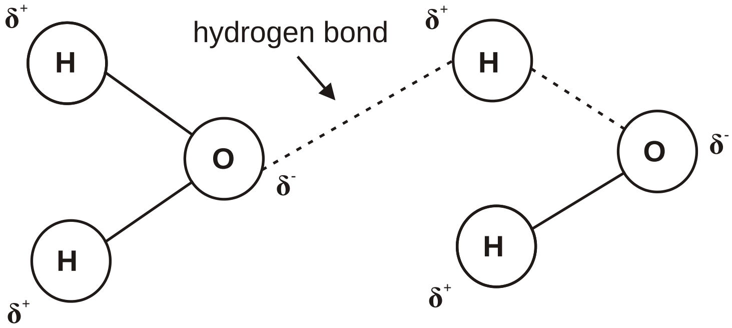
1.



1 hydrogen bond represented as,
horizontal / vertical, dashed line between **O** on one molecule and **H** on the adjacent molecule;

__DO NOT CREDIT__ if >1 H bond is drawn between the same two molecules

2 hydrogen / **H**, bond label (on any drawn bond between 2 molecules);

3 (delta positive) δ^+ on **each** drawn **H**
__and__ (delta negative) (2) δ^- on **each** drawn **O**;

*if both molecules drawn, δ^+ and δ^- on **all** atoms.*
__ACCEPT__ d (lower case) for δ

[3]

2. *ice floats*

P1 (ice less dense because) molecules spread out;

P2 molecules form, crystal structure / lattice / AW;

P3 ice forms insulating layer / clearly described;

e.g. acts as a barrier to the cold

P4 water (below ice), does not freeze / still liquid / remains water / kept at higher temperature;

S1 organisms do not freeze;

__DO NOT ACCEPT__ die (because 'survival' stated in stem)

S2 animals / organisms, can still, swim / move;

S3 allows, currents / nutrients, to circulate;

solubility

P5 ions / named ion, polar / charged;

P6 ions /named ion, attracted to / bind to / interact with, water;

S4 (named) organisms / plants / animals, uptake / AW, minerals / named mineral / nutrients;

__ACCEPT__ obtain / enters / goes in / gets

S5 correct use of named, mineral / nutrient, in organism;

needs to be more specific than 'for growth / metabolism' suitable examples include but are not limited to: nitrates for amino acids / protein / (named) nucleic acid / phosphate for ATP / phospholipids / plasma membrane / magnesium for chlorophyll etc

temperature stability

P7 many / stable, (hydrogen) bonds between molecules;

Many hydrogen bonds between molecules = 2 marks (gets P7 and H)

P8 at lot of energy to, force apart molecules / break bonds;

__ACCEPT__ heat as alternative to energy

P9 high (specific) <u>heat capacity</u>;

__DO NOT CREDIT__ latent heat capacity

S6 temperature does not change much / small variation in temperature;

could refer to organisms __or__ surrounding water
__ACCEPT__ stays cool in summer / stays warm in winter
__DO NOT CREDIT__ constant alone

S7 effect of temperature on, enzymes / metabolic rate;

__ACCEPT__ any reference to temperature affecting enzyme activity / metabolic rate

S8 gases remain soluble;

Award once in any section

H hydrogen bonds;

__DO NOT CREDIT__ if in incorrect context
(e.g. they are strong bonds)

7 max

QWC - Award if you see a P mark **and** an S mark within the **same** section;

Look for the __S__ mark first, then award QWC if there is a __P__ mark __in the same section__ in the mark scheme

1

[8]

3. hydrolysis / hydrolytic;
hydrophilic;

__ACCEPT__ phonetic spelling throughout
__IGNORE__ head

[2]

4. (i) X;

1

(ii) **1** substrate / PABA, **and**, inhibitor / sulfonamide, similar shape;
__ACCEPT__ similar structure __DO NOT CREDIT__ same

2 able to, bind / fit into / block, <u>active site</u>;

3 (shape) <u>complimentary</u> to <u>active site</u>;
__DO NOT CREDIT__ refs to PABA and sulfonamide being complementary to each other or to the enzyme (alone)

4 both have, hex / benzene / 6-C, (ring);

5 both have, NH_2 / amine;

6 correct ref to a difference between sulfonamide and PABA;
e.g. only sulfonamide contains S
sulfonamide has 1 more NH_2 group
sulfonamide has $SONH_2$ but PABA has N_2
only PABA has COOH group

3

[4]

5. (i) *without inhibitor*

1 more, PABA / substrate, molecules enter <u>active site</u>:
__ACCEPT__ more successful collisions between substrate and active site

2 more, enzyme substrate complexes / ESCs, formed;

3 at low concentration not all active sites occupied / at high concentration all active sites occupied;
__ACCEPT__ active sites filled / no free active sites
__DO NOT CREDIT__ active sites run out

4 achieves / reaches, max (turnover) rate / V_{max};
__ACCEPT__ ‘cannot work any quicker’
__DO NOT CREDIT__ ‘optimum rate’ or ‘rate levels off’

5 (at high substrate concentration) enzyme <u>concentration</u> limiting;

3 max

(ii) *with inhibitor*

1 inhibitor / sulfonamide, can, fit / block / bind to / compete for, active site;

2 (occupies it) for a short time / temporary / reversibly;

3 fewer active sites available (for substrate) / AW;

__ACCEPT__ substrate can't access active site

4 (idea of) more substrate reduces chance of inhibitor getting in;

__ACCEPT__ more ESC formed in context of overcoming inhibition / substrate can out-compete inhibitor

2 max

[5]

6. (a) (i) L;
M;
J;

If 2nd letter given, no mark

3

(ii) *__CREDIT__ answers from clearly drawn diagrams with bonds labelled*

1 peptide bond;

__ACCEPT__ peptide link

2 between, amine / **J** group (of one amino acid) and carboxyl / **L** group (of another);

3 H (from amine group) combines with OH (from carboxyl group);

4 condensation reaction
OR
water, lost / eliminated / produced / created / AW;

5 covalent;

3 max

(b) **1** some R groups, attract / repel;

2 <u>di</u>sulfide, bridges / bond;

3 between, cysteine / SH / S (atoms);

4 hydrogen / H, bonds;

DO NOT CREDIT *in context of* ***secondary*** *structure*

5 ionic bonds between, oppositely charged / + and –, R groups;

6 hydrophilic R groups, on outside of molecule / in contact with water (molecules);

7 hydrophobic R groups, on inside of molecule / shielded from water (molecules);

4 max

[10]

7. (i) ***AWARD*** *1 mark per correct row*
Comparative statements must be made in a row

	glycogen	collagen	
1	carbohydrate / polysaccharide	protein / polypeptide	;
2	(alpha) glucose (units)	amino acid (units)	;
3	identical units	different amino acid units	;
4	glycosidic, bonds / links	peptide, bonds / links	;
5	branched	unbranched / linear	;
6	non-helical	helical	;
7	one chain (per molecule)	three chains (per molecule)	;
8	no cross links	cross links (between chains)	;
9	contains C H O	contains C H O N	;

2 ***DO NOT CREDIT*** *beta*

5 ***ALLOW*** *straight*

7 ***DO NOT CREDIT*** *strands*

9 ***IGNORE S*** *(for collagen)*

3 max

(ii) (high tensile) strength / strong;

__IGNORE__ fibrous / tough

does not stretch / is not elastic;

insoluble;

flexible;

Mark the 1st answer on each numbered line

2 max

[5]

8. (i) deoxyribose (sugar);
phosphate (group);

__DO NOT CREDIT__ dioxyribose

__DO NOT CREDIT__ phosphate head or phosphate backbone

(nitrogenous / purine or pyrimidine) base / one correctly named base;

__DO NOT CREDIT__ letter instead of named base

__DO NOT CREDIT__ uracil

__DO NOT CREDIT__ incorrect spelling of thymine with 'a'

3

(ii) has ribose;

uracil / U, instead of, thymine / T;

__DO NOT CREDIT__ incorrect spelling of thymine with 'a'

single stranded;

3 forms / AW;

assume answer refers to RNA unless otherwise stated

2 max

[5]

9. **1** untwist / unwind;

__DO NOT CREDIT__ unravel

S **2** unzip / described;

__DO NOT CREDIT__ strands separating without qualification

S **3** H bond breaks;

4 both strands act as template;

N **5** (aligning of) free (DNA) nucleotides;

__DO NOT CREDIT__ bases

N **6** complementary, base / nucleotide, pairing;

N **7** C to G **and** T to A / purine to pyrimidine;

__6 & 7__ Do not consider for __QWC__ if mark awarded in the context of breaking apart or DNA structure only, rather than forming new double helix

R **8** hydrogen bonds reform;

R **9** sugar-phosphate back bone forms;

R **10** (using) covalent / phosphodiester, bond;

11 semi-conservative replication;

12 DNA polymerase;

__CREDIT__ at any stage in the process

13 AVP;

e.g. ligase / helicase / gyrase used in correct context
C – G 3 H bonds / T – A 2 H bonds
activation of free nucleotides (with 2 phosphates)
synthesis in the 5’ to 3’ direction
Okazaki fragments on lagging strand

6 max

QWC - correct sequence - 1 **S** mark, then 1 **N** mark, then 1 **R** mark;

It should be clear that candidate realises that the sequence is S, then N then R - even if not written in that order

__DO NOT CREDIT__ if any ref to transcription / translation

1

[7]

10. (i) polypeptide / protein / primary structure / a sequence of amino acids;

__DO NOT CREDIT__ ‘codes for an amino acid’
__IGNORE__ enzyme / named protein

1

(ii) different, sequence of amino acids / primary structure / AW;
different protein / protein folds up differently / different tertiary structure;
(product) no longer functions / different function;

__DO NOT CREDIT__ 'product' or incorrect biochemical (e.g. carbohydrate)

__ACCEPT__ suitable example, e.g. active site of enzyme no longer complimentary to substrate

2 max

[3]

11. double helix;
anti-parallel;
sugar-phosphate;
hydrogen;

[4]

12. (i) percentages / amount, C & G similar (in all organisms);
percentages / amount, A & T similar (in all organisms);

<u>different</u> / named, <u>organisms</u> have different proportions of, bases / named base / AW;
greatest similarity between human and grasshopper;
least similarity between *E coli* and the other three;
E. coli has similar proportions of all bases /
E.coli has <u>slightly</u> more CG than AT /
(named) eukaryote has more AT than CG;

mp 1 & 2 __DO NOT CREDIT__ ref to a single organism
mp 1 & 2 __IGNORE__ ref to complementary
__DO NOT CREDIT__ statements in context of organism size
e.g. statement that human has more A than E. coli /
human has the most AT / E. coli has the most CG

This mark is for a general statement

comparative figs with units to support any statement;

e.g. human C = 19.8<u>%</u> <u>and</u> G = 19.9<u>%</u>
human A = 30.9<u>%</u> <u>and</u> E. coli A = 24.7<u>%</u>

'human has more A (30.9%) than wheat (27.3%)' = __2__
(mp 3 & 7)

3 max

(ii) (suggests) A, bonds / pairs / links / connects / joins, to T;
(suggests) C, bonds / pairs / links / connects / joins, to G;
(suggests) purine bonds to pyrimidine;
(evidence for) complementary base pairing /
which bases pair with each other / base pairing rules;
suggests bases point 'inwards' rather than 'outwards';

IGNORE *A – T or A = T unqualified*
IGNORE *C – G or C = G unqualified*
ACCEPT *'bond' instead of 'pair'*

2 max

[5]

13. ***Award 1 mark per correct row***

feature	*DNA*	*RNA*	
number of strands	two / double	one / single	;
bases present	thymine / T (+ adenine + cytosine + guanine)	uracil / U (+ adenine + cytosine + guanine)	;
sugar present	deoxyribose	ribose	;

If a choice of answers is given, do not credit unless both answers are valid (e.g. two and double strands for DNA / ribose and pentose sugar)

ACCEPT *letters instead of names of bases*
Names of bases must be unambiguous, so
DO NOT CREDIT *adenosine / thiamine / cysteine / etc.*
If more bases mentioned than T and U, then all bases must be included

DO NOT CREDIT *dioxyribose / oxyribose/ hexose / sugar*
IGNORE *pentose*

[3]

14. carries / transfers, the (complementary DNA), code / genetic information / copy of gene;
out of the nucleus;
(transfers it) to the, ribosome / RER / site of translation;
for, protein / polypeptide, synthesis;

IGNORE *transcription*
DO NOT CREDIT *ref to the whole DNA code / molecule*

ACCEPT *'to make protein'*

[2]

15. (a) (i) **A** hydrogen;
B glycosidic;

DO NOT CREDIT *'H bond' as this is not a name*
Correct spelling only.
IGNORE *α or β or numbers*

2

(ii) hydrolysis / addition of water;

1

(iii) β / beta, glucose;

Must be qualified as β or beta or B or b

1

(b) enzymes are specific;
the, carbohydrate molecules / substrates, are different shapes;

active site and substrate are complementary;
so that substrate will fit / formation of ESC;
lock and key / induced fit;

3 max

(c) (i) pH <u>much</u>, higher / less acidic, than optimum (for enzyme 2);

Needs idea of <u>*much*</u> *greater or too high*
DO NOT CREDIT *just 'higher than' or 'above'*
DO NOT CREDIT *too / more, alkaline*

change in charge of active site;
hydrogen / ionic, bonds <u>break</u>;

tertiary structure / 3D shape / active site shape, altered;
enzyme / tertiary structure, <u>denatured</u>;

DO NOT CREDIT *peptide / disulphide, bonds break*
DO NOT CREDIT *in context of heat / vibration*

IGNORE *ref to denaturing active site*

IGNORE *ref to denaturing active site*
DO NOT CREDIT *kill / die*

substrate no longer fits active site / ESC does not form;

'substrate doesn't bind to enzyme' is not quite enough

3 max

(ii) *Mark 1st response on each numbered line unless no answer on one line, then mark 1st 2 answers*
temperature;
substrate <u>concentration</u>;
enzyme <u>concentration</u>;

IGNORE *ref to time*

2 max

[12]

16. Marking points 2 – 6 can be applied to the standard solutions or the sample

1 using, standard / known, concentrations (of reducing sugar);

2 <u>heat</u> with, Benedicts (solution) / $CuSO_4$ + NaOH;

3 (use of) same volumes of solutions (each time);

4 (use of) excess Benedicts;

5 changes to, green / yellow / orange / brown / (brick) red;

6 remove precipitate / obtain filtrate;

7 calibrate / zero, colorimeter;

8 using, a blank / water / unreacted Benedicts;

9 use (red) filter;

10 reading of, transmission / absorbance;

11 more transmission / less absorbance, of filtrate
= more sugar present; **ora**

12 (obtain) calibration curve;

13 plotting, transmission / absorbance,
against (reducing) sugar concentration;

14 use reading of unknown sugar solution and read off graph
to find conc.;

e.g. serial dilutions

***ALLOW** boil / > 80^{o}C* ***DO NOT CREDIT** warm*
***DO NOT CREDIT** amount / quantity*

***CREDIT** description of method*
e.g. filtering / centrifuging & decanting

ACCEPT 'measure how much light, does / does not,
pass through'

*If precipitate is **clearly indicated** as being present in*
*sample, **ALLOW** 'less transmission / more absorbance,*
= more sugar present'

[6]

17. breaking (glycosidic) bond; **R** if incorrect named bond
glycosidic / correct bond drawn; treat 'covalent' = neutral
addition of water / H_2O; max 2

[2]

18. *accept ✓ = yes ✗ = no*
each correct row = I mark

	gum arabic	amylase	cellulose	glycogen
branched structure		no;		yes;
heteropolysaccharide		no;		no;
found in animals/plants		plants;		animals;
function in organism		storage / reserve; **R** ‘energy’ alone	structural / strength / stops bursting / cell wall / support / gives cell shape; **R** protects rigid = neutral	

[4]

19. (i) crush (small amount of) seed pod;
add (small volume of) biuret, A / NaOH, and biuret, B / $CuSO_4$;
positive = colour change from blue to, mauve/purple; max 2

(ii) *preparation - allow 2 marks max:*
1 crush, samples / leaves and seed pods, separately with water;
2 use same mass of each / AW and use same volume of water;
3 filter;

method - allow 4 marks max:
4 add benedict’s reagent to filtrate; **A** $CuSO_4$ in alkaline solution
5 <u>excess</u> reagent used / stated volume;
6 same volume added;
7 heat in a water bath/ at near boiling;
8 for stated time (up to 5 min);

analysis - allow 2 marks max:
<u>either</u>
9 colour change from blue to green / yellow / orange / red;
10 shows increasing concentration of reducing sugar;

<u>or</u>
11 use of centrifuge to remove precipitate;
12 use of colorimeter to compare intensity of blue colour in liquid portion;
13 red filter used in colorimeter; 8

(iii) humans eat only the seeds so do not gain, nutrition / energy, from, leaves / pods;
seeds maybe deficient in (some) essential amino acids;
cattle better at digesting, plant matter / seeds / leaves / pods, than humans / AW;
meat (from cattle) provides more essential amino acids for humans (than plant material)/AW;
cattle also produce milk;

AVP; e.g. cattle naturally roam to find food / intensive labour needed for human collection of plant material; max 3

[13]

20. (i) deoxyribose sugar;
a nitrogenous/ nitrogen containing, base / named base; ecf for thiamine
phosphate group;

AVP; e.g. deoxyribose is a pentose sugar/correct diagram of same

accept A, T, G and C in place of names. max 3

(ii) hydrogen bonds between bases;
complementary base pairing;
purine to pyrimidine;
A to T and G to C;

AVP; further detail e.g. 2 H bonds between A and T / 3 H bonds between C and G
DNA polymerase max 4

[7]

21. ribose (instead of deoxyribose);
uracil / U, replaces thymine;
single stranded (instead of double stranded);
smaller molecule / different 3-D structure to DNA;

[3]

22. (a) *award two marks if correct answer (12) is given*
$6/30$ / $6/0.5 \times 60$;
12; 2

(b) *assume candidates are referring to the initial rate unless otherwise stated.*

concentration of, substrate / H_2O_2, molecules, high / higher at start;
more chance of, substrate/ H_2O_2, molecules entering active site;
all / most, active sites occupied; 3

[5]

23. *at optimum temp - max 3 marks*
molecules in culture have kinetic energy;
(frequent) collisions between enzyme and substrate molecules;
more enzyme-substrate complexes formed;
max rate of reaction / protein production achieved;

at higher temp - *max 5 marks*
(at higher temperature) molecules have more kinetic energy /
collisions occur more frequently and with more energy;
molecules vibrate and, bonds/ hydrogen bonds, broken;
tertiary structure / 3D shape, of enzymes altered;
active site loses, precise / complementary, shape;
enzymes are denatured;
substate molecule no longer fits active site;
(may be) irreversible so reaction/ protein production stops; **A** fungus destroyed

[8]

24. (a) (i) *Mark the first 2 types of biological molecule stated. Absence = neutral*
protein; **A** casein/polypeptide **R** *amino acid*
reducing sugar(s); **A** *correctly named reducing sugar(s)*
[but only lactose/galactose/glucose] 2

(ii) *Mark the first 3 types of biological molecule stated. Absence = neutral*

protein; **A** *casein/polypeptide* **R** *amino acid*
reducing sugar(s); **A** *correctly named reducing sugar(s)*
[but only lactose/galactose/glucose/fructose]
non-reducing sugar; **A** *sucrose* 3

(b) *Assume 'it' = 'Health-Milk'*

'Health – Milk' has

less reducing sugar(s); **A** *correctly named reducing sugar(s)*
[but only lactose/galactose/glucose/fructose]
less non-reducing sugar; **A** *sucrose*

"less sugar" = 1
credit converse statements relating to 'Energy – Boost'. 2

(c) states 'no added sugar'/implies low sugar;
contains more sugar than (fresh) milk/high in sugar;
more reducing sugar (than milk); **R** *'none in fresh milk'*
has non-reducing sugar (compared to none in milk);
fruit (extract) must contain (hidden) sugar; 3 max

(d) milk/drinks, already,
milky/cloudy/white/opaque/'not see through'/emulsion;
A *'positive result would not show up'* **R** *precipitate* 1

[11]

25. (i) **R** *statements linked to amylose/starch*

max 3 if stated that glycogen is amylopectin

polymer/polysaccharide/described;
(made of) α-glucose;
joined by 1,4 links;
glycosidic;
(chain is) branched;
1,6 links where branches attach;
AVP; e.g. compact
detail of glycosidic bond 4 max

(ii) condensation; **A** *polymerisation* 1

[5]

26. (i) 37 °C; **A** *any figure in the range 35 – 40* 1

(ii) (enzyme) increases in kinetic energy; **A** *'too much kinetic energy'*
enzyme vibrates too much;
breaks bonds;
named eg;
changes, tertiary/3-D, structure/shape, of enzyme;
active site changes, shape/AW;
substrate will not fit/no enzyme-substrate complex formed;
enzyme denatured;
will, decrease rate/stop reaction; 4 max

[5]

27. *1 mark per correct row*

Look for both ticks and crosses.

If a table consists of ticks ONLY or crosses ONLY, then assume that the blank spaces are the other symbol.

If a table consists of ticks, crosses and blanks then the blanks represent no attempt at the answer.

Nucleotides line up along an exposed DNA strand.	✓	✓;
The whole of the double helix 'unzips'.	✓	✗;
Uracil pairs with adenine.	✗	✓;
A tRNA triplet pairs with an exposed codon.	✗	✗;
Both DNA polynucleotide chains act as templates.	✓	✓;
Adjacent nucleotides bond, forming a sugar-phosphate backbone.	✓	✓;
The original DNA molecule is unchanged after the process.	✗	✓;
Adenine pairs with thymine.	✓	✓;

[8]

28. hydrolysis (of Hb);
by enzymes;
proteases;
breaks peptide bonds;
removal of haem group;
reference to, diffusion/active transport/pinocytosis/channel proteins;
AVP; 3 max

[3]

29. **one mark for each correct row**

if only ticks, assume that spaces are crosses; **if only crosses, assume that spaces are ticks**

R **hybrid ticks**

	statement					
substance	***use heat***	*use biuret reagent*	*use Benedict's reagent*	*boil with a dilute acid*	*a positive result is a blue-black colour*	*a positive result is an emulsion*
lipid	✗	✗	✗	✗	✗	✓
protein	✗	✓	✗	✗	✗	✗;
starch	✗	✗	✗	✗	✓	✗;
reducing sugar	✓	✗	✓	✗	✗	✗;
non-reducing sugar	✓	✗	✓	✓	✗	✗;

4

[4]

30. (i) glycosidic; **A** covalent / C-O-C / oxygen bridge
R oxygen bond / 'glucosidic' 1

(ii) hydrolysis / hydrolytic; *if qualified, needs to be correct* 1

[2]

31. **1** no (suitable) enzyme (in gut) to digest sucralose / sucrase will not act on sucralose / AW;

2 enzymes, are specific / only act on one substrate;

3 complementary shape;

4 idea that (*Cl* on sucralose instead of OH) gives different, shape / structure;

5 no ESC (enzyme substrate complex) / substrate will not fit into active site;

6 AVP; e.g. further detail of enzyme-substrate interaction 4 max

[4]

32. 1 hydrogen bonding;
2 detail; e.g. (electro)negative oxygen atom can hydrogen bond to (electro)positive H atom/ one water molecule hydrogen bonds with up to 4 others / H bonds individually weak / large collective effect of many hydrogen bonds

coral algae
3 (high) thermal stability / temperature remains fairly constant;
4 water has high specific heat capacity;
5 much energy needed to break hydrogen bonds;

polar bears
6 cooling allows maximum number of hydrogen bonds to form;
7 water molecules space out to allow this;
8 water expands as it freezes / ice is less dense than water;

mussels, filter-feeders and sessile animals
9 water is transport medium for, food particles / gametes;
10 (tentacles / appendages / cilia) create currents bringing food;
11 ref. tides / ocean currents;
12 medium for, male gametes to swim / external fertilisation;
13 no desiccation of gametes;
14 ref to low viscosity / AW;

corals
15 minerals / ions, are soluble in water;
16 water is polar / detail of electrostatic attraction; **A** AW

seaweeds, fish eyes
17 water is transparent to light;
18 photosynthesis possible (in shallow water);
19 wavelength of light varies with depth;

whales, jellyfish
20 cohesion / water molecules stick to each other;
21 water not easily compressed;
22 gives support to large bodies / detail of upthrust or relative density;
23 acts as hydrostatic skeleton;
24 AVP; e.g. zonation / pigments
25 AVP; e.g. solubility of named gas linked to use in named organism 7 max

QWC – legible text with accurate spelling, punctuation and grammar 1

[8]

33. (i) not enough points plotted / experiment not carried out at enough (different) pH values;
only 1 point between 3 + 4.3 / no points between 3.25 + 4.3;
don't know / uncertainty of, rate between those points / where peak should be / where optimum is;
3.25 reading might be anomalous;
cannot draw, curve / line of best fit;
rises to, 3 / 3.25, and falls after 4.3; 2 max

(ii) *note ~ enzyme is completely inactive at pH 7*

loss of tertiary structure / loss of 3D structure / (enzyme) denatured;
(change in pH/[H^+]) alters charge distribution on (enzyme) molecule;
hydrogen / ionic, bonds affected;
changes (shape of) active site;
enzyme substrate complex cannot be formed / substrate not attracted to active site / substrate cannot bind to active site / AW; 2 max

[4]

34. *mark each section (E, S and C) to max shown*

<u>E</u> ***enzyme concentration ~***

1 reaction (rate) increases with increased enzyme; **A** high / low

2 more active sites available;

3 in excess substrate / as long as enough substrate (molecules available to occupy active site);

4 (as reaction progresses) the rate will decrease as substrate, used up / becomes limiting; **R** plateau

E
(3 max)

<u>S</u> ***substrate concentration ~***

1 reaction (rate) increases with increased substrate; **A** high / low

2 more, molecules available to enter active site / ESC formed; **A** more successful collisions

3 reaches point where all active sites occupied;

4 no further increase in rate / reaches V_{max}; **A** plateau / levels off

5 enzyme conc. becomes limiting / unless add more enzyme;

S
(3 max)

<u>**C**</u>	***competitive inhibitor ~***	
1	inhibitor has similar shape to substrate;	
2	can, fit / occupy, active site;	
3	for short time / temporary / reversible;	
4	prevents / blocks, substrate from entering active site;	
5	rate determined by relative concentrations;	
6	little inhibition / rate little reduced, if substrate conc. > inhibitor conc.; *ora*	
7	ref to chance of, substrate / inhibitor, entering active site;	
8	effects can be reversed by increasing substrate conc.;	**C** (5 max)

	general points ~	
10	drawing a suitable graph to illustrate point made with labelled axes;	
11	ref to <u>optimum</u> (rate);	9 max

QWC ~ legible text with accurate punctuation, spelling and grammar 1

[10]

35. (a) protein / polypeptide, with,
carbohydrate (chain) / polysaccharide / sugar / glucose;
(*R*) *glycogen* 1

(b) (i) (α) helix; **R** double helix 1

(ii) (β) pleat(ed) (sheet); 1

(c) tertiary / 3°; 1

[4]

36. solvent;
liquid; **A** same
dense;
insulates; **A** keeps warm **R** protects / warms
hydrogen; **A** H / weak **R** H^+ / H_2
surface tension / cohesion; 6

[6]

37. cholesterol not soluble (in water) ;
lipids / cholesterol, hydrophobic / non-polar ;
glucose is (very) soluble (in water) ;
glucose is, hydrophilic / polar ; 2 max

[2]

38. **A** *correct formulae*
R *choice (if contradictory)*

type of molecule tested	*reagents used*	*positive result*	*negative result*
protein	biuret / copper sulphate and sodium (or potassium) hydroxide;	purple / mauve / lilac;	*blue solution*
fat / lipid / oil / triglyceride; **A** *phospholipid*	*alcohol and water*	*white emulsion*	*clear liquid*
starch	iodine (in potassium iodide solution);	blue-black / black;	*yellow solution*

[5]

39. (i) **R** *references to fruit juice*

use same <u>volume</u> of glucose solution;
use same <u>volume</u> of Benedict's solution;
use same concentration of Benedict's solution; **A** *strength / same batch*
boil for the same length of time; **A** *heat*
calibrate colorimeter / AW; **A** *same, filter / colorimeter* 2 max

(ii) 6.5; 1

(iii) hydrolyse**,** filtrate / juice / bond / non-reducing sugar;
either
with acid, neutralise / add alkali
or
treat with**,** sucrase / invertase;

either, if started with filtrate …
boil with Benedict's + test filtrate / repeat original procedure; **A** *heat*

or, if started with juice …
boil with Benedict's + test filtrate / repeat original procedure**,** to measure difference in absorbance with original; 2 max

[5]

40. (i) haemoglobin / haem; **R** *Hb* 1

(ii) iron / Fe^{2+} / Fe^{3+}; **R** *ion / Fe / Fe^{+}* 1

[2]

41. (i) breaking a bond with the addition of water; **A** *named bond* 1

(ii) <u>fatty</u> (<u>acids</u> produced);
[H+] increased / more acidic / products are acidic / acids produced;
'fatty acids produced' = 2 marks 2

(iii) *do not credit, substrate used up / lack of enzyme / end product inhibition*

pH**,** too low / not optimum; **A** *too acidic*
enzyme <u>denatured</u>;
equilibrium reached;
further detail; 2 max

[5]

42. reduces rate; **A** *stops* **R** *inhibits*
fits into**,** allosteric site / site other than active site;
A '*fits into active site <u>permanently</u>*'
alters**,** shape / charge**,** of active site;
so substrate cannot**,** fit to active site / bind to active site / form ESC;
will not reach V_{max};
increasing substrate concentration has no effect (on the rate); 3 max

[3]

43. (a) **R** *first reference to ^{15}N being radioactive*

semi-conservative replication would give

1 one, template / original / old / parent**,** strand and one,
new / daughter**,** strand;

2 complementary base pairing / joining of new nucleotides /
other detail of forming the new strand;

data shows that

3 two isotopes in <u>molecule</u> / <u>molecule</u> contains both ^{14}N and ^{15}N;

4 one strand with**,** 'heavy' N / ^{15}N; **R** *molecule*

5 one strand with**,** 'light' N / ^{14}N; **R** *molecule*

6 no <u>molecules</u> with only**,** 1 isotope / ^{14}N / ^{15}N;

*some points, particularly 4 and 5, could be awarded for a
correctly labelled or keyed diagram* 4 max

(b) *correct answer only - do not accept from a selection*

A;
C;
C and E; 3

(c) *1 band = 0*
3 bands = 0

band drawn for ^{14}N and $^{14}N/^{15}N$ only;
thick for ^{14}N and thin for $^{14}N/^{15}N$; 2

[9]

44. after a low carbohydrate diet athlete can exercise for, not long / (no more than) one hour; **AW *ora***
statement of trend observed; e.g. as carbohydrate in diet increases duration of exercise increases / carbohydrate loading improves performance; **AW *ora***
use of figures as a comparison; (look for 60, 125 – 130, and 185 – 190)
A two / three, times duration statements 3 max

[3]

45. *penalise sugar once in the answer*

glycogen is, source / store, of, energy / carbohydrate;
glycogen converted to glucose / glycogenolysis / glucogenesis;
glucose used in respiration;
to supply, energy / ATP, for muscle contraction;
more glycogen stored will last longer;
AVP; e.g. using muscle glycogen may be more efficient than transporting glucose from liver 2 max

[2]

46. (i) polypeptide; **A** oligopeptide 1

(ii) glycine; **A** proline / alanine 1

(iii) *in this answer assume that*
chain = polypeptide
molecule = groups of 3 polypeptide chains

A *ecf for named amino acid from (ii) but NOT a name of a base*
amino acids / glycine, small (to allow close packing);
the small one is, every 3rd amino acid / at every level in the molecule;
chains, form a tight coil / lie close to each other;
held together by hydrogen bonds; *ignore other bonds*

bonds form between R groups of lysines;
molecules form, fibres / bonds with adjacent molecules; **A** fibril
covalent bond between, adjacent molecules / CO-NH groups;
fibres composed of parallel molecules;
ends of parallel molecules staggered;
prevents line of weakness; 2 max

[4]

47. cell wall(s);
β / beta; **A** B
glycosidic; **NOT** glucosidic
180;
straight; **A** polysaccharide / unbranched / linear
hydrogen / H; **NOT** H_2 6

[6]

48. (i) 4; 1

(ii) deoxyribose; **NOT** ribose
phosphate;
nitrogen(ous) / organic / named, base; **A** purine / pyrimidine
NOT uracil
NOT letter
NOT thiamine / thyamine

take a correct base from a list unless that list includes uracil 3

[4]

49. **1** <u>2</u>, molecules / helices, (of DNA) produced;

2 identical (molecules of DNA produced);

3 (each made up of) 1, original / parent / old, strand;

4 1 new strand;

5 original / parent / old, strand<u>s</u>, act as template / described;

6 ref to (free DNA) nucleotides; 3 max

[3]

50. (a) idea that arachidonate is substrate;
phospholipid source in membrane;
prostaglandin / product, can be, transported / stored;
(S)ER for, lipid / steroid, synthesis / transport;
AVP;
AVP; e.g. separate from other reactions
cytoplasm environment not suitable for, reaction / enzyme ora
idea that prostaglandin isolated
COX does not, damage / use phospholipids from,
other membranes 2 max

(b) *ibuprofen*
competitive;
ibuprofen blocks / arachidonate cannot enter, channel; **A** substrate
cannot reach active site;

aspirin
non-competitive;
changes shape (of) / blocks;
active site;
AVP; e.g. <u>allosteric</u>

no ESC formed / AW; *allow once only* 4 max

(c) **A** *reverse argument as long as question is answered in terms of low temperature*

slows, reaction / rate / activity of enzyme / AW;
ref kinetic energy;
molecules moving, slowly / less;
few collisions / collisions less likely;
few ESC formed / ESC less likely to be formed;
reversible / enzyme not denatured / enzyme still works;
ref activation energy;
ref $Q_{10} = 2$; 4 max

[10]

51. *similar ~ allow valid similarities such as*

same number, carbon / oxygen / hydrogen (atoms) / OH (groups); **A** hexose
same formula; **R** similar / molecule
ring / ring with O (atom) in it;
correct ref CH_2OH;
contain C, H and O; 1 max

different ~ assume candidate is writing about fructose unless told otherwise
allow valid differences such as

(fructose has) 5-membered ring / glucose has 6-membered ring; **R** pentose
(*4 C in ring v. 5C in ring / furanose v. pyranose in glucose*)
(in fructose) 2 CH_2OH side chains / 1 CH_2OH side chain in glucose;
different angles between C atoms;
ref alignment of H and OH groups (on carbon 3 / carbon 4);
(in fructose) carbon 1 not in ring / carbon 1 in ring in glucose; 1 max

[2]

52. (i) glycosidic; **NOT** *glucosidic* 1

(ii) **1** carbon positions 1 and 2 on glucose and fructose;

2 formation of, water / H_2O, from 2 OH groups (plus separation);

3 oxygen bridge / – O –, shown; 2 max

[3]

53. (i) add / use, Benedict's (reagent);
heat; **NOT** use water bath alone
(blue to) green / yellow / orange / brown / red (precipitate); 3

(ii) hydrolysis;
boil / heat, with (dilute), acid / HCl; **A** (dil) NaOH
(add) hydrolytic enzyme / sucrase / invertase; 1 max

[4]

54. (a) active site correctly labelled; 1

(b) **C**; 1

(c) shape of active site;
complementary;
correct shape / correct molecule / correct substrate / **C**, will, fit / form ESC;
any other shape / any other molecule / any other substrate / **A** / **B** / **D** / **E**, will not;
award 2 marks if candidate writes 'only correct …..') 3 max

(d) *look for points relating to the substrate changing shape* *ignore refs to enzyme changing shape*

puts strain on the bonds in the substrate / bonds break more easily;
A weakens bonds

lowers activation energy;
AVP; e.g. referring to anabolic reaction 1 max

[6]

55. enzymes (of microorganisms) work in low temperatures;
<u>enzymes</u> used in stain removal / AW;
can be used for cool washes;
saves energy; 2 max

[2]

56. *marking points 1, 4, 8, 14, 19, 20 and 22 relate to the bullet points in the question*

1 liquid at normal temperatures;
2 hydrogen bonding between water molecules;
3 molecules more difficult to separate;

4 ice floats on water / water freezes from top down;
5 insulates water beneath;
6 large bodies of water don’t freeze completely / animals can still swim etc.;
7 (change in density with temperature) causes currents to circulate nutrients;

8 solvent for, polar / ionic, substances;
9 solubility of gases in environment;
10 allows reactions to take place;
11 transport medium;
12 e.g. (of substance carried in what);
13 transport medium for, gametes / blood cells;

14 water slow to change temperature;
15 lakes / oceans / large volumes, provide thermally stable environment;
16 internal body temperature changes minimised;
17 used for cooling;
18 e.g. (sweating / panting / transpiration);
19 large amount of energy must be removed for water to freeze;

20 organisms can use surface of water (as habitat);
21 e.g.; (of organism)

22 can form (long / unbroken) columns of water;
23 ref. to vascular tissue / xylem;

24 reactant (photosynthesis);
25 role in, hydrolysis / condensation;

26 AVP; e.g. transparency
27 AVP; plants can photosynthesise under water
incompressible
hydrostatic skeleton / turgor
buoyancy
guard cell mechanism
support for large organisms on ice (penguins / polar bears)
further detail of any point 9 max

QWC – legible text with accurate spelling, **punctuation and grammar**; 1

[10]

57. deoxyribose in DNA;
thymine in DNA; **R** thiamine
DNA is, made of two chains / double helix; **R** double molecule
longer; 2 max

[2]

58. (i) *answer has to relate to DNA nucleotide*

monomer unit;
deoxyribose;
nitrogenous base / named base(s); ecf for thiamine
phosphate;
AVP; e.g. deoxyribose is a pentose sugar / correct diagram 3 max

(ii) hydrogen bonds between bases;
complementary (base pairs);
purine to pyrimidine;
A to T and C to G;
2 H bonds between A and T / 3 H bonds between C and G;
DNA polymerase; 3 max

[6]

59. DNA codes for, protein / polypeptide;
transcription <u>and</u> translation (or described);
enzyme is <u>globular</u> (protein);
3 bases ≡ 1 amino acid;
sequence of bases / triplets, determines, sequence of amino acids / primary structure;
coiling / α helix / β-pleated sheet / particular secondary structure;
determines projecting side groups;
folding / bonding, for tertiary structure;
3-D structure is tertiary structure;
AVP; e.g. ref. active site related to shape
2 or more genes produce quaternary structure — 4 max

[4]

60. (i) *look for prokaryote feature*

no nucleus / no nuclear membrane / no nucleolus / DNA free (in cytoplasm); **R** DNA moving
naked DNA / DNA not associated with proteins / no chromosomes;
circular / loop, DNA;
no, membrane-bound organelles / e.g.;
smaller / 18nm / 70S, ribosomes;
no ER;
cell wall, not cellulose / polysaccharide and, amino acids / murein;
AVP; e.g. mesosomes / plasmids — 1 max

(ii) glycosidic (link) <u>and</u> peptide (bonds) (in correct context);
condensation;
ref. OH groups;
ref. NH_2 and OH group;
water, removed / produced / by-product;
enzyme;
AVP; e.g. energy required — 3 max

(iii) iron / Fe; *ignore pluses / minuses* — 1

(iv) *treat enzyme as neutral*

nitrogenase;
leghaemoglobin;
haemoglobin; — 2 max

(v) (nitrogen) fixation; **A** reduction — 1

(vi) type of inhibition (competitive / non-competitive / reversible / irreversible);
basic mode of action (e.g. binds to active site);
detail;
consequence (e.g. prevents, substrate / nitrogen, from binding); — 2 max

[10]

61. active site; — 1

[1]

62. activation (energy); 1

[1]

63. gene / allele; **A** cistron **R** genes / alleles / operon / intron 1

[1]

64. (a) (i) add / mix with, alcohol / ethanol / propanone / (suitable) organic solvent;
then, add to / add / mix with, water;
water alone = 0
R heat 2

(ii) emulsion / milky colour / cloudy / AW; **R** precipitate 1

(b) *phospholipids have*

1 less fatty acid (residue) / 2 fatty acid (residues) not 3; **A** hydrocarbon
1 less ester bond / 2 ester bonds not 3;
phosphate;
choline / base / nitrogen;
hydrophilic / polar, end / head; max 3

(c) (i) add, copper sulphate (solution) and sodium hydroxide (solution) / biuret (reagent);
R Biuret test unqualified
R heat 1

(ii) purple / mauve / lilac; **R** blue 1

[8]

65. *primary*

sequence / order, of amino acids (in a polypeptide); **A** R groups 1

secondary

coiling / folding, of the,
polypeptide / chain of amino acids / peptide chain / primary structure;
(α-) helix;
(β-) pleated sheet;
hydrogen bonds;
between amino acids in (same) chain;
(between) –NH and –CO;
AVP; e.g. random coiling max 4

[max 5]

66. (a) (malonate) same / similar, shape as, succinate / substrate;
A idea that inhibitor is complementary to active site

binds to / fits / blocks, active site;
for a limited time / reversible / may leave / AW;
R does not bind permanently

prevents, formation of ESC / substrate from binding; AW
no / less, product formed; **A** suitable ref. to conversion of succinate max 3

(b) rate increased;
greater chance of substrate binding with, active site / enzyme; ora
more, product formed / substrate converted;

will reach V_{max} / rate unaffected, if great excess of succinate;

AVP; e.g. graph of rate against substrate concentration
effect of time (using up substrate) max 3

[6]