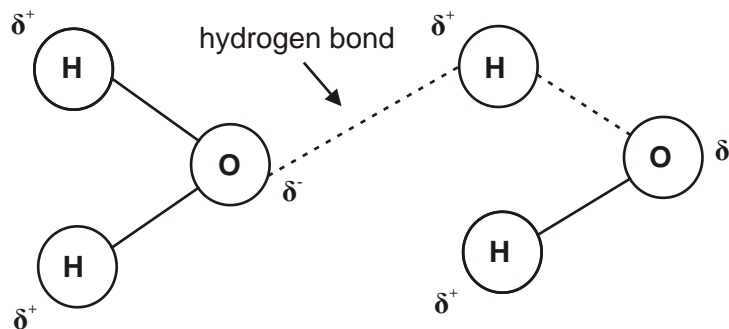


1.



- 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)  $\delta^+$  on **each** drawn **H**  
**and** (delta negative) (2)  $\delta^-$  on **each** drawn **O**;

*if both molecules drawn,  $\delta^+$  and  $\delta^-$  on **all** atoms.*

*ACCEPT d (lower case) for  $\delta$*

[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) heat capacity;

***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, active site;

3 (shape) complimentary to active site;

**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<sub>2</sub> / amine;

6 correct ref to a difference between sulfonamide and PABA;

e.g. only sulfonamide contains S  
sulfonamide has 1 more NH<sub>2</sub> group  
sulfonamide has SONH<sub>2</sub> but PABA has N<sub>2</sub>  
only PABA has COOH group

3

[4]

5. (i) without inhibitor

1 more, PABA / substrate, molecules enter active site:

**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<sub>max</sub>;

**ACCEPT** 'cannot work any quicker'  
**DO NOT CREDIT** 'optimum rate' or 'rate levels off'

5 (at high substrate concentration) enzyme concentration 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 2<sup>nd</sup> 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 disulfide, 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 1<sup>st</sup> answer on each numbered line*

2 max

[5]

8. (i) deoxyribose (sugar);  
 phosphate (group);  
**DO NOT CREDIT** dioxribose  
**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);  
different / named, organisms 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 slightly 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% and G = 19.9%*

*human A = 30.9% and E. coli A = 24.7%*

*'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

<i>feature</i>	<i>DNA</i>	<i>RNA</i>
<i>number of strands</i>	two / double	one / single
<i>bases present</i>	thymine / T (+ adenine + cytosine + guanine)	uracil / U (+ adenine + cytosine + guanine)
<i>sugar present</i>	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** dioxribose / 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**  $\alpha$  or  $\beta$  or numbers

2

- (ii) hydrolysis / addition of water;

1

- (iii)  $\beta$  / beta, glucose;

Must be qualified as  $\beta$  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 much, higher / less acidic, than optimum (for enzyme 2);

*Needs idea of much 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 break;

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

*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 1<sup>st</sup> response on each numbered line unless no answer on one line, then mark 1<sup>st</sup> 2 answers*

temperature;  
substrate concentration;  
enzyme concentration;

*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 heat with, Benedicts (solution) /  $\text{CuSO}_4 + \text{NaOH}$ ;
- 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°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<sub>2</sub>O;

max 2

[2]

18. accept ✓ = yes ✗ = no  
each correct row = 1 mark

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

[4]

19. (i) crush (small amount of) seed pod;  
add (small volume of) biuret, A / NaOH, and biuret, B / CuSO<sub>4</sub>;  
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<sub>4</sub> in alkaline solution
- 5 excess 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:*

either

- 9 colour change from blue to green / yellow / orange / red;
- 10 shows increasing concentration of reducing sugar;

or

- 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 /  $\text{H}_2\text{O}_2$ , molecules, high / higher at start;  
 more chance of, substrate/  $\text{H}_2\text{O}_2$ , 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;  
 substrate 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)  $\alpha$ -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

substance	statement					
	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 (C/ 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  $\text{pH}/[\text{H}^+]$ ) 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*

E *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)

S *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  $V_{\text{max}}$ ; **A** plateau / levels off  
 5 enzyme conc. becomes limiting / unless add more enzyme;

**S**  
 (3 max)

**C** *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 optimum (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**
- (b) (i) ( $\alpha$ ) helix; **R** double helix
- (ii) ( $\beta$ ) pleat(ed) (sheet);
- (c) tertiary / 3°;

1

1

1

1

**[4]**

36. solvent;  
liquid; **A** same  
dense;  
insulates; **A** keeps warm **R** protects / warms  
hydrogen; **A** H / weak **R** H<sup>+</sup> / H<sub>2</sub>  
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)**

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

[5]

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

use same volume of glucose solution;  
use same volume 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 /  $\text{Fe}^{2+}$  /  $\text{Fe}^{3+}$ ; **R** *ion / Fe / Fe<sup>+</sup>* 1 [2]
41. (i) breaking a bond with the addition of water; **A** *named bond* 1  
(ii) fatty (acids produced);  
 $[\text{H}^+]$  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 denatured;  
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 permanently'*  
alters, shape / charge, of active site;  
so substrate cannot, fit to active site / bind to active site / form ESC;  
will not reach  $V_{\text{max}}$ ;  
increasing substrate concentration has no effect (on the rate); 3 max [3]
43. (a) **R** *first reference to  $^{15}\text{N}$  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 molecule / molecule contains both  $^{14}\text{N}$  and  $^{15}\text{N}$ ;  
4 one strand with, 'heavy' N /  $^{15}\text{N}$ ; **R** *molecule*  
5 one strand with, 'light' N /  $^{14}\text{N}$ ; **R** *molecule*  
6 no molecules with only, 1 isotope /  $^{14}\text{N}$  /  $^{15}\text{N}$ ;  
*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  $^{14}\text{N}$  and  $^{14}\text{N}/^{15}\text{N}$  only;  
thick for  $^{14}\text{N}$  and thin for  $^{14}\text{N}/^{15}\text{N}$ ;

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 / gluconeogenesis;  
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 3<sup>rd</sup> 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);  
 $\beta$  / beta; **A** B  
 glycosidic; **NOT** glucosidic  
 180;  
 straight; **A** polysaccharide / unbranched / linear  
 hydrogen / H; **NOT** H<sub>2</sub> 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 / thiamine
- take a correct base from a list unless that list includes uracil 3
- [4]

49. 1 2, 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, strands, 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. allosteric  
 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<sub>2</sub>OH;  
 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<sub>2</sub>OH side chains / 1 CH<sub>2</sub>OH 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<sub>2</sub>O, 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;  
enzymes 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 and translation (or described);  
enzyme is globular (protein);  
3 bases  $\equiv$  1 amino acid;  
sequence of bases / triplets, determines, sequence of amino acids /  
primary structure;  
coiling /  $\alpha$  helix /  $\beta$ -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) and peptide (bonds) (in correct context);  
condensation;  
ref. OH groups;  
ref.  $\text{NH}_2$  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;  
 ( $\alpha$ -) helix;  
 ( $\beta$ -) pleated sheet;  
 hydrogen bonds;  
 between amino acids in (same) chain;  
 (between)  $\text{-NH}$  and  $\text{-CO}$ ;  
 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; or a  
 more, product formed / substrate converted;  
 will reach  $V_{\text{max}}$  / 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]**