1. Galactosaemia is an inherited disorder that produces an inability to metabolise galactose. Babies with galactosaemia vomit soon after they have started to breast feed because of the production of metabolic toxins. If it is not treated it can result in mental retardation. The babies obtain the galactose because it is a sub-unit of lactose which is present in milk.

(a) (i) State the general formula for disaccharide.
$C_{12}H_{22}O_{11}$;

(1 marks)

(ii) Name the chemical process by which lactose is broken down into its constituent sub-units.
hydrolysis / eq;

(1 marks)

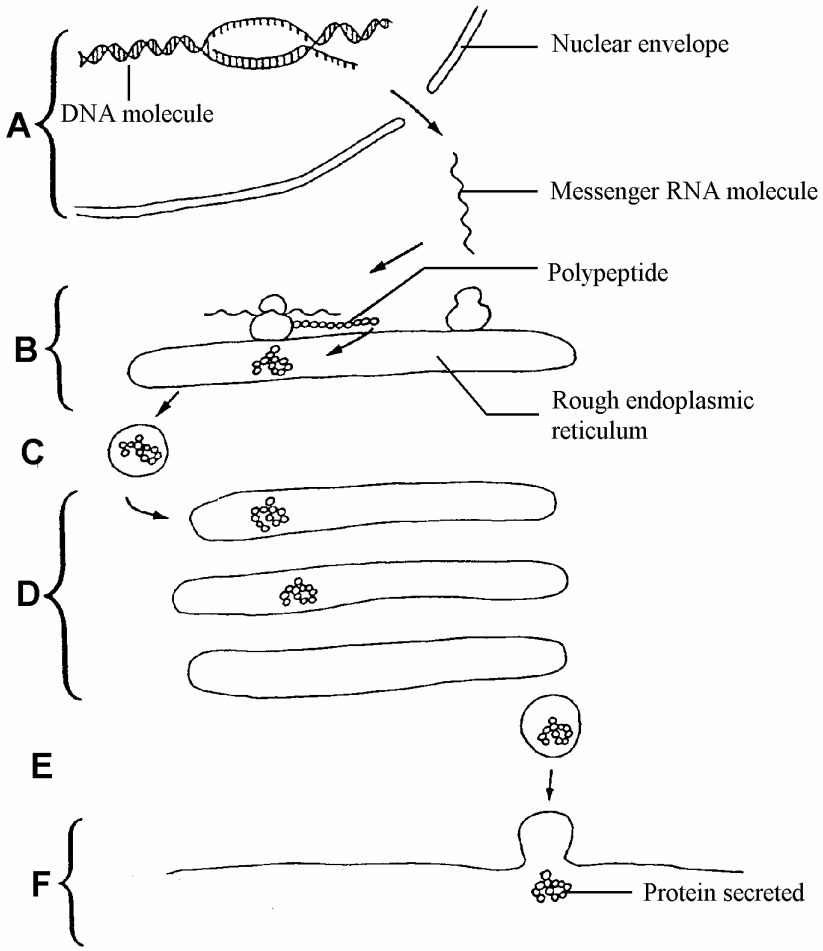
(iii) State one chemical difference between lactose and maltose.
lactose consists of glucose + galactose, maltose consists of glucose only / lactose contains galactose but maltose does not;

(1 marks)

(b) Suggest a simple treatment for a baby who has galactosaemia and give a reason for your answer.
use non-human milk / named example / artificial / powdered; no lactose / no galactose / add enzymes to break down galactose; replace (lactose) with another sugar;

(2 marks)
[Total 5 marks]

2. The diagram below shows some of the stages in protein synthesis and secretion in a mammalian cell.



(a) (i) Name the processes taking place during stages A and B.

A transcription;

B translation;

(2 marks)

(ii) Name the process by which protein is secreted in stage F.

exocytosis / reverse pinocytosis;

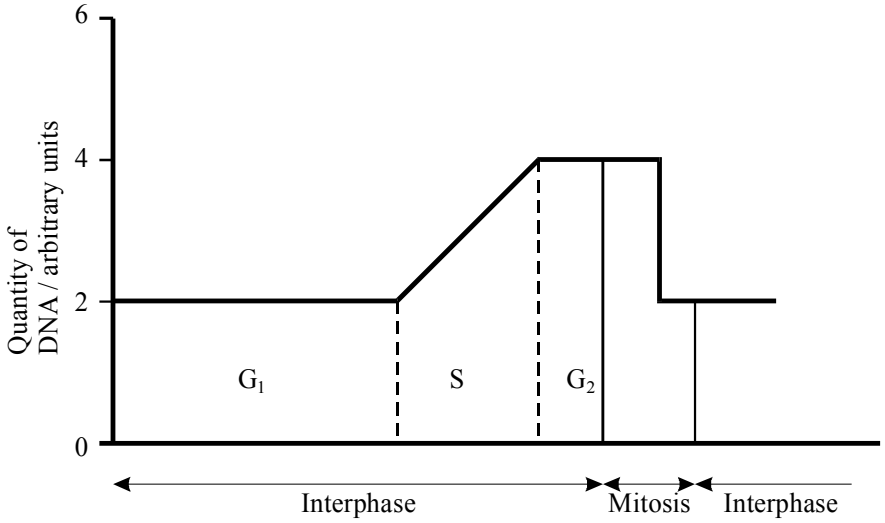
(1 marks)

(b) Describe the part played by transfer RNA in the formation of the polypeptide chain during stage B.

tRNA has an unpaired triplet of bases / anticodon; attaches to / binds to mRNA codon / complementary bases; tRNA carries a specific amino acid; which becomes part of polypeptide / reference to formation of peptide bonds;

(3 marks)
[Total 6 marks]

3. The graph below shows how the quantity of DNA, measured in arbitrary units, varies with time during the different phases of the cell cycle in an animal cell.



(a) Interphase is made up of two growth phases, G_1 and G_2, separated by an intermediate phase, S.

(i) Explain what is happening within the cell during phase S.
quantity of DNA doubles;
replication of DNA / chromosomes;
preparation for mitosis / nuclear division / cell division / asexual reproduction;

(2 marks)

(ii) State *one* process other than cell growth which occurs during phase G_2.
mitochondria divide / energy stores increase / ATP produced / respiration / duplication of centrioles / spindle begins to form / protein synthesis;

(1 marks)

(b) Account for the changes in the quantity of DNA in the cell during mitosis.
DNA content halves / returns to original level;
DNA / chromosomes / chromatids shared between (daughter) cells / nuclei;
during cell division / cytokinesis;

(2 marks)
[Total 5 marks]

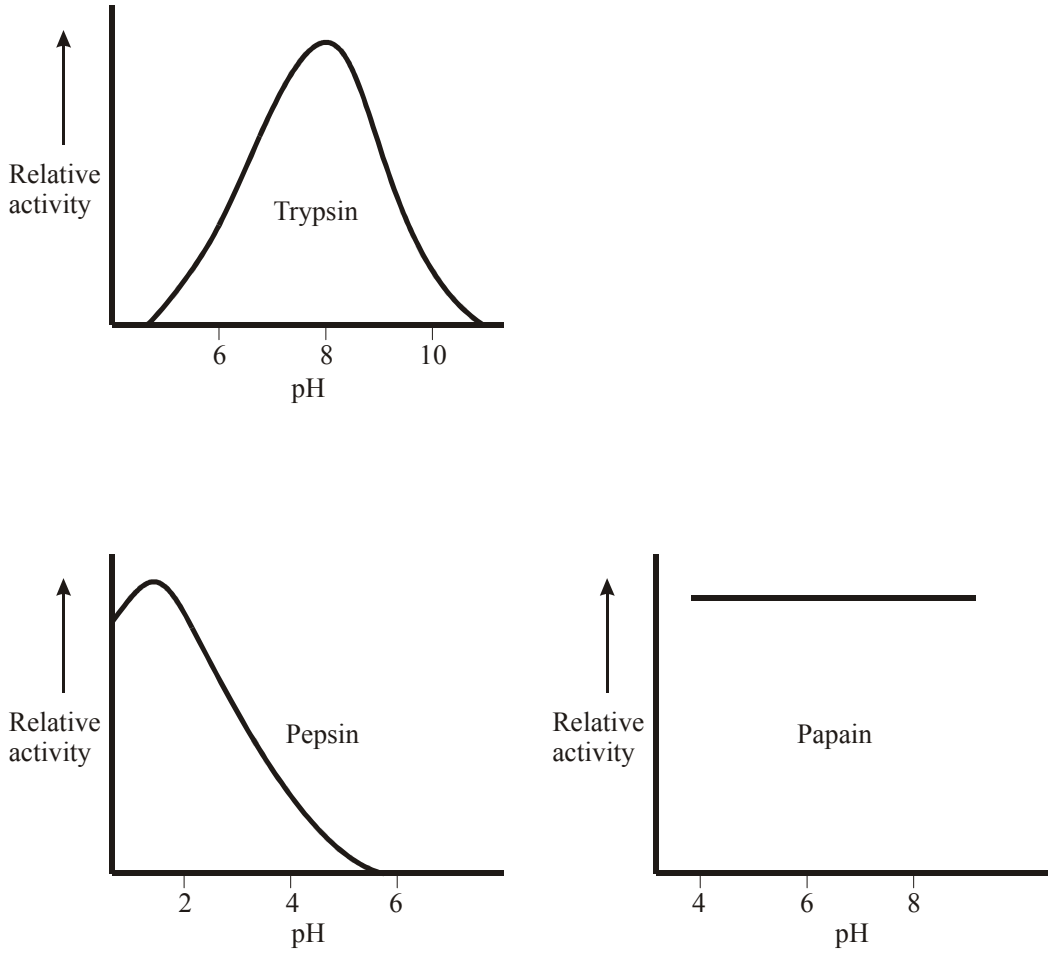
4. The table below refers to some features of prokaryotic and eukaryotic cells.

If the feature is present, place a tick (√) in the appropriate box and if the feature is absent, place a cross (x) in the appropriate box.

Feature	Prokaryotic cell	Eukaryotic cell	
Nuclear envelope	✗	✓	;
Cell surface membrane	✓	✓	;
Ribosomes	✓	✓	;
Microtubules	✗	✓	;
Mitochondria	✗	✓	;

[Total 5 marks]

5. The graphs below show the relationship between pH and the relative activity of three different protein digesting enzymes: trypsin, pepsin and papain.



(a) Explain why changes in pH usually affect the activity of the enzymes.

pH affects ionisation / changes / ionic bonds / hydrogen bonds; this affects shape of enzyme / active site; could affect ionisation of substrate; affects formation of enzyme - substrate complexes; enzymes may be denatured at extremes of pH / at unsuitable pH values;

(3 marks)

(b) Comment on the effect of changes in pH on the activity of trypsin, pepsin and papain.

trypsin has an optimum activity at pH 8 (range 7.5 - 8.5);

pepsin has an optimum activity at pH 2 (range 1.5 - 2);
activity decreases on either side of the optimum;
activity of papain is not affected by changes in pH;
papain has a relatively high activity over pH range 4 to 8 / has no optimum pH;

(4 marks)

(c) Which of these three enzymes would be most suitable to use as a meat tenderiser? Give an explanation for your answer.

papain; has a high activity over wide range of pH values; optima of pH 2 or 8 are unsuitable for culinary use / trypsin (or pepsin) has too specific pH requirements;

alternative:

trypsin;
pH optimum close to that of meat / blood;

(2 marks)

(d) Rennin, an enzyme extracted from the stomach of calves, is used in the manufacture of cheese. Maxiren®, an enzyme similar to rennin, is produced by gene technology.

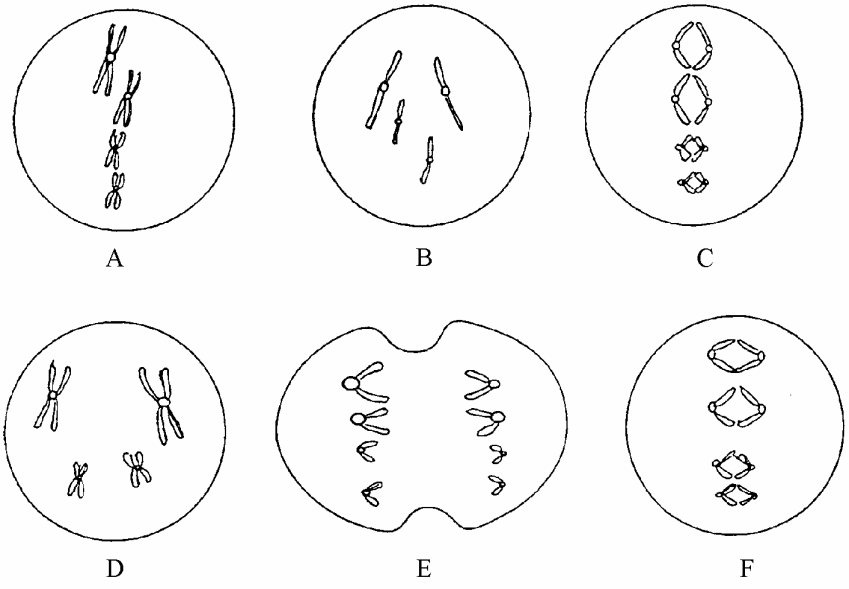
State *two* advantages of using Maxiren®, instead of rennin in cheese manufacture.

1 **may be cheaper to produce / extract;**
easier to extract;

2 **can be produced in large quantities / faster;**
ethical considerations / suitable for vegetarians;
microbial enzymes are temperature stable;
standardised quality / enzyme always the same / purer;

(2 marks)
[Total 11 marks]

6. (a) The diagrams below represent the chromosomes during stages in the process of mitosis.



Write the letters in the order that represents the sequence in which these stages occur.
B D A C F E / D A C F E B :

(1 marks)

(b) State *two* ways in which meiosis differs from mitosis.

1 pairing of homologous chromosomes / eq;
chiasmata formation / crossing over occurs;

2 chromosome number halved / haploid cells formed;
two divisions to complete process / four cells formed;

The converse of these points allowed if a clear reference to <u>mitosis</u> was made.

(2 marks)

(c) Explain the significance of mitosis in living organisms.

production of genetically identical cells;

daughter cells have same function as parent cell;

for growth / repair;

for asexual reproduction / clone formation;

rapid reproduction in favourable conditions;

(3 marks)
[Total 6 marks]

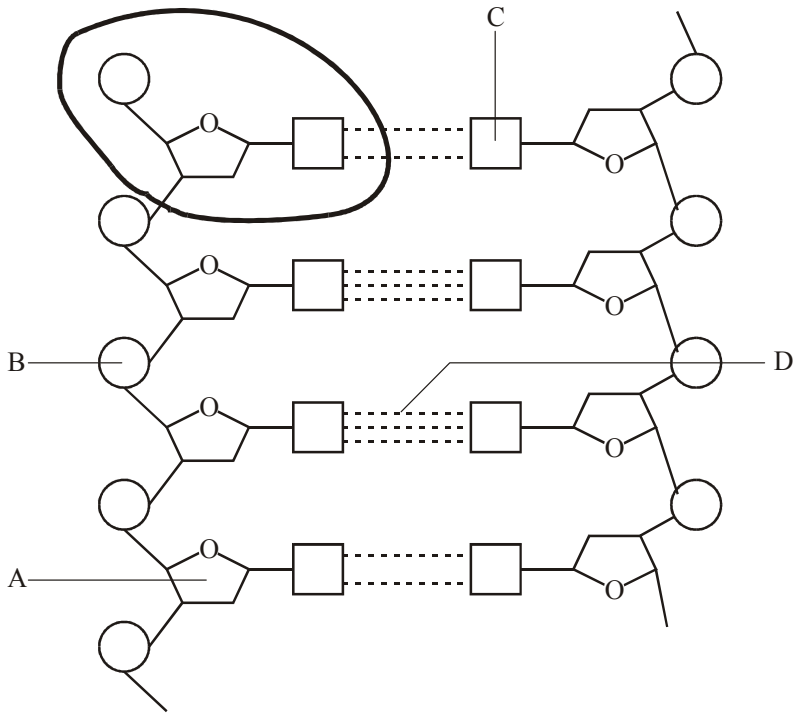
7. The table below refers to three organic compounds found in cell organelles.

If the compound is found in the organelle, place a tick (√) in the appropriate box and if the compound is not found in the organelle, place a cross (***x***) in the appropriate box.

Organelle	Phospholipid	DNA	RNA	
Ribosome	✗	✗	✓	;
Chloroplast	✓	✓	✓	;
Smooth endoplasmic reticulum	✓	✗	✗	;
Mitochondrion	✓	✓	✓	;

[Total 4 marks]

8. The diagram below shows the structure of part of a molecule of deoxyribonucleic acid (DNA).



(a) Name the parts labelled A, B, C and D.

A deoxyribose;

B phosphate / phosphate group;

C organic base / named example / purine / pyrimidine;

D hydrogen bond / dipole - dipole link;

(4 marks)

(b) (i) On the diagram, draw a ring around *one* nucleotide.

(1 mark)

(ii) What type of chemical reaction is involved in the formation of a molecule of DNA from nucleotides?
condensation / dehydration / polymerisation;

(1 mark)
[Total 6 marks]

9. The diagram below shows part of a messenger RNA (mRNA) molecule.

(a) (i) How many codons are shown in this section of mRNA?
four / 4;

(1 mark)

(ii) What is specified by a sequence of codons in an mRNA molecule?
sequence / order of amino acids / primary structure of polypeptide / protein;

(1 mark)

(b) A tRNA molecule carries a complementary base sequence for a particular codon.

(i) Write the complementary sequence for the first codon in the mRNA sequence given above.

AUG;

(1 mark)

(ii) Describe the role of tRNA molecules in the process of protein synthesis.

tRNA has an unpaired triplet of bases / anticodon;

attaches / binds / joins to MRNA codon / triplet of bases;

tRNA carries a specific / eq. amino acid;

correct reference to formation of peptide bond /

OR amino acids joined by peptide bond;

(3 marks)
[Total 6 marks]

10. Give an account of the structure and functions of polysaccharides in living organisms.

[Total 10 marks]

1 (a) polysaccharides consist of monosaccharides joined;

(b) by glycosidic bonds;

(c) correct general formula for polysaccharide;

2 correct details of bond formation / accept from clear diagram;

3 α glucose in starch / glycogen / α 1-4 linkages;

4 β glucose in cellulose / β 1-4 linkages;

5 starch consists of amylose and amylopectin;

6 amylase is unbranched / amylopectin branched;

7 glycogen branched;

8 cellulose unbranched;

9 starch / glycogen are storage carbohydrates;

10 (a) starch in plants;

(b) glycogen in animals / liver / muscle;

11 reference to osmotic effects / insolubility;

12 (a) can be broken down to glucose;

(b) glucose / starch / glycogen as source of energy;

13 cellulose in plant cell wall;

14 hydrogen bonding between hydroxyl groups of adjacent chains;

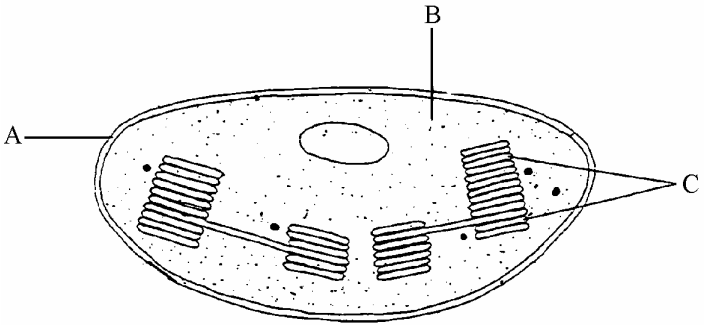
15 forming microfibrils;

16 has high tensile strength / reference to structural support;

17 credit for 2 other polysaccharides; e.g. callose, inulin, pectins, peptidoglycans, chitin; name and correct function / location.

18 cellulose as roughage;

11. The diagram below shows the structure of a chloroplast, as seen using the electron microscope.



(a) Name the parts labelled A, B and C.

A chloroplast envelope / double / outer membrane / inter-membranous space;

B stroma;

C thylakoids / granum / granal lamellae;

(3 marks)

(b) The actual length of this chloroplast is 2.5 μm. Calculate the magnification of this diagram. Show your working.

(78 to 80 × 10^3) ÷ 2.5 ;
(measurement)

Answer **31 200 to 32 000.**

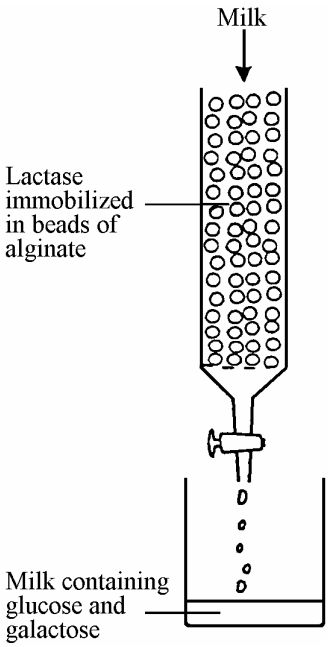
(2 marks)
[Total 5 marks]

12. Some people become ill if they drink milk or milk products as they do not secrete the enzyme lactase in their intestine. This is known as lactose intolerance.

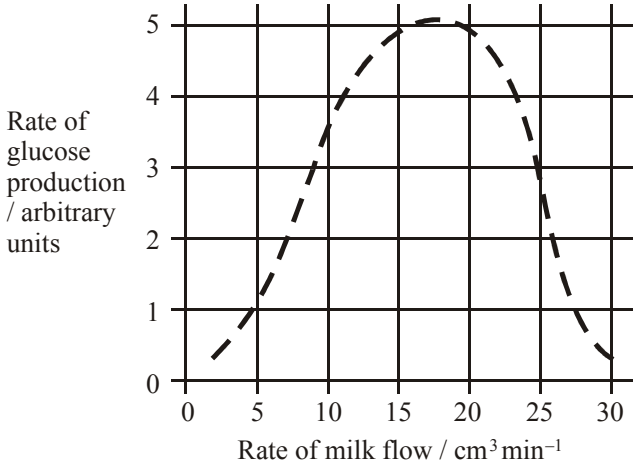
Lactose, present in milk, is converted to glucose and galactose by the action of the enzyme lactase.

In an investigation, milk was passed at different rates over lactase immobilised in beads of sodium alginate. The rate of glucose production was measured at each flow rate.

The apparatus used is shown in the diagram below.



The results are shown in the graph below.



(a) (i) Describe the effect of the rate of flow of milk on the rate of glucose production.
maximum rate between 15 – 20cm^3 min^{-1};

rate decreases either side of maximum / increases to maximum then decreases;

rapid increase at 5-10 cm^3 min^{-1} flow rate / rapid decrease at 25 – 28 cm^3 min^{-1} / eq;

(2 marks)

(ii) Suggest *two* reasons why variations in the rate of flow of milk should produce this effect.

1 too fast means insufficient time for enzyme to act on lactose / eq;

2 too slow means galactose / glucose / products will accumulate and inhibit reaction

(2 marks)

(b) (i) Explain what is meant by *enzyme immobilisation.*
enzyme bound to a surface / ref to entrapment / eq;

not allowed to mix with its substrate in solution;

(2 marks)

(ii) Suggest *two* advantages of using immobilised enzymes in commercial processes.
enzyme retained / can be re-used / eq;

enzyme more heat stable / pH stable / eq;

does not contaminate product / can easily be separated from product;

less enzyme needed (therefore reduces cost);

can control rate of reaction.

(2 marks)

(c) (i) Suggest why it may be advantageous to treat milk with lactase during the manufacture of dairy products.
removes lactose from milk;

makes milk / milk products sweeter;

makes dairy products available for lactose intolerant people;

(2 marks)

(ii) Suggest why most people with lactose intolerance only develop the illness after infancy.
lactase present in gut of young infants / lactose present in natural milk so young infants produce lactase;

(1 mark)
[Total 11 marks]

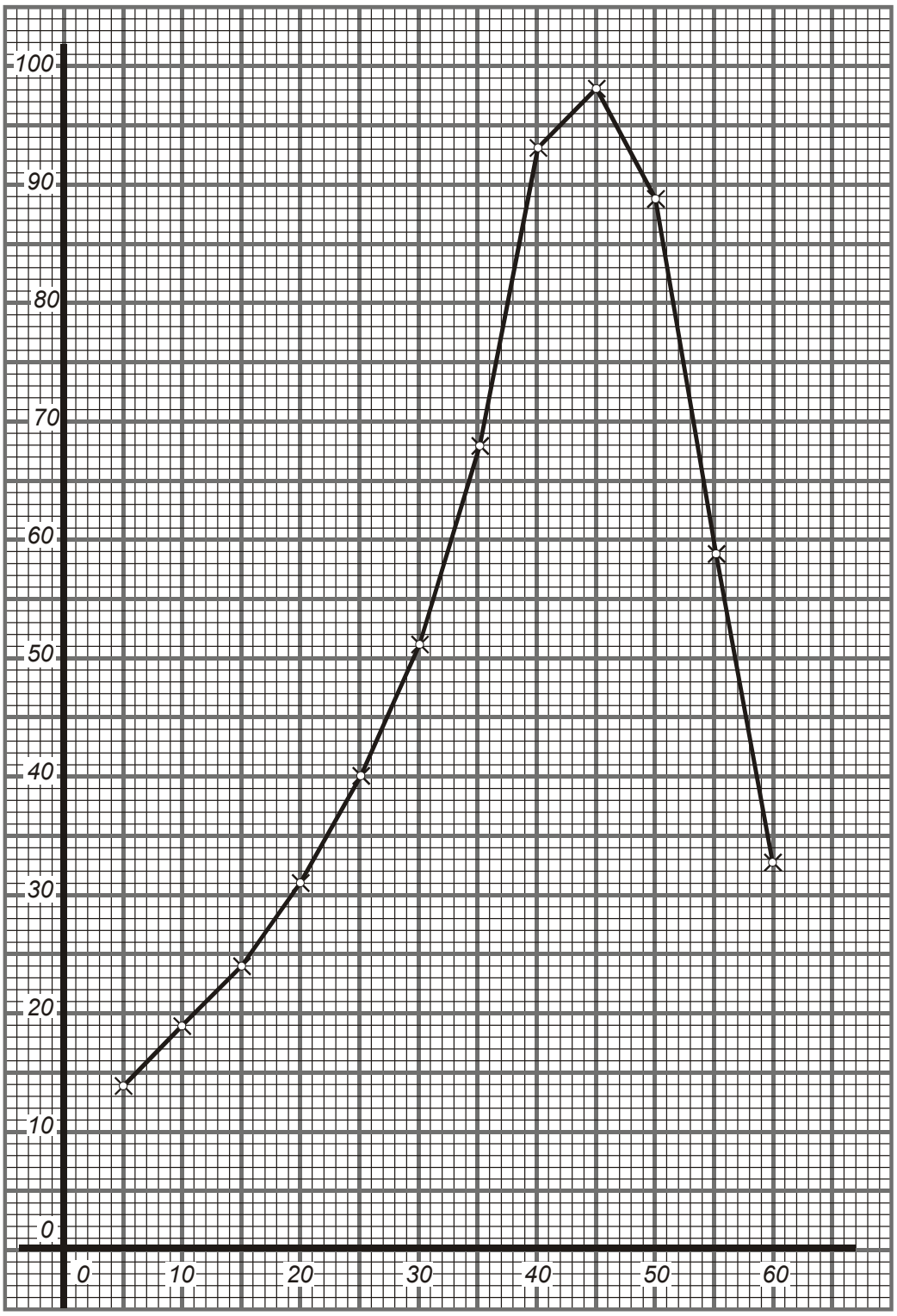
13. An experiment was carried out to determine the effect of temperature on the activity of an enzyme digesting the protein gelatin.

Gelatin was incubated with the enzyme at a range of temperatures from 5 °C to 60 °C. The rate of amino acid production was measured over a three-hour period.

The results are shown in the table below, expressed as rate of amino acid production in mg dm^{-3} h^{-1}

Temperature / ºC	Rate of production of amino acid / mg dm^{-3} h^{-1}
5	14
10	19
15	24
20	31
25	40
30	51
35	68
40	93
45	98
50	89
60	33

(a) (i) Plot the data on the graph paper below.



(4 marks)

(ii) Comment on the effect of temperature on the activity of the enzyme as shown in the graph.

rate increased exponentially / eq. until 40 °C;

slower / eq. increase to 45 °C / maximum / optimum rate at 45 °C / reaches a peak at 45 °C;

reference to steep / eq fall / ref to specified figures / after 45 °C / 50 °C / after optimum / OR correct ref to specified figs and temperatures;

reference to (kinetic) energy / movement of molecules / eq;

reference to denaturing of enzymes at higher temperatures;

(3 marks)

(b) The experiment was continued at 45 °C for a further 7 hours. At the end of this time, an additional 292 mg dm^{-3} of amino acid had accumulated.

(i) Calculate the mean rate of reaction during the 10 hours at 45 °C.

[(3x98) + 292] ÷ 10 =) 58.6 / 59 mg dm $^{-3}h^{-1}$

(1 mark)

(ii) Give *two* possible reasons for the difference between the rate at the end of 10 hours and the rate after 3 hours incubation.

1 substrate / gelatin / protein used up;
enzyme (starts to) denature(s);

2 inhibition by end product of reaction / ref to equilibrium reached / eq;

(2 marks)

(c) Protein-digesting enzymes can be used as an ingredient in biological washing powders.

Suggest how the results of this experiment could be used to design a suitable washing programme using a biological washing powder.

set programme at (40-) 45 °C / optimum temperature;

ref to short time / up to 3 hours for washing cycle;

bring wash up to temperature before adding washing powder / ref to pre-wash with powder;

(2 marks)
[Total 12 marks]

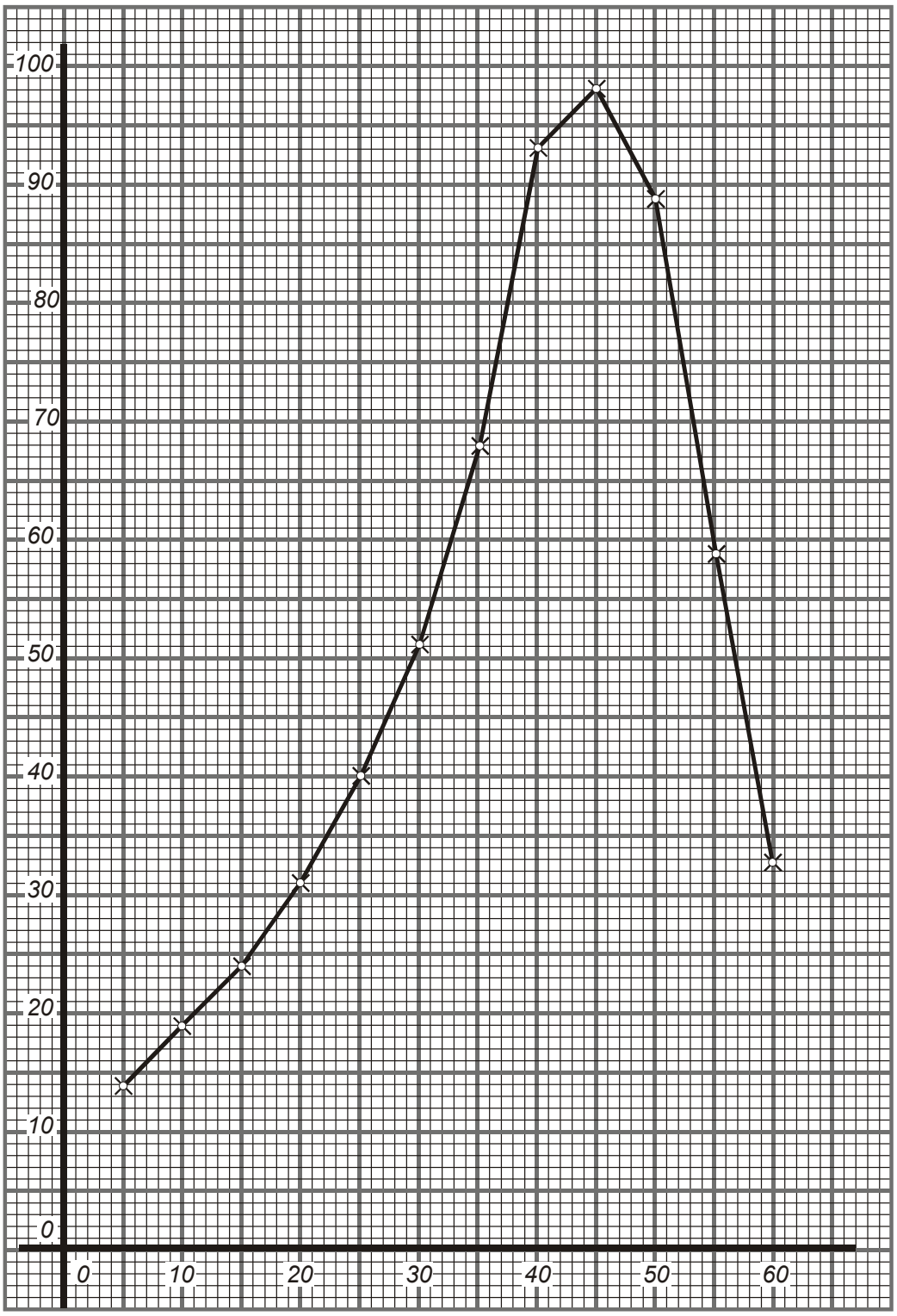
14. An experiment was carried out to determine the effect of temperature on the activity of an enzyme digesting the protein gelatin.

Gelatin was incubated with enzyme at a range of temperatures from 5 °C to 60 °C. The rate of amino acid production was measured over a three-hour period.

The results are shown in the table below, expressed as rate of amino acid production in mg dm^{-3} h^{-1}

Temperature / ºC	Rate of production of amino acid / mg dm^{-3} h^{-1}
5	14
10	19
15	24
20	31
25	40
30	51
35	68
40	93
45	98
50	89
60	33

(a) (i) Plot the data on the graph paper below.



(4 marks)

(ii) Comment on the effect of temperature on the activity of the enzyme as shown in the graph.
rate increased exponentially / eq. until 40 °C;

slower / eq. increase to 45 °C / maximum / optimum rate at 45 °C / reaches a peak at 45 °C;

reference to steep / eq fall / ref to specified figures / after 45 °C /50 °C / after optimum / OR correct ref to specified figs and temperatures;

reference to (Kinetic) energy / movement of molecules / eq;

reference to denaturing of enzymes at higher temperatures;

(3 marks)

(b) The experiment was continued at 45 °C for a further 7 hours. At the end of this time, an additional 292 mg dm^{-3} of amino acid had accumulated.

(i) Calculate the mean rate of reaction during the 10 hours at 45 °C.
[(3x98) + 292] ÷ 10 =) 58.6 / 59 mg $dm^{-3}h^{-1}$

(1 mark)

(ii) Give *two* possible reasons for the difference between the rate at the end of 10 hours and the rate after 3 hours incubation.
1 substrate / gelatin / protein used up;
enzyme (starts to) denature(s);

2 inhibition by end product of reaction / ref to equilibrium reached / eq;

(2 marks)

(c) Protein-digesting enzymes can be used as an ingredient in biological washing powders.

(i) Suggest how the results of this experiment could be used to design a suitable washing programme using a biological washing powder.
set programme at (40-) 45 °C / optimum temperature;

ref to short time / up to 3 hours for washing cycle;

bring wash up to temperature before adding washing powder / ref to pre-wash with powder;

(2 marks)

(ii) Suggest possible advantages of using biological washing powders rather than non-biological detergents.
works at/can be used at lower temperatures;

so energy-saving;

less harmful / damaging to fabrics / eq;

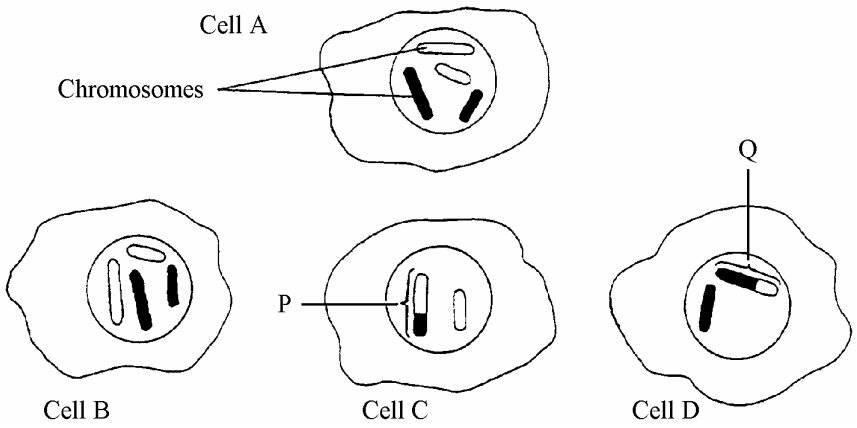
better at getting rid of organic / specific stains;

ref to environmental effect / biodegradable / no / less phosphate / eq;

(2 marks)
[Total 14 marks]

15. (a) Cell A in the diagram below has two pairs of chromosomes.

Cell B, C and D have each arisen from A by cell division.



(i) For each of the cells labelled B and C, identify the type of cell division which has occurred to produce the cell. In each case give a reason for your answer.

Cell B

Type of division Mitosis;

Reason no reduction in chromosome number / same number of chromosomes / both diploid / still diploid / identical to Cell A;

Cell C

Type of division meiosis / reduction division;

Reason chromosome number halved / crossing over has occurred / haploid / chromosomes different from A;

(2 marks)

(ii) Explain the reasons for the difference between the parts labelled P and Q in cells C and D.

homologous chromosomes pair / synapsis occurs / bivalents formed;

chiasma formed / crossing over took place;

exchange of materials / genes / genetic information between chromatids;

(3 marks)

(b) State *one* way in which oogenesis differs from spermatogenesis.

one egg cell produced (in oogenesis) four spermatoza in spermatogenesis

polar bodies formed in oogenesis / not in spermatogenesis;

oogenesis in embryo / spermatogenesis from puberty onwards / final division of oogenesis after fertilisation / not in spermatogenesis;

(1 mark)

(c) State *two* ways in which embryo development in flowering plants differs from embryo development in humans.

1 double fertilisation in plants / ref to two male nuclei involved / only one in human;
plant embryo develops in seed / human embryo develops in uterus;

2 **embryo supplied with food store / eq in plant / ref to food via placenta / eq in humans; dormant stage of development of plant embryo / no dormant stage in humans;**

(2 marks)
[Total 8 marks]

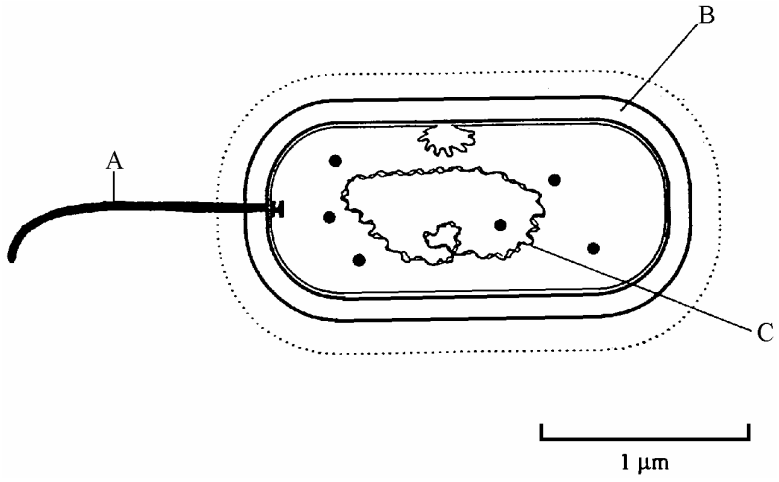
16. The table below refers to components of the cell surface membrane (plasma membrane) and to their roles in transporting substances across the membrane.

Complete the table by inserting an appropriate word or words in the empty boxes.

Component	Subunits	Chemical bond between subunits	Role in transport
Phospholipid	Fatty acids, glycerol and phosphate	*ester;*	*Ref. to vesicle formation/cytosis/ chylomicrons/ref.to diffusion;*
Carbohydrate side chain	*monosaccharide/ named e.g. of a monosaccharide/ ref. to pentose/hexose;*	*glycosidic;*	Receptor
Protein	*amino acids;*	Peptide	*Ref. to channels/pores allowing passage/ facilitated diffusion/ receptor/enzyme/ carrier/active transport;*

[Total 6 marks]

17. The diagram below shows the structure of a bacterial cell as seen using an electron microscope.



(a) Name the parts labelled A, B and C

A Flagellum / flagella;

B (peptidoglycan) / cell wall;

C (circular) DNA / chromosome / nucleoid;

(3 marks)
[Total 3 marks]

18. Read through the following passage on the cell cycle and mitosis, then write on the dotted lines the most appropriate word or words to complete the passage.

In the cell cycle, replication of DNA takes place during …….**interphase / S phase;**…….
At the beginning of prophase the chromosomes become visible and can be seen to consist of two ……. **chromatids;**……. joined at the .....**centromere;**.....….. .

The .....**nucleolus / nucleoli;**..... and nuclear membrane disappear and a spindle develops in the cell.
The chromosomes become attached to the spindle at the equator during .....**metaphase;**..... . At anaphase one copy of each chromosome is pulled towards each .....**pole / end / aster;**..... of the spindle. The final phase, called telophase, involves the formation of two new nuclei. In plant cells the two daughter cells are separated by the formation of a ……. **cell plate / cell wall / phragmoplast / middle lamella;**...…… .

[Total 7 marks]

19. The monosaccharides glucose and fructose are *reducing sugars*. Sucrose is a disaccharide which is not a reducing sugar.

The Benedict's test is used to detect reducing sugars. When reducing sugars are boiled with Benedict's solution a red precipitate is produced. This precipitate can be filtered from the solution, dried and weighed. If excess Benedict's solution is used, the mass of precipitate produced is proportional to the concentration of reducing sugar in the solution. The enzyme sucrase is a hydrolase and does not reach with Benedict's solution.

(a) In an experiment, sucrase was added to a solution of sucrose and incubated for five minutes. The Benedict's test was then carried out on the resulting solution and a red precipitate was produced.

Suggest an explanation for this result.

sucrase breaks down / hydrolyses / eq. sucrose / substrate;
to glucose and fructose / to monosaccharides;

(2 marks)

(b) A further experiment was carried out to investigate the effect of silver nitrate on the activity of sucrase. The procedure described above was repeated, but different concentrations of silver nitrate were added to the sucrase. The solutions were kept at the same pH for the same time. The mass of precipitate produced by the Benedict's test at each concentration was measured. The results are shown in the table below.

Concentration of silver nitrate / mol dm^{-3}	Mass of precipitate / mg
0 (control)	50
10^{-6}	37
10^{-5}	27
10^{-4}	10

(i) Calculate the percentage decrease in the mass of precipitate produced in the solution containing 10^{-5} mol dm^{-3} silver nitrate compared with the control test. Show your working.
(23 ÷ 50) × 100 / eq;

Answer **46%;**

(2 marks)

(ii) Suggest an explanation for the effect of the silver nitrate solution on the activity of the enzyme sucrase.
silver nitrate is an inhibitor;
block / affects shape of active site;
substrate no longer able to bind;
reduces rate of reaction;

(2 marks)

(c) (i) Explain why it is important to maintain constant pH when investigating enzyme activity.
(changes in pH) affect formation of enzyme-substrate complexes;
changes shape / tertiary structure / 3D structure / eq. of enzyme / active site by changing (hydrogen) bonding / charges / ionisation;
ref to optimum pH / eq;

(2 marks)

(ii) State *three* precautions, other than maintaining constant pH, which should be taken to produce reliable results in the above investigation.

1 **constant / same temperature;**
equilibration of enzyme and substrate;
same volume of Benedict's;
same time of heating with Benedict's;
same temperature for heating with Benedicts;

2 **same filtration / drying method;**
dry precipitate to constant mass;
same volume of sucrose;
same volume of sucrase;

3 **same concentration of sucrose;**
same concentration of sucrase;
leave enzyme and substrate for same time to react;
use same volume of silver nitrate;
replication;

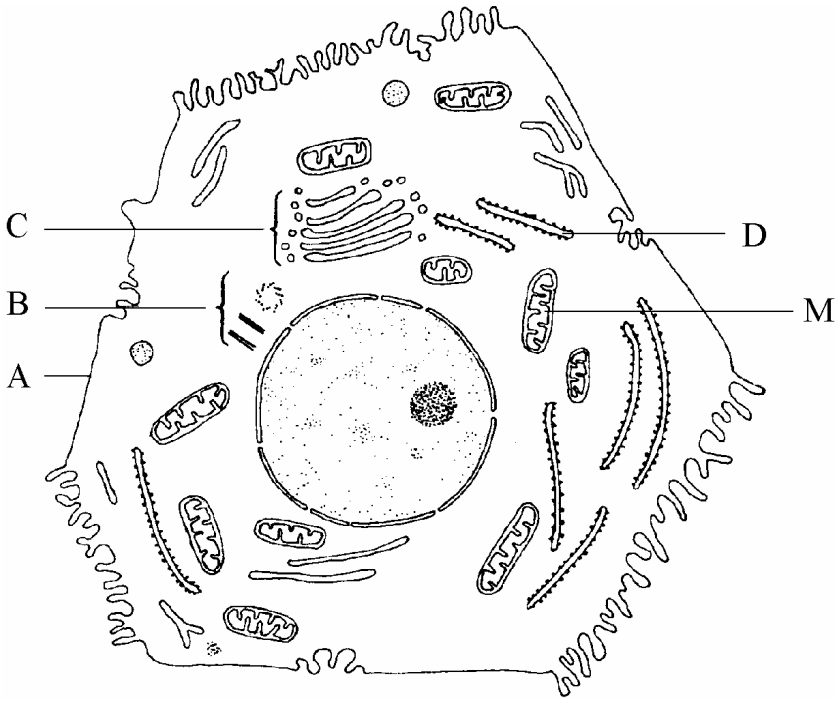
(3 marks)
[Total 11 marks]

20. Read through the following passage about enzymes and their industrial uses, then write on the dotted lines the most appropriate word or words to complete the account.

As much as 75% of the world's adult population maybe unable to tolerate and digest the sugar in milk, and so this sugar is removed during the manufacture of some milk products. This is done using the enzyme .....**lactase / β-galactosidase**;..... which hydrolyses the milk sugar into .....….**glucose;**…..... and .....**galactose;**..... . Unlike the sugar in milk, these are both .....**monosaccharide;**..... sugars. They are both .....**sweeter / more soluble;**..... than milk sugar, so milk products treated in this way are particularly useful in the manufacture of confectionery.

[Total 5 marks]

21. The diagram below shows the structure of a liver cell as seen using an electron microscope.



(a) Name the parts labelled in A, B, C and D.

A plasma membrane / cell membrane / cell surface membrane;

B centriole(s) / microtubule(s) / centrosome;

C Golgi apparatus / Golgi body / smooth ER;

D rough ER / ribosome;

(4 marks)

(b) The magnification of this diagram is × 12 000. Calculate the actual length of the mitochondrion labelled M, giving your answer in μm. Show your working.

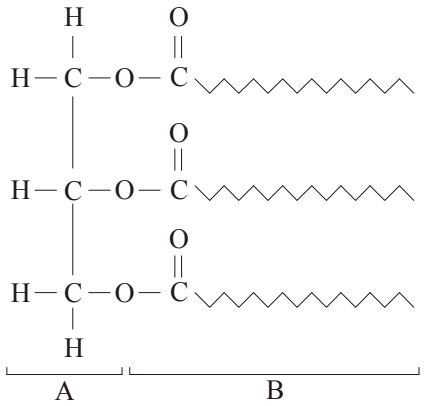
(Accept measurement between 11 and 12 mm)

11 ÷ 12 000; OR 12 ÷ 12 000;

= 0.92; = 1.0;

(2 marks)
[Total 6 marks]

22. The diagram below shows the structure of a lipid molecule.



(a) (i) Name the parts labelled A and B.

A glycerol / propan–1, 2,.3–triol;

B fatty acid(s) / fatty acid chain;

(2 marks)

(ii) Name this type of lipid.

triglyceride;

(1 mark)

(iii) Name the chemical reaction used to form the bonds between A and B.

condensation / esterification;

(1 mark)

(b) (i) State *one* function of this type of lipid in living organisms.

energy store / energy source / insulation / waterproofing / production of metabolic water / buoyancy / protection;

(1 mark)

(ii) State *one* feature of the molecules of this type of lipid which makes them suitable for the function you have given.

insoluble / non-polar / high energy value / poor heat conductor / low density / less dense than water;

[points in (b)(ii) need to be correctly linked to the answer given in (b)(i)]

(1 mark)
[Total 6 marks]

23. The statements in the table below refer to three polysaccharide molecules. If the statement is correct, place a tick (√) in the appropriate box and if the statement is incorrect, place a cross (***x***) in the appropriate box.

Statement	Starch	Glycogen	Cellulose	
Polymer of α – glucose	✓	✓	✘	;
Glycosidic bonds present	✓	✓	✓	;
Unbranched chains only	✘	✘	✓	;
Energy store in animal cells	✘	✓	✘	;

[Total 4 marks]

24. Give an account of the factors affecting enzyme activity.

1. **enzymes are protein catalysts;**
2. **comment on complementary shape of active site and substrate / lock and key mechar**
3. **increasing temperature increases kinetic energy / movement of molecules;**
4. **increases chances of enzyme substrate interactions / collisions;**
5. **increases rate of reaction up to an optimum;**
6. **above this enzyme is denatured / ref to denaturation;**
7. **disruption of (hydrogen) bonding;**
8. **changes in pH affect enzyme activity / work within narrow range of pH;**
9. **by altering the charges / ionisation / bonding in the molecule;**
10. **changes shape of active site;**
11. **activity decreases on either side of optimum;**
12. **enzyme may be denatured at extreme pH values / eq;**
13. **increasing enzyme concentration increases rate of reaction;**
14. **as more active sites available;**
15. **increasing substrate concentration increases rate of reaction;**
16. **up to an optimum rate / ref to V_{max};**
17. **inhibitors are substances which decrease enzyme activity;**

18. competitive inhibitions have similar shape to substrate / eq;

19. can block active site temporarily / reversibly;

20. credit reference to named example;

21. irreversible inhibitions permanently inactivate enzymes / non-competitive inhibitors attach to places other than active site;

22. credit reference to named example;

23. credit reference to co-factors / co-enzymes / activators;

[Total 10 marks]

25. Write an essay on the following topic.

The structure and functions of cell surface membranes (Bio, Hbio)

structure and function of cell surface membranes:

Introduction could include:
outline of fluid mosaic model -
communication with external medium, barrier -
controls exchange of material -

fluid mosaic model:

phospholipids and orientation -
proteins, glycocalyx, channels -
microvilli -

passage through the membrane:

diffusion, facilitated diffusion, Na/K -
osmosis, active transport, ATPase -
lipid soluble molecules, adrenaline
polar molecules through pores, channels -

Vesicles:
cytosis -
endocytosis, phagocytosis, pinocytosis -
exocytosis, secretory vesicles *others:*
glycosides as receptors, insulin-
adhesion between cells -
immunological response S = 13, B = 2,C = 2

[Total 15 marks]

26. Read the following passage about the palisade cells of a leaf and write on the dotted lines the most appropriate word or words to complete the passage.

The palisade cell is typical of plant cells in that it has three structures,
cell wall; vacuole / tonoplast and
chloroplasts / plastids;
plasmodesmata;
starch grain / starch granules;
(accept structures in any order)

none of which is present in animal cells. In common

with animal cells, plant cells (such as palisade cells) have membrane-bound organelles

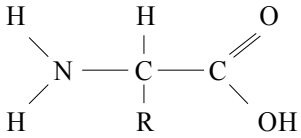
which are not present in **prokaryotic / bacterial** cells. In a leaf, palisade cells are

grouped together as a layer just below the epidermis forming a

tissue / mesophyll the function of which is to carry out photosynthesis.

[Total 5 marks]

27. Polypeptides are synthesised from amino acids. The diagram below shows the molecular structure of an amino acid.



(a) (i) In the space below, draw a molecular diagram to show how this amino acid reacts with another amino acid to produce a dipeptide.
both amino acids drawn correctly / two residues correct;

removal of water shown correctly;

correct structure of dipeptide

(3 marks)

I. Name the type of reaction involved.
condensation / polymerisation;

(1 mark)

(b) State *two* functions of the R groups in a polypeptide chain.
(i) bonding / interactions within molecules / specific examples of bonds .g. S — S or H bonds;

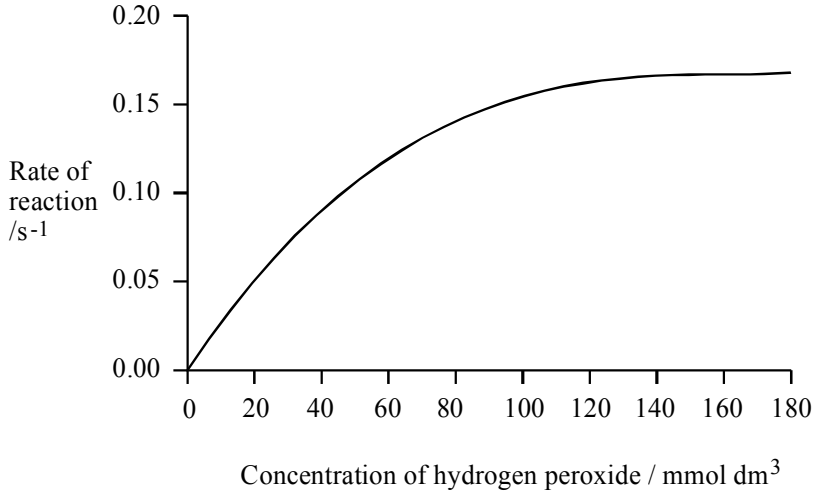
(ii) forming active sites; ref to tertiary structure; interactions with substrate / receptors; form receptors in membranes; affect solubility; can act as buffers;

(2 marks)
[Total 6 marks]

28. Catalase is an enzyme which breaks down hydrogen peroxide into oxygen and water. The activity of catalase can be measured by soaking small discs of filter paper in a solution containing the enzyme. The discs are immediately submerged in a dilute solution of hydrogen peroxide. The filter paper discs sink at first but float to the surface as oxygen bubbles are produced. The reciprocal of the time taken for the discs to rise to the surface indicates the rate of reaction.

An experiment was carried out to investigate the effect of substrate concentration on the activity of catalase. A filter paper disc was soaked in a solution containing catalase, and then submerged in a buffer solution containing hydrogen peroxide. The time taken for the disc to rise to the surface was recorded. This experiment was repeated using a range of concentrations of hydrogen peroxide.

The results are shown in the graph below.



(a) State why a buffer solution was used in this experiment.

to keep pH constant / enzymes are affected by pH;

(1 mark)

(b) (i) Describe the relationship between the rate of reaction and the concentration of hydrogen peroxide as shown by the graph.

rate increases as substrate concⁿ increases;
steady / constant / linear increase between 20 to 80* mmol dm—3;
then begins to level off;
(*accept any quoted figure in this range)

(3 marks)

(ii) Explain this relationship between substrate concentration and the rate of reaction.

as substrate concⁿ increases, the number of collisions / number of enzyme-substrata complexes will increase; therefore the rate will increase;
until all enzymes in use / limited number of active sites;
rate then remains constant / reaches a maximum / reference to Vmax :

(3 marks)

(c) Describe how a solution containing 160 mmol of hydrogen peroxide per dm3 would be diluted to prepare a solution containing 80 mmol of hydrogen peroxide per dm3.

use equal volumes of hydrogen peroxide solution;
and distilled / deionised water / buffer solution :
(accept suggested volumes)

(2 marks)

(d) Describe how this experiment could be modified to investigate the effect of temperature on the activity of catalase.

use a water bath;
suggested range of temperatures (at least 3 stated);
use same volume / depth of hydrogen peroxide;
allow substrate / enzyme to equilibrate before adding filter paper disc; ref to uniformity of discs;
use constant enzyme concentration;
repeat at each temperature;
plot a graph of rate of reaction against temperature;

(4 marks)
[Total 13 marks]

29. Read through the following passage on the use of enzymes in the extraction of juice from fruit, then write on the dotted lines the most appropriate word or words to complete the account.

Enzymes made by microorganisms may be used in commercial processes. In order to speed up the extraction of juice from fruit, enzymes called **pectinases / cellulases** are used. The fruit is first **chopped up / eq**. and then the enzymes are added to break down the **pectin / cellulose** present in the **cell walls.** These enzymes help to make the extracted juice **clearer / clarified / eq.**

[Total 5 marks]

30. Write an essay on the following topic.

factors affecting enzyme activity:

temperature:

increase increases rate of reaction –
in the range 0 - 40°C –
ref to optimum temperature –
ref to temperature coefficient / Q IO –
kinetic effect explained in terms of collisions / complex formation–
denaturation explained in terms of high temp and bonding -

pH:

change affects H-bonds –
correct reference to effect on shape of active site –
reference to optimum pH –
named examples of enzymes and pH range –
effect of extremes of pH -

enzyme concentration:

increase increases rate –
explained in terms of numbers of active sites –
reference to substrate concentration as a limiting factor -

substrate concentration:

increase increases rate –
maximum explained in terms of turnover numbers of enzyme –
reference to enzyme concentration as a limiting factor -

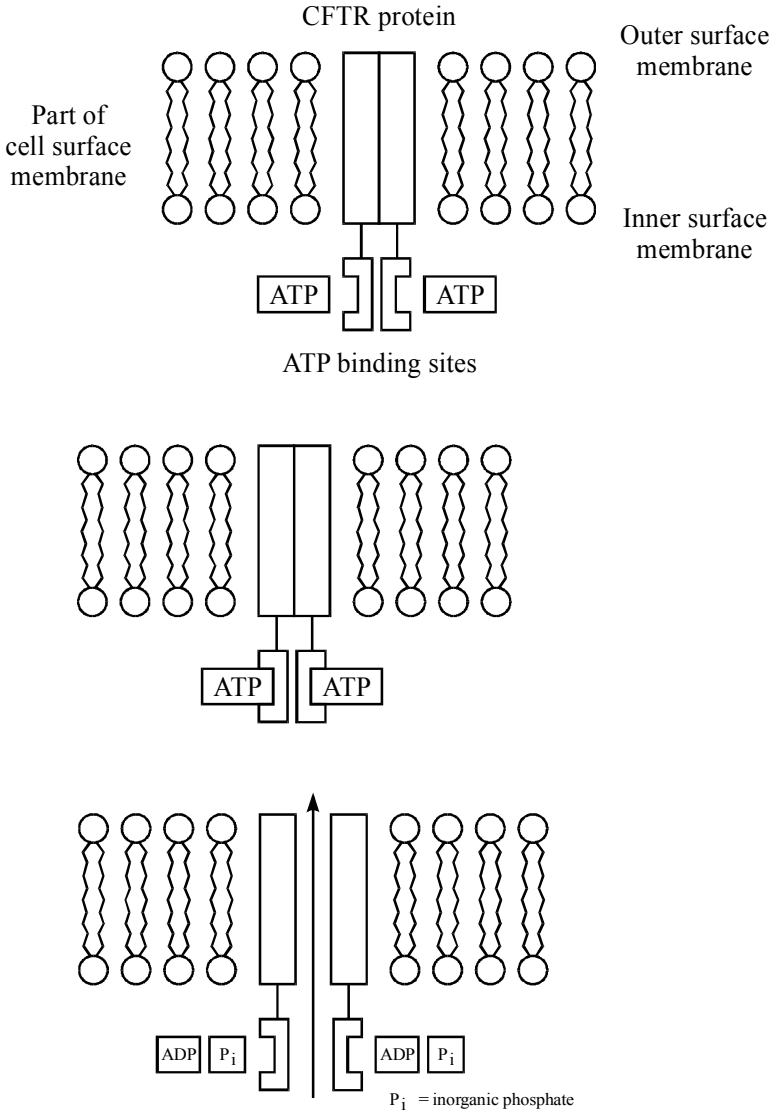
inhibition irreversible by heavy metals –
named examples competitive inhibition

S = 13, B = 2, C = 2

[Total 15 marks]

31. Cystic fibrosis is a genetic disorder caused by a mutation in the gene which codes for a protein known as the CFTR protein. This protein is involved in the transport of chloride ions through the cell surface membrane.

The diagram below shows how the normal CFTR protein is believed to function in the cell surface membrane.



(a) (i) Describe the sequence of events that takes place when ATP is present.
ATP binds to CFTR protein / binding sites;
ATP hydrolysed / eq. to ADP + Pi;
changes shape of protein / opens (ion) channel / eq.

(3 marks)

(ii) What is the function of ATP in this sequence of events?
to <u>provide</u> energy.

(1 mark)

(b) One symptom of cystic fibrosis is the production of very sticky, thick mucus which cannot easily be moved. This occurs particularly in the lungs, pancreas and testes.

Suggest an explanation for each of the following.

(i) Many people affected by cystic fibrosis suffer from repeated lung infections.
thick mucus hinders removal of <u>bacteria</u> / pathogens from the lung.

(1 mark)

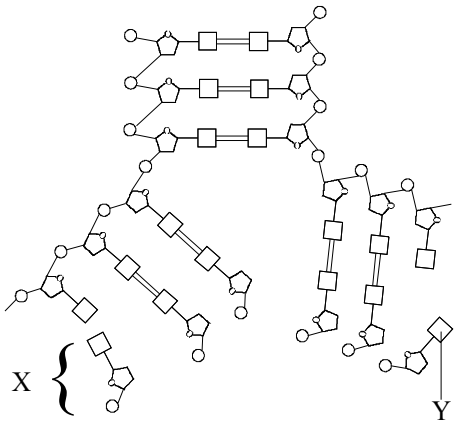
(ii) Reduced ability to digest starch in the small intestine is common among people affected by cystic fibrosis.
mucus impedes the release of (pancreatic) amylase (into the duodenum).

(1 mark)

(iii) 95% of males affected by cystic fibrosis are infertile.
mucus hinders the passage / mobility of the spermatozoa.

(1 mark)
[Total 7 marks]

32. The diagram below shows the process of DNA replication.



(a) Name the parts labelled X and Y.
X **nucleotide;**

Y **(organic / nitrogenous) base / purine / pyrimidine;**

(2 marks)

(b) Name *one* enzyme involved in DNA replication and state the type of reaction it catalyses.
Enzyme **(DNA) ligase / polymerase;**

Reaction **condensation / polymerisation;**

(2 marks)

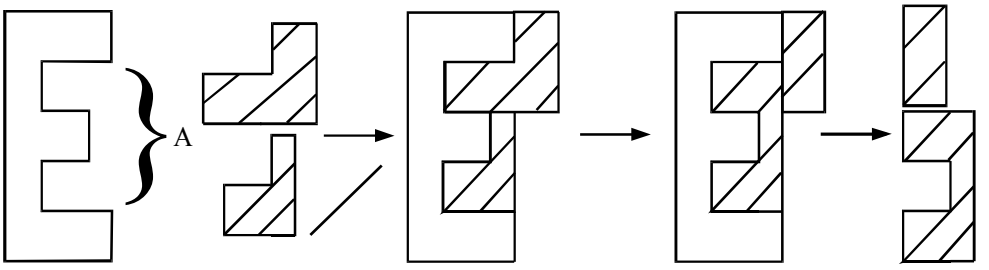
(c) Suggest why DNA replication is described as *semi-conservative*.
Newly synthesised molecule has one parental / original / template strand / has half of the original;

(1 mark)

(d) Name the stage of the cell cycle during which DNA replication occurs.
S / synthesis phase / interphase;

(1 mark)
[Total 6 marks]

33. The diagrams below illustrate one model of enzyme action.



(a) Name the part of the enzyme labelled A.
active site;

(1 mark)

(b) Explain how this model can account for enzyme specificity.
active site / part A has a particular / specific shape; only the substrate will fit and form products;

(2 marks)

(c) With reference to this model, explain the effect of a competitive inhibitor on an enzyme-catalysed reaction.
competitive inhibitor has a similar shape to substrate / same shape as substrate / can fit into active site;

prevents the substrate combining / blocks the active site;

reduces the rate / slows reaction;

(2 marks)
[Total 5 marks]

34. The table below refers to *two* organic molecules.

If the statement is correct for the molecule, place a tick (√) in the appropriate box. If it is incorrect, place a cross (*X*) in the appropriate box.

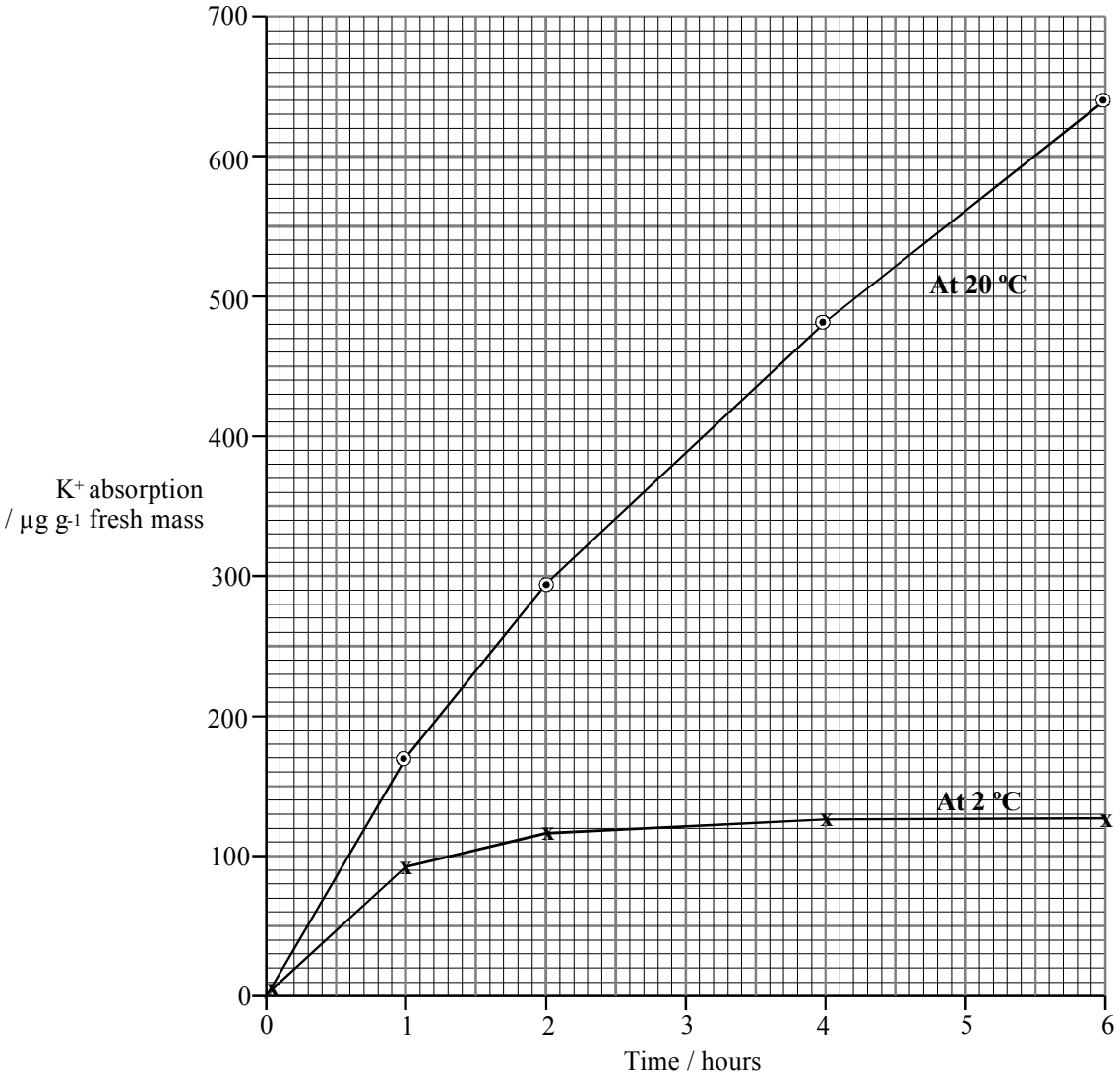
Statement	Triglyceride	Glycogen	
Contains only carbon hydrogen and oxygen	✓	✓	;
Glycosidic bonds present	✗	✓	;
Soluble in water	✗	✗	;
Provides storage of energy	✓	✓	;
Occurs in flowering plants and animals	✓	✗	;

[Total 5 marks]

35. An experiment was carried out with cells of carrot tissue to determine the effect of temperature on the absorption of potassium ions.

Slices of carrot tissue were immersed in a potassium chloride solution of known concentration. The changes in concentration of potassium ions in the solution were determined at intervals for 6 hours. From these measurements, the mass of potassium ions taken in by the carrot cells was found. The experiment was carried out at 2°C and 20°C. The solutions were aerated continuously.

The results are shown in the graph below. Absorption of potassium ions is given as micrograms of potassium per gram of fresh mass of carrot tissue (μg g^{-1}).



(a) During the first hour, some of the potassium ions enter the cells by diffusion. State *two* conditions which are necessary for a substance to enter a cell by diffusion.

1. **membrane must be permeable to substance;**

   must be a concentration gradient / higher outside cell than inside;

2. **substance must be in solution / a gas / a liquid;**

(2 marks)

(b) (i) Calculate the mean rate of absorption of potassium ions at 20°C, between 2 and 6 hours. Show your working.

640 – 295 OR 345;

° 4;

= 86.25 μg g^{-1} $hour^{-1}$;

(3 marks)

(ii) Compare the rates of absorption of potassium ions at 2°C and 20°C during this experiment.

fastest uptake occurs at start / both decrease;

rate of uptake at 20°C is greater than at 2°C converse;

uptake at 20°C continues, levels off at 2°C;

credit manipulation of figures, e.g. final mass taken up at 20°C greater than at 2°C quoting Two figures from graph;

(3 marks)

(iii) Suggest an explanation for the differences in the rates of absorption of potassium ions at the two temperatures.

reference to increase in temperature increasing movement / kinetic energy / OR converse;

(So) faster / eq. diffusion at higher temperature; diffusion no longer occurs when there is no concentration gradient / eq.;

ions also taken up by active transport / ref. to ion pumps;

active transport increases at higher temperatures;

reference to increased respiration / increased ATP;

uses more K^+ higher temperature;

(3 marks)
[Total 11 marks]

36. Give an account of the process of mitosis.

1. **daughter cells have same number of chromosomes as parent cell / are genetically identical to parent cell;**
2. **concerned with growth / repair / replacement of tissues / asexual reproduction;**
3. **reference to cell cycle consisting of interphase, mitosis, cell division;**
4. **named stages in correct sequence;**
5. **(during prophase) chromosomes condense / eq.;**
6. **each consists of a pair of chromatids joined by centromere;**
7. **reference to centrioles;**
8. **formation of spindle;**
9. **by microtubules;**
10. **disappearance of nucleolus / nucleoli;**
11. **breakdown of nuclear envelope;**
12. **(at metaphase) chromosomes attached to spindle fibres;**
13. **lined up at equator of cell;**
14. **(at anaphase) centromeres split / duplicate;**
15. **separation of chromatids;**
16. **daughter chromosomes / chromatids pulled to opposite poles of cell;**
17. **(at telophase) chromosomes / chromatids reach poles of cell;**
18. **uncoil / eq.;**

19. formation of nuclear membrane;

20. (daughter) nuclei formed;

21. followed by cytokinesis (in animal cells) / or description;

22. formation of a cell plate / eq. in plant cells;

[Total 10 marks]

37. Human Biology

Haemoglobin in mammals is made up of four polypeptide chains, two identical α chains and two identical β chains. The sequence of amino acids in these chains has been determined for a number of different mammals.

Table 1 below shows a sequence of fifteen amino acids in an ? chain from four different primates: a chimpanzee, a human, a gorilla and an orang-utan.

Table 1

Primate	Amino acid sequence
Chimpanzee	K A A W G K V G A H A G E Y G
Gorilla	K A A W G K V G A H A G D Y G
Human	K A A W G K V G A H A G E Y G
Orang-utan	K T A W G K V G A H A G D Y G

Key: A = alanine D = asparagine E = glutamic acid G = glucine H = histidine
K = lysine T = threonine V = valine W = tryptophan Y = tryrosine

(a) (i) What differences are there between the amino acid sequence for the orang-utan and the chimpanzee?
orang-utan has T / threonine instead of A / alanine and has D / asparagine instead of E / glutamic acid / T and D / chimp has A and E;

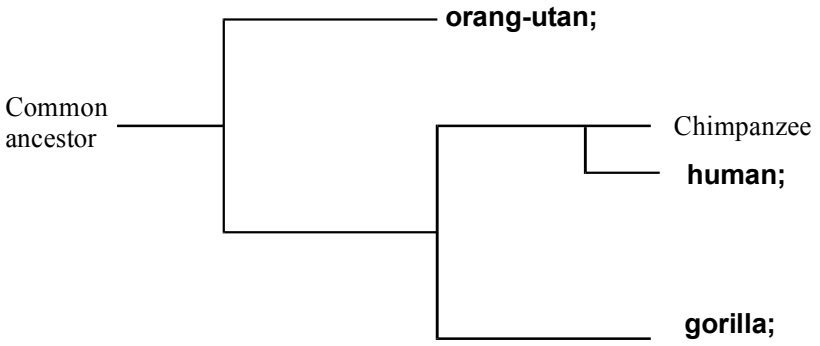
(1 mark)

(ii) Name *one* other pair of primates in the table in which there is a difference in the amino acid sequence.
chimpanzee and gorilla / gorilla and human / orang-utan and gorilla / orang-utan and human;

(1 mark)

(b) Comparisons of amino acid sequences have been used to determine evolutionary (phylogenetic) relationship in the primates.

(i) Using evidence given in Table 1, complete the evolutionary tree diagram below to show the possible evolutionary relationship between chimpanzees, gorillas, humans and orang-utans.



(3 marks)

(ii) Give two ways in which the data in Table 1 support your suggested evolutionary relationship.

1. **human and chimp have (exactly) same / eq. sequence (so must be together);**

   gorilla differs by one amino acid so more closely related to humans;

2. **orang-utan more differences / 2 amino acids so not as close as gorilla / eq;**

(2 marks)

(c) When human blood serum is injected into a rabbit, the rabbit produces antibodies against human serum proteins. When blood serum from humans and other mammals is mixed with rabbit serum containing these antibodies, precipitation occurs.

Table 2 below shows the percentage precipitation when this rabbit serum was mixed with serum from a human, a gibbon, a spider monkey and a hedgehog.

Table 2

Mammal	Percentage precipitation
Human	100
Gibbon	79
Spider monkey	58
Hedgehog	17

What do these data suggest about the phylogenetic relationship of the four mammals in Table 2?

gibbon closest to human;

hedge hog distantly / eq. related (to human);

spider monkey more distant than gibbon (to human)

(2 marks)

(d) (i) Describe how fossils can be used to provide evidence for human evolution.
sequence of changes can be seen;

ref. to dating of fossils;

skeleton / eq. shows trend from quadripedal to bipedal locomotion / eq.;

changes in hands show evolution of dexterity;

changes in jaws / teeth show changes in diet;

changes in skull / eq. show evolution of brain;

(3 marks)

(ii) Give *one* disadvantage of the use of fossils in providing evidence for human evolution.
incomplete record / eq. incomplete / eq. fossils / unreliable dating / fossil displacement;

(1 mark)
[Total 13 marks]

38. Write an essay on the following.

Lipids in organism

Lipids in living organism

lipids as water insoluble substances -
triglycerides as esters -
fatty acids / saturated and unsaturated -
glycerol -
fats / oils / waxes / phospholipids / steroids -
triglycerides as energy store -
relative calorific value -
fats in the diet -
fat storage in mammals -
fat as an insulator -
for buoyancy in aquatic mammals -
storage of oils in plants / eg in seeds -
formation of metabolic water by oxidation of fats -
waxes as waterproofing in leaves / insect exoskeleton -
phosholipids as constituents of cell membranes -
neurones and myelination -
steroids / testosterone / oestrogen and progesterone S = 17, B = 3, C = 3

[Total 20 marks]

39. Write an essay on the following.

Lipids in humans

Lipids in living organism

lipids as water insoluble substances -
triglycerides as esters -
fatty acids / saturated and unsaturated -
glycerol -
fats / oils / waxes / phospholipids / steroids -
triglycerides as energy store -
relative calorific value -
fats in the diet -
fat storage in mammals -
fat as an insulator -
for buoyancy in aquatic mammals -
storage of oils in plants / eg in seeds -
formation of metabolic water by oxidation of fats -
waxes as waterproofing in leaves / insect exoskeleton -
phosholipids as constituents of cell membranes -
neurones and myelination -
steroids / testosterone / oestrogen and progesterone S = 17, B = 3, C = 3

[Total 20 marks]

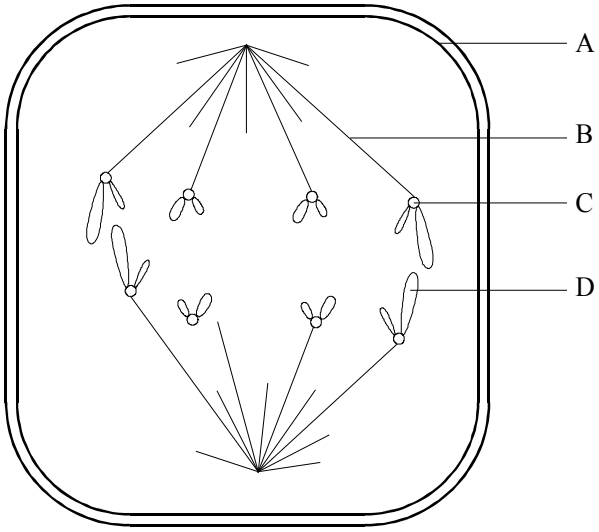
40. The table below refers to features of prokaryotic and eukaryotic cells.

If the feature is present place a tick (√) in the appropriate box and if the feature is absent, place a cross (***x***) in the appropriate box.

Feature	Prokaryotic cell	Eukaryotic
Endoplasmic reticulum	***x***	√
Mesosome	√	***x***
Ribosomes	√	√
Golgi apparatus	***x***	√

[Total 4 marks]

41. The diagram below shows a plant cell which is undergoing mitosis.



(a) name the parts labelled A, B, C, and D.

A cell wall;

B spindle (fibre) / microtubule:

C centromere;

D chromatid / (daughter) chromosome;

(4 marks)

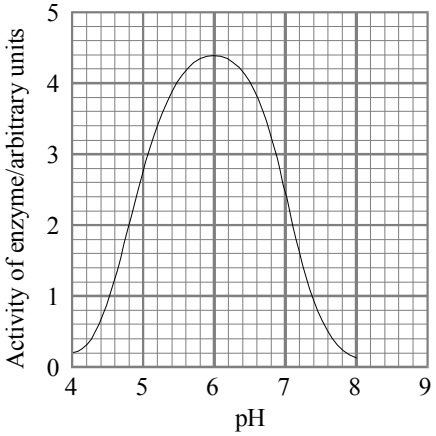
(b) name the stage of meiosis shown in this diagram.

Anaphase;

(1 mark)
[Total 5 marks]

42. Glucose oxidase is an enzyme which catalyses the oxidation of glucose from gluconic acid and hydrogen peroxide.

An experiment was carried out to investigate the effect of pH on the activity of glucose oxidase. The activity of this enzyme was determined at a range of pH values. The results are shown in the graph below.



(a) (i) State how the different pH values could be obtained in this experiment.

reference to use of buffer solutions;

(1 mark)

(ii) Describe the effect of changes in pH on the activity of this enzyme.

optimum / eq is pH6;

activity decreases on either side of optimum; little activity av pH4 / pH 8 / extremes;

(2 marks)

(iii) Explain why changes in pH affect the activity of enzymes.
reference to charges / ionisation of R groups / eq / hydrogen bounding / ionic bonding;

affects shape of active side;

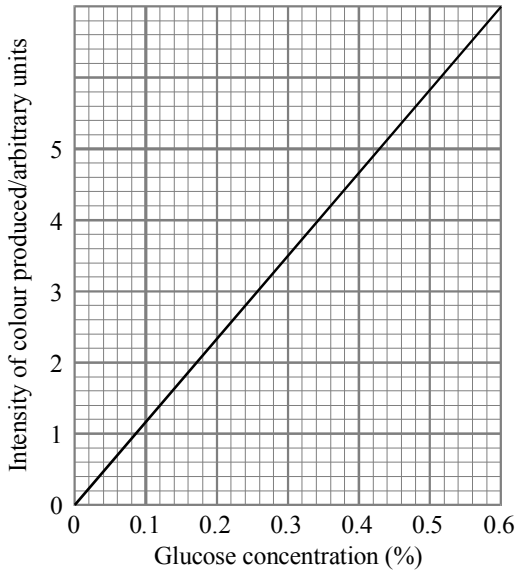
affects binding with substrate; denaturation at extreme values;

(3 marks)

(b) Glucose oxidase with another enzyme, peroxidase, can be used to measure the concentration of glucose in solutions.

The solution to be tested is first incubated with glucose oxidase, and then with peroxidase, plus an indicator which changes colour when it is oxidised. Peroxidase breaks down the hydrogen peroxide formed by glucose oxidase, and simultaneously changes the colour of the indicator.

The intensity of the colour produced is directly proportional to the concentration of glucose in the solution, as shown in the graph below.



(i) From the graph, determine the concentration of glucose corresponding to a colour intensity of 6.5 arbitrary units.
0.56 %; (accept values 0.55 to 0.56%)

(1 mark)

(ii) Describe how this method could be used to compare the concentration of glucose in two samples of fruit juice.

use same / equal volumes* of fruit juice; add same volume* / concentration of glucose oxidase to each;

incubate for standard / stated time / stated constant temperature;

add same volume* / concentration peroxidase + indicator; read intensity of colour;

use graph to find glucose concentrations;

[* accept stated volumes, but not amounts]

(4 marks)
[Total 11 marks]

43. Give an account of the biological significance of polysaccharides.

1. **polysaccharides consist of many monosaccharides;**

2. **joined by glycosidic bonds;**

3. (a) **credit details of formation glycosidic bond showing condensation;**

3. (b) **reference to insolubility of polysaccharides;**

4. **starch storage in plants;**

5. **two forms of starch, amylose and amylopectin;**

6. **α glycogen storage in animals;**

7. **glucose in starch / glycogen;**

8. **these can be broken down to provide glucose / monosacch for energy / respiration;**

9. **ref. to no osmotic effect of polysaccharides;**

10. **ref. to compact shape of glycogen / starch for storage;**

11. **cellulose in plant cell walls;**

12. **cellulose contains for β glucose;**

13. **cellulose forms long unbranched chains;**

14. **hydrogen bounding between chains;**

15. **ref to orientation of chains in layers / microfibrils of cell wall conferring strength;**

16. **ref. to chitin in cell walls of fungi / exoskeleton of arthropods;**

17. **ref. to murein in bacterial cell walls;**

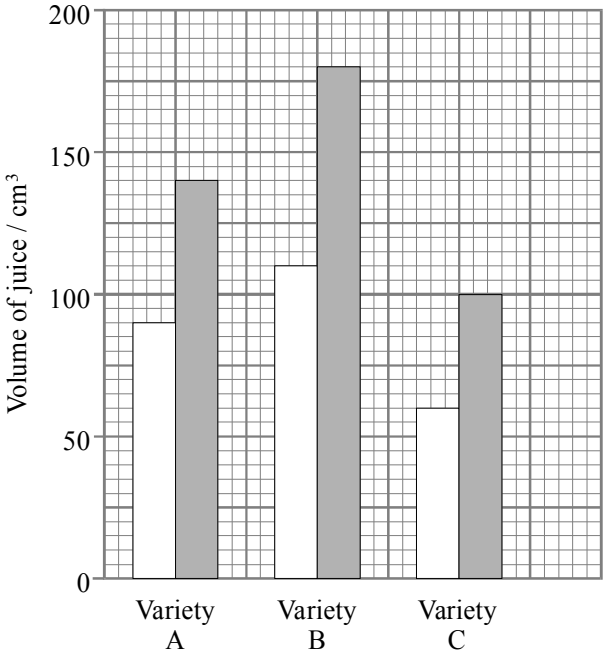
18. **polysaccharides attached to proteins / lipids in cell surface membranes;**

19. **ref. to cell identification / recognition;**

20. **credit specific example such as determination of A an B blood groups;**

[Total 10 marks]

44. A comparison was made between the volume of juice which could be extracted from the same mass of three varieties of apples, with and without pectinase. In this comparison, the same mass of pectinase was added to apples from each variety. The results are shown in the graph below.



Key

☐ Without pectinase ▩ With pectinase

(a) (i) Calculate the percentage difference in volume of the juice extracted without pectinase from variety A compared to the volume extracted from variety C. Show your working.

90 - 60 / 30; **(allow 90/91 - 60/61)**

$\frac{30}{90} \times 100$ $\frac{30}{60} \times 100$;

33.3% Less from C; **50% more from A**

Answer ……

(3 marks)

(ii) Explain the effect of the use of the pectinase on the volume of juice extracted from the apples.

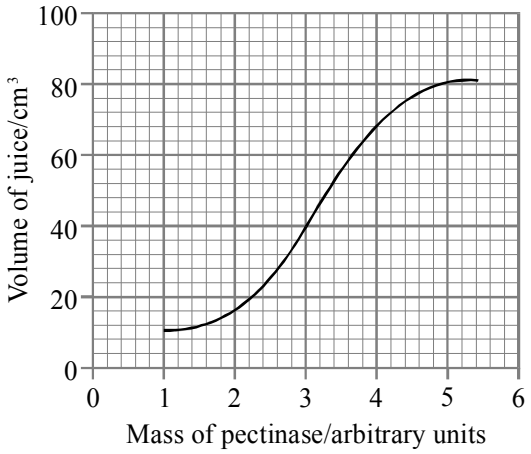
pectinase increases the volume of juice/makes it easier to extract the juice/eq.;

enzyme catalyses the break down of pectin in cell walls;

(2 marks)

(b) The effect of increasing the mass of the pectinase used on the volume of juice extracted was then investigated.

The results are shown in the graph below.



Using the information available from both graphs, suggest how a manufacturer of apple juice could make use of these results.

increase in concentration of the enzyme increases the volume of juice extracted;

use variety B/eq.;

add up to 4/4.5 units of pectinase;

above 4.5/5.0 increase in concentration does not increase the volume much;

(3 marks)

(c) Suggest *two* factors, other than apple variety and use of pectinase, which could affect the extraction of juice from apples.

1. **temperature (at which process carried out);**

   pH; crushing / chopping/pressure used;

2. **ripeness of apples;**

   age of apples / ref. to storage time;

(2 marks)
[Total 10 marks]

45. Write an essay on the following topic.

The roles of RNA in protein synthesis (*Bio, Hbio*)

Introduction could include

- **reference to basic structure of RNA**
- **types of RNA**
- **protein coded for in DNA but made in cytoplasm**
- **mRNA enables DNA integrity to be maintained**
- **reference to transcription and translation**

Transcription

- **occurs in nucleus**
- **unzipping of section of DNA/cistron**
- **synthesis of mRNA, role of RNA polymerase**
- **reference to role of nuclear pores**

Translation

- **occurs in cytoplasm, free and on RER**
- **ribosome structure, sub-units, rRNA, proteins, A and P sites**
- **ribosome activity, peptide bonds, polysomes**
- **mRNA codons, sites for binding, control, initiation, termination**
- **tRNA structure, anticodon, internal bonding**
- **tRNA activity, AA complex, anticodon-codon**
- **protein structure, peptide and other bonds**
- **potein use, in cytoplasm, role of secretory vesicles**

S=13 marks

B= 2 marks

C= 2 marks

[Total 15 marks]

46. Write an essay on the following.

The movement of molecules and ions through membranes

General introduction

Expect some discussion of most of the areas below with suitable examples

reasons for movement, uptake into cells, release of substances from cells, involved with metabolism, synthesis, elimination of waste products

membrane structure, details of fluid mosaic model, concept of permeability, hydrophobic nature of fatty acid chains
definition of diffusion, explanation, conditions under which diffusion is effective, reference to distance, concentration gradients, suitable examples of diffusion

facilitated diffusion, reference to carrier proteins, suitable example

osmosis as a special case of diffusion, description of conditions, reference to water potential in plant cells

active transport, definition, conditions, expect reference to the need for energy, some description of mechanism, reference to situations where active transport is important

endocytosis and exocytosis

S = 17 marks

B = 3 marks

C = 3 marks

[Total 20 marks]

47. mitochondrion 1

ribosomes 1

chloroplast 1

centrioles / centrosome / basal body 1

nucleus 1

[5]

48. specificity / specific 1

active site / active centre 1

high/eq temperature / extreme/ eq pH / heavy metals /
bonds being broken / non–competitive inhibitors / irreversible inhibitors 1

an inhibitor / reaction products 1

oxidoreductases 1

[5]

49. (a) (i) A = glycerol 1

B = fatty acid (residue) 1

(ii) hydrolysis 1

(b) polar (molecules) / hydrophilic heads/eq & hydrophobic tails/eq 1
form a bilayer / bimolecular double layer
[accept from clear diagram] 1
(polar/hydrophilic) heads outside / (non–polar/hydrophobic) tails inside 1

[6]

50. (a) (i) protein / polypeptide / enzyme / named protein / a peptide hormone 1

(ii) (R.E.R. has) ribosomes/eq 1

(ribosomes / R.E.R. are) site of protein synthesis 1

(iii) (after 10 mins) proteins / polypeptides move to Golgi apparatus max 3

where protein is modified/eq /OR credit for suitable example of modification such as glycoprotein formation

and enclosed in membranes to form vesicles /eq /OR ref. to packaging

so most activity in vesicles after 45 minutes

(iv) amino acids moving (diffusing) between sites / not being used / remain in the cytoplasm max 2

proteins used in other parts of cells / not all proteins go to the Golgi / e.g. of other use / moving between sites

proteins also synthesised in mitochondria / mitochondria have ribosomes / ref. to free ribosomes/not attached to R.E.R.

ref. to amino acids being broken down / metabolised/eq

(b) exocytosis — max 3

vesicles move to cell membrane

(membrane of) vesicle fuses/eq with cell membrane

so contents of vesicle now outside cell / release of contents

[accept from clearly labelled diagrams]

[11]

51.

1.	DNA is a polynucleotide / polymer – monomers called nucleotides / any ref to DNA made of nucleotides		1
2.	nucleotide consists of deoxyribose, phosphate and a base *[labelled diagram]*		1
3.	bases are adenine, guanine, cytosine and thymine requires correct spellings; penalise "thiamine" spelling once		1
4.	A and G are purines		1
5.	C and T are pyrimidines		1
6.	DNA is a double/eq helix		1
7.	phosphate – sugar linked to form strands / sugar–phosphate backbone / ref. to phospho–diester bonds /	*[labelled diagram]*	1
8.	strands are antiparallel / run in opposite directions	*[labelled diagram]*	1
9.	pairing of A with T and of G with C	*[labelled diagram]*	1
10.	hydrogen bonding between base pairs	*[labelled diagram]*	1
11.	replication semi–conservative / 1 old & 1 new strand in each daughter molecule		1
12.	replication occurs during interphase / S phase		1
13.	strands separate by breaking H bonds	*[labelled diagram]*	1
14.	correct involvement of / new strand synthesised by DNA polymerase		1
15.	complementary base–pairing in daughter strands / use of correct base pairing to give accurate copy /eq		1
16.	reference to unwinding / separation of the strands by helicase		1
17.	5' to 3' direction of synthesis by DNA polymerase		1
18.	lagging /eq strand sections joined by ligase		1

Clearly annotated diagrams could include points other than those indicated above — max 10

[10]

52. (a) break open cells / break cell walls / release cell contents /eq — 1

increase surface area for pectinase / enzyme to work — 1

increase/eq volume / quantity / rate of flow of juice — 1

(max 2)

(b) (pectinase) breaks down / hydrolyses

pectin / middle lamella *(not "softens")* 1

therefore: juice extracted more quickly / easily /OR more juice extracted 1
(2)

(c) reference to presence of pectins (still remaining in juice) 1

(pectinase) clarifies juice / removes cloudiness / reduces viscosity/eq

(not "smoother", "softer") 1
(2)

[6]

53. (a) A phospholipid ;
B protein ;
C glycoprotein ; 3

(b) act as a marker / antigen / recognition site ;
other molecules combine with it / detecting similar / non-self cells ;

OR

reference to receptor / binding site ;
other (specific) molecules / named e.g. / combine with it ; 2

[5]

54. solvent ;
enter / diffuse into /eq ;
insoluble /osmotically inert / non-polar /eq ;
lipids / triglycerides / fats / oils ;
glycogen ;
plant ;

[6]

55. (a) Stage l = transcription ;
Stage 2 = translation ; 2

(b) ribosome(s) / RER ; 1

(c) tRNA carries amino acid /eq ;specific amino acids link with specific tRNAs /eq ;
tRNA has anticodon / specific base triplet ;pairs with /eq codon /
complementary triplet of mRNA ;peptide bond formed
when bond to tRNA broken /eq ; max 3

[6]

56. (a) (i) activity at 65 ºC = 35 (units), activity at 75 ºC = 47 (units) ;
percentage increase = (12 ÷ 35) × 100 ;34.28 / 34.3 (%) ; 3

(ii) increasing temperature increases kinetic energy / movement of molecules;
increases chances of collision / formation of enzyme-substrate complexes;
<u>therefore</u> activity increases ;optimum at 75 ºC;
above optimum enzyme becoming denatured /eq;
so active site distorted / changed in shape /
no longer complements substrate /eq ; max 4

(iii) stable at high temperatures / less likely to be denatured;
temperature control less important;
can be used continually / ref.. to high productivity / faster;
reduced risk of contamination by (other) microorganisms max 2

(b) activity will stop / decrease /eq ;heavy metals are inhibitors /
disrupt internal bonding / tertiary structure / denature enzymes ; 2

[11]

57. (a) (i) 42.7 ; 1

(ii) more juice extracted with cellulase only than with pectinase only /eq ;
same volume extracted with cellulase+pectinase mixture
as with cellulase only ; 2

(b) ref. to pectins in middle lamella and/or cellulose in cell walls ;
pectinase hydrolyses / breaks down/eq pectins ;
cellulase hydrolyses / breaks down/eq cellulose ;
cell contents / juices released from cell
(as cell walls broken down / softened /eq) ; 3

(c) variety ;
ripeness ;
size of pieces / surface area /eq ;
pressure applied ;
temperature ;
freshness / length of storage time ; max 2

(d) no contamination of juice with enzyme /eq ;
enzyme can be used several times ;
ref. to continuous flow ;
less enzyme needed ;
ref. to increased stability to pH / temperature / less likely to denature ; 3

[11]

58. (a) (i) galactose ; 1

(ii) $0.24 \div 4.8 \times 100$;
5% ; 2

(b) some people do not produce lactase ;
(therefore) cannot digest lactose / are lactose intolerant ;
milk / milk products still available to them /
ref. to they would get diarrhoea/eq if normal milk ingested ; max 2

[5]

59. *The roles of carbohydrates in living organisms*
Introduction could include
Mono, di, polysaccharides –
Ref. production by photosynthesis –
Ultimate source from producers –
Heterotrophs obtain them from producers –
Ref. energy source, conversion to other organic molecules, storage, support –

Roles

Transport –
Size and relative solubility –
Glucose in animals, sucrose in plants –
Osmotic effects described –

Metabolism

Role in Calvin cycle –
Carbon dioxide fixation and RuBP
Regeneration from triose –
Triose conversion to other compounds –
Respiration and energy release –
Ref. glycolysis –
Ref. TCA –
Synthesis of other organic compounds e.g. lipids, amino acids –
Role of pentoses in nucleic acids –

Storage

Solubility , compaction , non-osmotic effects –
Starch in plants –
Glycogen in animals –

Support / other

Plants and cellulose cell wall –
Bacteria and peptidoglycans –
Fungi and chitin –
Glycosides and cell recognition , receptors –

Scientific content: **max 13**
Balance: **max 2**
Coherence: **max 2**

[15]

OUTLINE SCHEME FOR MARKING ESSAYS

Scientific content

Above average

13 Excellent

11 Good

Essays in this category demonstrate a sound understanding of the topic, contain a significant amount of material relevant to two or more units of the specification, and suitable examples where appropriate.

Average

9 Slightly above average

7 Average

5 Slightly below average

Essays in this category contain factually correct and relevant material. Some areas should show a progression from GCSE, particularly if a mark of 9 is awarded.

Below average

3 Some correct facts

1 Very few correct facts

0 No correct information

Essays in this category contain few relevant facts. The material that has been included has little depth and barely reaches the standard expected at GCSE.

S = 13 marks

Balance

2 A balanced essay covering all the main areas outlined
Some discussion of each area covered with, suitable examples where applicable
Material all relevant to the topic
Few, if any, errors

1 Most of the main areas of the topic covered, but possibly one or two lacking
Some discussion of each of the areas chosen
Some irrelevance, either in the areas chosen or in the material within an area
Some errors

0 Very limited account, possibly only one aspect chosen
Material mostly irrelevant
Large number of errors

B = 2 marks

Coherence

2 Material logically presented, with little or no repetition
Essay has coherence, ideas are developed well; continuous prose used throughout
Essay has an introduction and a conclusion, summing up the main points
Technical terms have been used correctly
Spelling, punctuation and grammar are sound

1 Material is presented in an orderly way and some ideas developed
Continuous prose used throughout
The introduction and conclusion may be present, but brief
Technical terms are used and generally in the correct context
Spelling, punctuation and grammar are generally sound

0 Essay style not used
Material in note form or numbered points
Very poor standard of spelling, punctuation and grammar

C = 2 marks

[max 15]

60.

Structures	Liver cell	Leaf palisade cell
Mitochondria	✓	✓;
Starch grains	**X**	✓;
Microtubules	✓	✓;
Golgi apparatus	✓	✓;
Glycogen granules	✓	**X**;

X is *incorrect*. *If there are no crosses, assume blanks are crosses. If a mixture of ticks and crosses, blanks are incorrect.*

[5]

61. (a) Maltose ; 1

(b) Disaccharide / reducing sugar ; 1

(c) Glycosidic (ignore qualifications, e.g. 1- 4) ; 1

(d) (i) Form *plant* cell walls / structural support in *plants* ; 1

(ii) *Second mark depends on first, cannot get second mar unless linked to a structural point.*

correct structural point ;	*link to relevant function ;*
1. large molecules / many glucoses linked / polymer ;	insoluble ;
2. (forms) straight / unbranched chains ;	high (tensile) strength / "strong" forms microfibrils / forms fibres ;
3. cross links / (hydrogen) bonds, *between* molecules ;	high (tensile) strength / forms microfibrils / forms fibres ;
4. forms microfibrils ;	high strength / forms fibres ;
5. β (1-4) glucose links ;	difficult to digest ;
6. many glucoses linked ;	cellulose can be hydrolysed and (glucose) used in respiration ;

max 2

[6]

62. (a) A = chromatid ;
B = centromere ;
C = centriole ; 3

(b) (i) Mitosis (Check spelling) ; 1

(ii) (Homologous) chromosomes not paired / no chiasma / no crossing-over / no bivalents / results in two diploid cells / cells which have four chromosomes / chromatids ; 1

(c) Increase number of cells / growth / replace cells / repair (of tissues) (not cells) ;
Genetically identical daughter cells /eq same chromosomes / same diploid number DNA in each cell /eq clones ;

Asexual reproduction ; max 2

[7]

63. (a) A = glycoprotein / glycosidic chain / carbohydrate ;
B = phospholipid (but not "phospholipid bilayer") ; 2

(b) (i) More sodium (ions) enters when ATP present / fewer when no ATP ;
Faster uptake when ATP present / slower when no ATP ;
Maximum concentration not reached with ATP, but max. with no ATP / description ;

Correct use of figures, e.g. with ATP 10 (to 20) times faster / 5.7(AU) more with ATP, at 5 minutes / two comparative figures quoted ;
Fastest rate in first minute in both ; max 3

(ii) Sodium (ions) moved against / up the concentration gradient ;
Active transport / uptake ;
ATP needed to provide energy ;

To enable sodium / potassium pump to operate / to enable change in shape of *protein carrier* / *transport protein* ;

(Some) diffusion occurs /eq passive transport ; 4

(c) To keep rate of reactions involved constant /eq temperature
affects rate of movement / diffusion across membrane /
affects kinetic energy / changes permeability of membranes /
affects enzyme activity / enzymes denatured at high / extreme temperature ; 1

[10]

64. (a) Points in (a) need not be paired
Change diameter of nozzle (e.g. "use a needle") / of syringe ;
Smaller nozzle ® smaller beads ;
Change flow rate / pressure applied to syringe ;
Faster flow / more pressure ® smaller beads;
Change alginate viscosity / concentration ;
Lower viscosity ® smaller beads ; 2

(b) Increase rate ;
Greater surface area (of beads) / reduces flow rate ;
Increased contact between enzyme and substrate /eq ;

More active sites available ;

If a single bead used: less enzyme ; Decrease in rate ;

Less contact between enzyme and substrate / fewer active sites ; 3

(c) (i) Increased concentration increases rate of reaction / increased rate of production of glucose ;

No increase in rate above 0.15 mol dm^{-3} /eq (e.g. max. or highest) ;
Reference to increased number of collisions with active sites / enzyme ;

(At higher concentrations) rate limited by number of active sites /eq all active sites occupied /
concentration of enzyme limiting rate ; max 3

(ii) Flow rate ;
Affects time for contact between enzyme and substrate /eq ;

OR

pH ; Affects bonding in enzyme / shape of enzyme / active sites ;

Denatured at extremes of pH ; max 2

(d) (i) Production of lactose-free / lactose reduced milk / dairy products / named e.g. kitten / cat milk / production of glucose / fructose / galactose from whey ; 1

(ii) Continuous production ;
Uses less enzyme / re-use of enzyme /eq can easily remove enzyme ;

Avoids contamination of product /
can easily separate enzyme from products ;

More stable ; max 2

[13]

65. 1 Correct reference to translation ;

2 mRNA becomes attached /eq to ribosome (in cytoplasm) ;

3 Reference to ribosome attachment site / P site or S'end / sequence /eq start sequence (AUG) ;

4 tRNA in cytoplasm attached to specific /eq amino acid ;

5 Reference to structure of tRNA / anticodon on tRNA ;

6 tRNA (carries amino acid) to the ribosome /eq ;

7 Complementary /eq anti-codon of tRNA lines up with codon of mRNA ;

8 Two tRNA molecules held in position /eq (may be implied) ;

9 Amino acids joined by peptide bond(s) ;

10 Reference to enzyme / enzyme complex in ribosome / ATP in loading tRNA ;

11 tRNA free / released to pick up another amino acid / re-used / recycled ;

12 Ribosome moves along mRNA until reaches end / stop codon / non-sense codon /eq (UAA, UGA, UAG) ;

13 Polypeptide chain produced ;

14 (Polypeptide) chain twisted / folded to form protein / reference to a - helix / b pleated sheet etc ;

15 Reference to polysomes or description / free and RER ribosomes / reference to modification (post-translation) by Golgi ;

(Accept 2, 5, 6, 7, 8, 9, 11, 13, and 15 from diagram. Diagrams must be appropriately labelled to gain mark.)

[max 10]

66. Phospholipids ;

Proteins ;

(Mono)saccharide / sugar / carbohydrate / named monosaccharide ;

Receptors / recognition sites /eq antigens ;

*Endo*cytosis / phagocytosis pinocytosis ;

[5]

67.

Statement	Glycolysis	Krebs cycle
C6 compounds are involved	✓	✓ ;
Pyruvic acid is produced	✓	X ;
Carbon dioxide is produced	X	✓ ;
ATP is hydrolysed	✓	X ;
Reduced co-enzyme is produced	✓	✓ ;

[5]

68. (a) A Crista ;

B (Outer) membrane envelope / (double) membrane ;

C *Inter*membrane space /eq inner membrane / envelope (if not given for B) ; 3

(b) Krebs /eq cycle / link reaction 1

(c) *Accept measurement of 104 to 106 mm*

$$\frac{105 \pm 1 \times 1000}{6}$$

or $\frac{105 \pm 1}{6 \times 10^{-3}}$

or $\frac{10.5 \pm 0.1}{6 \times 10^{-4}}$

(Allow for consequential error for measurements outside range if calculated correctly) ;

= 17 333 to 17 667 ; 2

[6]

69. (a) Monohybrid involves *one character,* dihybrid *two characters* /*eq* ;

Monohybrid *one gene* / locus, dihybrid two genes / loci /eq // monohybird *one pair of alleles,*dihybrid *two pairs of alleles* involved ;

Credit for examples genotypes / phenotypes of *both;*

Monohybrid reference to allelic interaction *at one locus* /dihybrid gene interaction between *two loci* / reference to epistasis (accept "eye colour" for *monohybrid) ;*

Heterozygous cross monohybrid gives 3:1, dihybrid 9:3:3:1 (accept correct ratios for other *specified* crosses) ; Max 3

(b) Continuous has (complete) range of measurements / phenotypes, discontinuous only a few categories /eq ;

Continuous is polygenic / controlled by a large number of genes, discontinuous one / only a few genes ;

Continuous likely to / may be influenced by the environment, discontinuous little / no environmental influence ;

Credit for examples of both (accept "eye colour"/"coat colour in mice" for discontinuous) ;

Allow 1st and 4th points if shown on clearly labelled sketch graphs. Axes must be labelled. Max 3

[6]

70. (a) Mutation I - *deletion;*
Mutation II - insertion / addition / duplication 2

(b) Alanine ; 1

(c) If only mutation I occurred then all the following amino acid / codon / triplets / bases sequence would be altered / frame shifted / eq Mutation II corrects mutation I only the sequence between the two mutations is altered /eq 2

(d) Mutagen / mutagenic (agent) 1

[6]

71. (a) *Must be* heterozygous *to score mark in (a)*

Aa / X^A X^a / X A Xa /eq: 1

(b) *Only* males have the disease / disorder /eq (accept converse) ;

(Probably) carried on the X chromosome ;

Male sufferers are produced from unaffected/eq parents ;

Recessive only expressed when no dominant allele is present /eq females may be carriers;

Male has only one locus / allele for the disease / disorder / no locus on Y /eq ; Max 3

(c) Person 3 / father is X^AY/eq ;

(As) person 4 / mother is carrier / X^AX^a / Aa / heterozygous ;

Person 5 / son inherits Y from person 3 / father /eq ;

And X^a / recessive allele / disorder from person 4 / mother /eq Max 3

(d) *Accept marks from genetic diagram. If unclear whether mother is AA or Aa, can only score mark for person 6's genotype.*

Person 6 / father is X^A Y / A /eq

Person 7 / mother is carrier /eq is heterozygous / Aa ;

All the females / daughters will be unaffected / eq ;

Half /eq of the sons / males will be unaffected /eq (or converse) ;

There is a *one in four /eq chance* (but not ratios) of producing a sufferer (or converse) Max 4

[11]

72. (a) 7 ; 1

(b) (Repeat the experiment at) a range of closer pHs (between 6 and 8) ; 1

(c) In *very* /eq acidic conditions / high concentration of H^+ ;

Reference to changes in R group / side group ionisation charge /eq ;

Bonding disrupted /eq ;

Shape of enzyme / active site /eq denaturation /eq ;

Substrate / urea does not bond /eq *with active site* ; Max 3

(d) (Change in pH) affects shape of enzyme / active site ;

Enzyme-substrate complex formed less efficiently /eq ; 2

(e) Use (buffer solution) *pH7* (throughout) / optimum pH ;

Same / stated volume / concentration of urease / enzyme ;

Range of concentrations of urea / substrate ;

Use the same / stated *volume* of urea / substrate ;

Named variable kept constant / e.g. time, temperature / same *volume* of buffer; Max 4

[11]

73. *All points must be made in an appropriate context*

1 Produces cells with haploid number of chromosomes /eq produces gametes in animals / spores in plants / halves chromosome number;

2 Leads to *genetic* variation ;

3 Pairing of *homologous* chromosomes / reference to bivalent (in interphase or prophase 1) ;

4 Named stages in correct sequence for *either* 1st *or* 2nd division ;

5 *Description* of chiasmata / *description* of crossing over;

6 (Elaboration of spindle formation) e.g. reference to centrioles, microtubules

7 (Prophase) e.g. condensation of chromosomes / disintegration of nuclear envelope / disappearance of nucleolus ;

8 (Metaphase 1) e.g. attachment /eq of pairs of chromosomes / bivalents to spindle fibres / at equator ;

9 (Anaphase 1) e.g. separation of pairs of chromatids /eq homologous sets of chromosomes ;

10 (Telophase 1) e.g. chromosomes /eq at poles / decondensation / nuclear membrane reforms / spindle disintegrates ;

11 (2nd prophase) duplication of centrioles / reference to chromosome state (i.e. number) ;

12 (2nd metaphase) e.g. spindles at right angles / attachment of (individual) chromosomes ;

13 (2nd anaphase) e.g. separation of sister chromatids /eq (clearly described)

14 (2nd telophase) e.g. reintegration /eq of nuclear envelope / spindle disintegrates ;

15 Division of cytoplasm / decondensation / cytokinesis in animals / formation of cell plate /eq in plants

[10]

74. (a) (i) 1. Add enzyme to sodium alginate solution ;

2. Drop into solution with calcium ions (any salt) (allow credit for correct alternative method) ;

3. (Strain off beads) and place in column /eq ;

4. Use same beads throughout /equal number / mass of same size bead ;

5. Use of buffer solutions ;

6. Suitable pH values, at least 5 with 1 above pH7 ;

7. Run buffer through column before starting ;

8. Standard concentration of lactose ;

9. Equilibrate at stated suitable temperature before adding to column ;

10. Use the same column for each solution (even if different beads) ;

11. Add same volume of lactose solution (to column) ;

12. Test drops of solution separately with indicator strips ;

13. Time to get standard colour / colour after stated time ;

14. Preparation of standard colour(s) / use of standard colour chart ;

15. Rinse column / beads between tests ;

16. Repetition of whole experiment ; Max 9

If enzyme **not immobilised**

allow points 5, 6, 8, 11, 13, 14, 16 and the following alternative points

4a. Use of same volume and concentration of lactase ;

9a. Equilibrate and test in water bath at stated suitable temp ;

Allow only to max 7

(a) (ii) Tabulation ;

Columns / rows with units where appropriate ;

Calculation of means ;

Calculation of rate by suitable means /eq 1/time ;

Line graph ;

Axes - pH on *x*, time or rate on *y* / intensity of colour ; Max 4

(b) Temperature difficult to control /eq ;

Rate of flow can vary / gets slower /eq ;

Possible loss of enzyme from beads ;

Sample drop size may vary ;

Beads not fully washed / previous solution may penetrate beads / beads may vary (if different ones used) ;

End point / colour standards subjective ; Max 2

[15]

75. Treat with *warm HCl*;

Name of suitable stain e.g. orcein, Schiffs, Leishman's, fuelgen, Toluidine blue ;

Detail of removal of suitable region of root tip 1.5 mm (max) ;

Break up tissue with glass rod /eq ;

Allow time for staining / warm to intensify orcein stain. ;

Cover with cover slip ;

Place in folded filter paper /eq ;

Apply firm pressure / press with thumb on cover slip ;

Avoid moving cover slip /eq ;

[max 7]

76. (Nuclear) membrane / envelope;

Glycogen ;

Lipids / fats / triglycerides oils

Plasmids ;

Flagellum /flagella;

[5]

77.

Disaccharide	Constituent Monomers	**One** role in living organisms
	Glucose and galactose	
Maltose		Energy / food *source* in (germinating) seeds
Sucrose	Glucose and fructose	

[5]

78. (a) A Crista / cristae

B (Outer) membrane/inter-membrane space / eq envelope;

C Matrix ; 3

(b) *Aerobic* respiration / description /eq link reaction / Krebs cycle oxidative phosphorylation / electron transport chain;

Production of ATP; 2

[5]

79. (a) (Linear) sequence / order / arrangement / pattern of amino acids**;** 2

(b) Description of H bond / attraction between dipoles e.g δ^+ and δ^- / weak electrostatic bond

Between H and O;

In amine and carboxyl groups

Reference to the α helix / secondary structure / β- sheet/β – strand ;

(Bond between) *R groups* in coiling / tertiary stucture / 3D shape Max 3

(c) Long chain / long strand / fibrils / reference to linear molecule

Repeating sequence of amino acids;

Many parallel strands lie side by side /eq;

Reference to a helix / β (pleated) sheet;

Collagen has triple helix; Max 3

[8]

80. (a) Palisade (mesophyll);

Reference to elongated shape / presence of (large numbers of) chloroplasts / location e.g. near top / near upper surface under / below epidermis / vertically orientated 2

(b) Photosynthesis / description of process 1

(c) Magnification [between 55 - 75mm] **M** ;
Proportions [height – 2½ - 3½ × width] **P ;**
Drawn correct two cells *only;* **D ;**
Cell wall, varying thickness / chloroplasts shown **C ;**
Nucleus [approximately correct position] **N ;** 5

[8]

81. (a) **A -** chromatid;
B- centromere; 2

(b) Anaphase;
Chromatids separate / centromere splits
Move / pulled to (opposite) poles / ends of cell / ends of spindle to centrioles ;
By spindle *fibres* / microtubules 3

(c) Daughter cells *genetically* identical (to parent cell) /maintains chromosome number/eq; 1

(d) Interphase / G1 / S / G2 / cytokinesis / cleavage
If interphase or named stage - growth/synthesis of organelles
synthesis / replication of DNA / division of organelles
OR
If cytokinesis - division of the cytoplasm / formation of cell plate in plants ;
Points linked. [if give 'telophase'and then describe division of cytoplasm allow second mark] 2

[8]

82. (a) 7 1

(b) Repeat experiment at a range of pH values at closer intervals / at smaller intervals of pH /eq (on either side of the optimum) 1

(c) In *very* /eq acidic conditions / high concentration of H^+;
Reference to *changes* in R group ionisation /eq
Bonding disrupted /eq**;**
Enzyme / active site changes shape / tertiary structure changes denaturation ;
Substrate / urea does not bond /eq with *active site;* 3

(d) Shape affected more at pH 9 than 8 / more denaturation at pH9 than 8 H converse ;
Enzyme-substrate complex formed less efficiently / eq 2

(e) Use (buffer solution) *pH7* throughout / optimum pH ;

Same / stated concentration / volume of urea / substrate

Range of concentrations of urease / enzyme;

Use the same / stated volume of urease / enzyme;

Named variable (e.g. time / temperature / volume of buffer) kept constant Max 4

[11]

83. (a) A Phosphate

B Deoxyribose

C (Organic) base / thymine / adenine;

D Hydrogen bond / H bond; 4

(b) Total percentage of C + G = 84 %;

Therefore T will be (100 – 84) ÷2;

= 8%; 3

(c) (i) CGC\AGU\ACG;; 2

[all correct = 2 marks, 1 error1 mark]

(ii) 3 ; 1

[10]

84. *All points must be in an appropriate context*

Diffusion

1 (Molecules / ions) *move down / with* a concentration gradient

2 Rate increased by larger concentration difference / higher temperatures / smaller molecules or ions / larger surface area of membrane / small diffusion distance (or converse) ;

3 Credit example of diffusion e.g. oxygen, carbon dioxide, water;

Facilitated diffusion 4(Molecules / ions) *move down/ with* a concentration gradient/eq

5 Requires protein channel / carrier in membrane;

6 Credit example of facilitated diffusion, such as glucose / amino acids / named ion

Osmosis

7 Movement of water;

8 From high / less negative *water potential* / Ψ to low / more negative *water potential* /Ψ/eq;

9 Across partially permeable /eq membrane;

Active transport

10 (Molecules / ions) move *up* / *against* concentration gradient;

11 Requires protein channel / carrier in membrane;

12 Credit further details of mechanism of active transport;

13Credit example of active transport, such as sodium / potassium / proton pumps;

Endocytosis / exocytosis /pinocytosis / phagocytosis 14 Description of process;

15 Active transport / endocytosis / etc require ATP / energy;

OR

Diffusion / facilitated diffusion / osmosis do not require ATP / energy;

[10]

85. No mark scheme available

86. No mark scheme available

87. No mark scheme available

88. No mark scheme available

89. No mark scheme available

90. No mark scheme available

91. No mark scheme available

92.

Process	Takes place against a concentration gradient	Requires energy in the form of ATP
Diffusion	**X**	**X**
Facilitated diffusion	**X**	**X**
Osmosis	**X**	**X**
Active transport	√	√

Any two correct boxes for one mark

[4]

93. Condensation / polymerisation ;

Deoxyribose ;

Thymine ; [watch spelling]

(double) helix ;

Hydrogen ; [accept H]

[5]

94.

Name of organelle	Description	Function
	Stack / group / eq, of, (flattened / curved), cisternae /tubules / sacs ;	Transport of lipids / storage of lipids / modification of lipids / formation of glycoproteins / modification of proteins / formation of secretory / eq vesicles / formation of lysosomes / transport of carbohydrates ;
Centrioles / centrosome;		
Mitochondria ;		Aerobic respiration / ATP production / ETC / oxidative phosphorylation / Krebs cycle;

[5]

95. (a) Phospholipid ; 1

(b) A Glycerol / propan 1,2,3 triol ;

B Ester bond / ester linkage ; 2

(c) Insoluble in water / does not dissolve in water / non-polar ; 1

(d) (Fluid because) phospholipids move (around membrane) ;

(Mosaic because) membrane contains proteins / glycoproteins (lying amongst phospholipids) / eq ; 2

[6]

96. (a) anaphase ;

prophase ;

telophase ;

metaphase ;

[if 'I' or 'II', penalise ONCE] 4

(b) (i) (G lasts) 7.0 hrs (and cell cycle time is 14 hrs) / 18-11 ;

$7 \times 100 \div 14$;

= 50 % ; 3

(ii) B ;

DNA replication / DNA mass beginning to, increase / double ; 2

[9]

97. (a) (Solution) heated / boiled (with Benedict's solution / reagent ;
Green / yellow / orange / red / brown (precipitate) ; 2

(b) Heat with acid *or* add sucrase ;
Neutralise *or* incubate [if using enzyme] ;
(Heat with) Benedict's / repeat test / eq ; 3

(c) Same / stated, volumes of each (test) solution ;
Same / stated, volume Benedict's solution (to each) ;
Stated / same , time / temperature (for heating) / boil in waterbath;
Weigh precipitate / colour comparison / reference to colorimeter comparison / time taken to reach standard or same colour / reference to rate of colour change ; max 3

[8]

98. (a) central C with R and H attached by single bonds ;
NH_2 and COOH attached to carbon by single bonds ;
[accept NH_3^+ and /or COO^-] 2

(b) (i) A Ribosomes ;
B Rough ER ;
C Golgi apparatus ; 3

(ii) (Rises by 15 units in 15 minutes)
Rate = 15 ÷ 15 ; [accept other correct figures]
= 1 ;
unit per min ;
[allow unit mark if figures from incorrect curve] 3

(c) Radioactivity will continue to drop in (all) organelles ;
Reference to half life (of isotope) / natural drop in radioactivity over time ;
Moved out of cell / exocytosis / secreted ;
As protein / named example ;
Radioactivity will not reach zero ;
Because some, amino acids / proteins, incorporated ;max 3

[11]

99. (a) Glucose ;
Fructose ; 2
[allow either way round]

(b) Same slope / mass of products , at lower temperatures / below 43°C ; 1

(c) (Activity of) both increases as temp. increases up to 45°C ;

Credit manipulated figures from graph up to 43°C;

Peak / optimum , at 43 to 45°C / lower for solution and 51 to 52°C / higher for immobilised ;

Comparison of figures between 42 °C – 60°C ;

Activity ceases at 60°C / lower for solution and 69 to70°C / higher for immobilised ; max 3

(d) Immobilised enzyme / more stable (at high temperatures) ;

Because held in position / eq ; 2

(e) Constant / stated, temperature / time for both ; (below 43 °C)

Same / stated volume / concentration, of sucrose solution / substrate ;

Same / stated volume / concentration, of enzyme / sucrose ;

Use buffers over range of pH ;

Mass of products determined ;

Plot graph of mass of products against pH for sucrase solution and immobilised sucrase ; max 4

[12]

100. *Award marking points only in correct context*

1 Consists of amino acids held together by peptide bonds (in either) ;

2 Insulin is globular and collagen is fibrous ;

3 Hydrogen bonds hold, secondary structure / (alpha) helix / beta strands, in shape (in either) ;

4 R groups determine, tertiary / 3D, shape (in either) ;

5 Reference to named type of bonding in tertiary structure ;

Insulin

6 Relatively small protein / 51 amino acids ;

7 Reference to, alpha helix / beta sheet ;

8 Two polypeptide chains / A chain and B chain ;

9 Reference to disulphide bonds ;

10 Reference to binding site for cell membrane receptor ;

Collagen

11 Relatively large protein / over 1000 amino acids ;

12 3 polypeptide chains / triple helix ; [ignore alpha here]

13 Hydrogen bonds between chains ;

14 Regular amino acid sequence / repeating sequence ;

15 Molecules form (micro)fibres / cross-linking between molecules ;

[10]

101. (a) A Plasma membrane / cell membrane / cell surface membrane;

B Centriole(s) / microtubule(s) / centrosome;

C Golgi apparatus / Golgi body / smooth ER;

D Rough ER / ribosome; 4

(b) (Accept measurement between 11 and 12 mm)

11 ÷ 12 000; OR 12 ÷ 12 000;

= 0.92; = 1.0 2

[6]

102. (a) A Glycerol / propan - 1, 2, 3 - triol
B Fatty acid (s) / fatty acid chain 2

(b) Triglyceride 1

(c) Condensation / esterification 1

(d) Energy store or source / insulation /waterproofing / production of metabolic water / buoyancy / protection; 1

(e) insoluble / non-polar / high energy value / poor heat conductor / low density / less dense than water (points in (e) need to be correctly linked to the answer given in (d)) 1

[6]

103.

Statement	Starch	Glycogen	Cellulose
Polymer of aglucose	✓	✓	✗
Glycosidic bonds present	✓	✓	✓
Unbranched chains only	✗	✗	✓
Energy store in animal cells	✗	✓	✗

[4]

104. (a) Diffusion of water molecules;
Through a partially permeable membrane;
From a region of high concentration of water molecules to a region of lower;
concentration of water molecules/eq in terms of water potential; 3

(b) Means whereby polar molecules are transported across membranes;
Molecules bind with transport proteins;
Transport protein changes shape and moves molecule across membrane;
No metabolic energy required; 3

[6]

105. (a) A = Flagellum;
C = (Peptidoglycan) cell wall;
D = (Circular) DNA / chromosome / nucleoid; 3

(b) B = location of enzymes associated with aerobic respiration;
C = maintains shape / protection / etc;
E = storage of carbohydrate / eq; 3

[6]

106. (a) (Lower) epidermis of leaf;
Stomata allow gaseous exchange / eq;
Protection from desiccation / eq;
Allows penetration of light to photosynthetic mesophyll; 3

(b) Correct size / magnification;
Correct proportions;
Minimum number of cells / both stomata and cells touching;
Cell wall thickness appropriate;
Accurate detail of cell contents in guard cell; 5

[8]

107. (a) Protein / polypeptide / eq 1

(b) RER has ribosomes;
Site of protein synthesis; 2

(c) Proteins / polypeptides / move to Golgi apparatus;
Ref. to protein modification;
Enclosed in membranes to form vesicles;
So most activity in vesicles after 45 minutes; 3

(d) Amino acids moving between sites / eq;
Amino acids being broken down / metabolised;
Proteins used in other parts of cells / eq;
Proteins also synthesised in mitochondria / eq; 3

(e) Exocytosis;
Vesicles move to cell membrane;
Vesicle fuses with cell mebrane;
Contents released outside cell; 3

[11]

108. (a) To keep pH constant / enzymes are affected by pH 1

(b) Rate increases as substrate concentration increases
Steady / constant / linear increase between 20 to 80* mmol dm^{-3};
Then begins to level off;
(*accept any quoted figure in this range) 3

(c) As substrate concentration increases, the number of collisions / number of enzyme - substrate complexes will increase;
Therefore the rate will increase;
Until all enzymes in use / limited number of active sites;
Rate then remains constant / reaches a maximum / ref to V_{max}; 3

(d) Use equal volumes of hydrogen peroxide solution;
And distilled / deionised water / buffer solution;
(accept suggested volumes); 2

(e) Use a water bath;
Suggested range of temperatures (at least 3 stated)
Use same substrate concentration;
Use same volume / depth of hydrogen peroxide
Allow substrate / enzyme to equilibrate before adding filter paper disc
Ref. to uniformity of discs;
Use constant enzyme concentration;
Repeat at each temperature;
Plot a graph of rate of reaction against temperature; 4

[13]

109. 1 Daughter cells have same number of chromosomes as parent cell / are genetically identical to parent cell;
2 Concerned with growth / repair / replacement of tissues / asexual reproduction;
3 Reference to cell cycle consisting of interphase, mitosis, cell division
4 (During prophase) chromosomes condense / eq so each consists of a pair of chromatids joined by centromere;
5 Reference to centrioles / movement / position
6 Formation of spindle by microtubules;
7 Disappearance of nucleus / nucleoli
8 Breakdown of nuclear envelope;
9 (At metaphase) chromosomes attached to spindle fibres
10 Lined up at equator of cell :
11 1 (At anaphase) centromeres split / duplicate / separation of chromatids
12 Daughter chromosomes / chromatids pulled to opposite poles of cell (at telophase) chromosomes / chromatids reach poles of cell;
13 Formation of nuclear membrane / (daughter) nuclei formed;
14 Followed by cytokinesis (in animal cells) / or description
15 Formation of a cell plate / eq in plant cells;

[10]

110.

Feature	Prokaryotic Cell	Eukaryotic cell
Cell surface membrane	✓	✓
Plasmids	✓	***X***
Ribosomes	✓	✓
Mitochondria	***X***	✓

[4]

Any two correct boxes for one mark
*Blanks are **incorrect***
*Circle **correct** answers*
*Put in appropriate number of ticks for **total** mark*

111. amino acids / polypeptides / peptides ;
peptide ; [not dipeptide] [accept peptide / hydrogen / disulphide / ionic if peptide or

polypeptides given above]

condensation / polymerisation ;

(α) helix / (alpha) helix ;
hydrogen / H ;

[5]

112. (a) (net) movement / eq of, molecules / ions / particles / gases / solute / named example ;
from high concentration to low concentration / <u>down</u> a concentration gradient ;
[ignore references to membrane] 2

(b) concentration gradient / eq ;
temperature ;
(diffusion) distance / thickness (of membrane) ; [not 'size']
permeability (of membrane) ;
surface area (of membrane) ;
size of, molecules / ions / particles ;
polarity / solubility in lipids / eq ; 2

(c) (active transport) up / against concentration gradient / from low to high concentrations / involves carriers / ATP / energy / respiration ; 1

[5]

113. (a)
1. (mRNA) is a copy of DNA ;
2. (copy of) part of DNA / eq ;
3. (copy of) one strand / sense strand ;
4. mRNA is complementary (to DNA) / mRNA made up of complementary bases ;
5. mRNA strand, built / formed (looking for idea that mRNA strand is put together during the process) / reference to enzyme ;
6. carries genetic code to, cytoplasm / out of nucleus / to ribosome ; 3

(b)
1. genetic information / base sequence / code, in mRNA determines amino acid sequence ;
2. codons / base triplet on mRNA ;
3. determines amino acid ;
4. (codons) pair with, <u>complementary</u> triplet / anticodons, on tRNA ;
5. reference to start / stop codons / sequences / binding sequences ;
6. occurs on ribosomes ; 3

[6]

114. (a) centrioles / centrosomes ;
asters ;
no cell wall ;
[ignore chloroplasts and vacuole] 2

(b) A chromatid / chromosome / daughter chromosome ;
B spindle (fibres) / microtubules ; 2

(c) anaphase ; [ignore I or II] 1

(d) 80 ÷ 1000 ; [accept 80 to 83 or 8 to 8.3]
0.08 mm / 0.008 cm / 80 μm ; [accept answer consistent with measurement] 2

[7]

115. (a) pH ;
enzyme concentration ;
enzyme (solution) volume ;
substrate (solution) volume ;
total volume ; 2

(b) more collisions / complexes ;
with, enzyme / active site (and substrate) ;
in unit time / eq ; 2

(c) enzymes are working as fast as they can / reference to V_{max} ;
all active sites occupied / eq ;
substrate concentration is no longer a limiting factor ;
enzyme concentration is limiting ; 2

(d) line on graph begins at zero and is below original line ;
less kinetic energy / molecules moving more slowly ;
fewer collisions (between enzyme and substrate) ;
less energetic collisions ;
in unit time / eq ; 3

[9]

116. (a) prevent, entry / exit, of water ;
by osmosis ;
which may affect / eq, organelles ; 2

(b)

Pellet	Organelle
A	nuclei ;
B	mitochondria ;
C	ribosomes ;

2

(c) glucose / monosaccharides / disaccharides / sugar ;
glycogen ;
proteins / (poly)peptides ;
enzymes / suitable named example ;
ions / named example ;
amino acids / named example ;
lipids / phospholipids / triglycerides / fats ;
microtubules / centrioles ;
microfilaments ;
RNA / mRNA / tRNA ;
[accept other correct substances present in liver cells] 2

(d) two membranes shown [**M**] ;
inner membrane shown folded [**F**] ;
membrane / envelope ;
intermembranal space ;
cristae ;
matrix ;
ribosomes / DNA, in matrix ;
stalked particles / ATPase ; 4

(e) to produce (large amounts) of ATP ;
by, aerobic respiration / Krebs cycle / electron transport chain ;
(because) liver cells are (metabolically) very active / eq ; 2

[12]

117. (a) A phosphate ;
B pentose / ribose / deoxyribose / 5C sugar ;
C purine / pyrimidine / (organic) base / named example ; [watch spelling] 3

(b) U C G G C A G G G C A G ; ;
[one mistake = 1 mark, two mistakes = 0] 2

(c) making new DNA / copying DNA ;
makes identical copies ;
new molecule has one old and one new strand ;
DNA strands separate / eq ;
each strand acts as a template ;
individual nucleotides line up against (old) strand ;
complementary base pairing ;
nucleotides joined (by DNA polymerase) ; 4

(d) one eighth / 12.5% ;
eight strands have been formed from each original strand / eq ; 2

(e) interphase / S phase ; 1

[12]

118. Accept points only in correct context

1. phospholipid bilayer ;
2. polar / phosphate / hydrophilic (groups of phospholipids) face outwards ;
3. nonpolar / hydrophobic / fatty acid tails face inwards ;
4. reference to cholesterol ;
5. molecules can move around ;
6. proteins present in membrane ;
7. qualification of the location of these proteins ;
8. glycosidic / carbohydrate side chains on lipids / proteins / glycolipids / glycoproteins / glycocalyx ;
9. involvement of proteins in transport (across membrane) ;
10. by active transport / facilitated diffusion described (e.g. reference to attachment / change in shape) ;
11. some proteins are enzymes ;
12. partially / selectively permeable / eq ;
13. reference to cell-cell interaction / recognition / antigens ;
14. reference to receptors for hormones / neurotransmitters ;
15. vesicle fusion / formation / description of membrane involvement in exo- or endo-cytosis ;

[10]

119.

Statement	Sucrose	Maltose
Contains glucose	✓	✓
Is a reducing sugar	✗	✓
Contains glycosidic bonds	✓	✓
Is transported in the phloem of flowering plants	✓	✗

Encircle CORRECT answers
Any TWO correct responses = 1 mark
Blanks and ambiguous ticks are incorrect
Put correct numbers of ticks to correspond with total mark

[4]

120. H_2O ;
(di)polar ;
Hydrogen / H ;
Solvent ;
(specific) heat capacity ;
[not latent heat capacity]

[5]

121. (a) A flagellum ;
B DNA / (bacterial) chromosome ;
C cell wall ; 3

(b)

Marking point	Prokaryotic cell	Eukaryotic cell
1	Smaller	Larger ;
2	Do not have a nucleus / nucleolus / have a nucleoid	Have a nucleus / nuclear envelope / nucleolus (allow description) / no nucleoid ;
3	Do not have membrane-bound organelles / absence of named organelle	Have membrane-bound organelles / presence of named membrane-bound organelle ;
4	Smaller / 70S ribosomes	Larger / 80S ribosomes ;
5	Mesosomes / description of infoldings	No mesosomes ;
6	Circular DNA	Linear DNA ;
7	No histones / chromosomes	Histones / chromosomes ;
8	Murein / mucopeptide / peptidoglycan cell walls / no cellulose	Cellulose cell walls (if present) ;
9	Flagellum with no microtubules / eq / reference to basal structure	Flagellum with microtubules / 9+2 arrangement / reference to basal structure ;

3

[6]

122. (a) Making more DNA ;
Molecule unwinds / strands separate ;
Each strand acts as a template / eq ;
Each molecule contains, one parental/ one new / one daughter strand ;
New DNA is identical to original DNA / identical to each other / eq ; max 3

(b) Folding of secondary structure / eq ;
To form irregular / 3D / globular shape ;
Maintained by, hydrogen / ionic / disulphide bonds / eq ;
Bonding determined by R-groups ;
Shape is important for function ; max 3

[6]

123. (a) 14 mm (allow 12 - 15 mm) ;
÷ 800 ;
= 17.5 / 18.0 ; 3
[allow consequential error]

(b) Only 2 cells drawn (D);
Both cells with correct magnification (M) ;
Nucleus of A has correct shape (N) ;
Drawn with single line and no additional details / structures (L) ; 4

[7]

124. (a) Reference to named stain (acetic orcein / acetocarmine / Feulgens / Schiffs) ;
Warm / heat ;
Break open tip with (mounted) needle /eq ;
Mount in stain / acid / water ;
(gently) squash under coverslip / eq ; max 4

(b) (i) A ; 1

(ii) C ; 1

(c) Synthesis / division / multiplication of organelles (or named organelle) ;
Growth ;
Replication of DNA/ chromosomes ;
Protein synthesis / name of specific protein being synthesised ;
Any normal cell activities, named example (e.g. respiration) ; max 2

[8]

125. (a) (i) Movement down concentration gradient / eq ;
Involves protein in membrane ; 2

(ii) (Active transport) requires, ATP/ energy ;
(Active transport) occurs against/up the concentration gradient ; 2

(b) (i) (0.05 mol dm-3 =) 90% and (0.07 mol dm-3 =) 15% ;
Difference = (90-15) = 75% ;
[allow 14% reading, no consequential error] 2

(ii) Water potential of solution is more than that of red blood cells / allow converse ;
Water enters the cells ;
By osmosis / down water potential gradient ;
Expansion of cytoplasm / eq / increasing pressure / stretching the membrane ; max 3

(iii) Shrink / shrivel up / crenate / eq / water would move out / exosmosis ; 1

(c) Cell wall ;
Resists expansion / eq ; 2

[12]

126. (a) (i) The production of juice is increased / more juice is produced ;
Four times as much / 15 cm^3 more juice was produced ;
The rate of production increases / the graph has a steeper line with pectinase ;
Production lasts longer ; 2

(ii) Enzyme digests/breaks down/ hydrolyses pectin ;
In cell walls ;
Allowing release of juice / reference to permeability ; 2

(b) (i) Inhibitor has similar shape to, substrate / pectin ;
Binds to active site ;
Prevents entry of / competition with, substrate ; 2

(ii) More juice released / juice released faster ;
Increased enzyme activity / decreased inhibition ; 2

(c) 1. Use same type / variety of apples ;
2. Same / stated mass / volume of pulp ;
3. Range of temperatures / at least three stated temperatures ;
4. Same / stated volume / concentration of enzyme / pectinase ;
5. Same time / stated time period ;
6. Measure volume of juice extracted ;
7. Plot graph of volume of apple juice vs. temperature ; 4

[12]

127. ACCEPT POINTS ONLY IN CORRECT CONTEXT

1. Contain carbon, hydrogen and oxygen ;
2. Insoluble (in water) / hydrophobic ;
3. Triglycerides consist of glycerol plus three fatty acids ;
4. Joined by condensation reactions / formation of ester bonds ;
5. Correct reference to saturated and unsaturated fatty acids ;
6. Phospholipids consist of glycerol plus two fatty acids and a phosphate group ;
7. Reference to non-polar/hydrophobic tails/fatty acids and polar/hydrophilic heads/phosphates of phospholipids ;
8. Correct orientation of phospholipids, in cell membrane / phospholipids bilayer ;
9. Role of phospholipids in cell membrane (fluidity/permeability etc) / role of surfactants ;
10. Energy stores ;
11. Reference to energy from fats / oils, compared with carbohydrates ;
12. (mechanical) protection / packing qualified ;
13. Insulation qualified (either electrical or thermal) ;
14. Buoyancy ;
15. Qualified reference to waterproofing / protection against entry of pathogens in plants ;

[10]

128.

Component	DNA	mRNA
Cytosine present	✓	✓
Uracil present	✗	✓
Pentose sugar present	✓	✓
Is single stranded	✗	✓

[Any two correct = 1 mark]
[Blanks and alterations are incorrect]

[4]

129. Sequence / order ;
Peptide ;
Condensation / polymerisation ;
Hydrogen / H ;
(di)sulphide / covalent ; [accept sulphur]

R groups / side chains / sulphur / SH groups / thiol groups ;

[6]

130. (a) Genetically identical ;
(identical) to {each other / the parent cell} ; 2

(b)

1

(c) Daughter cells {suitable / eq} for surviving in the present conditions / preserves desirable characteristics / eq ;
Rapid / eq ;
Only one parent is needed ; 2

[5]

131. (a) To {remove / digest} {protein / named example / blood / gravy / eggs} ;
(proteins broken down to) peptides / amino acids ;
Correct reference to solubility ;
Less {heat / energy} required / lower temperature needed / less damage to material ; 3

(b) Do not denature at temperatures that the detergents work at / greater stability ;

Optimum temperature is higher / works faster than other enzymes at higher temperature ;
Stains easier to shift at high temperatures ;
Have longer shelf-life / eq ; 2

(c) Enzymes will only {be released / start working} {during washing procedure / when needed} ;
Less danger of harm to users ;
Increases stability of the enzyme ; 2

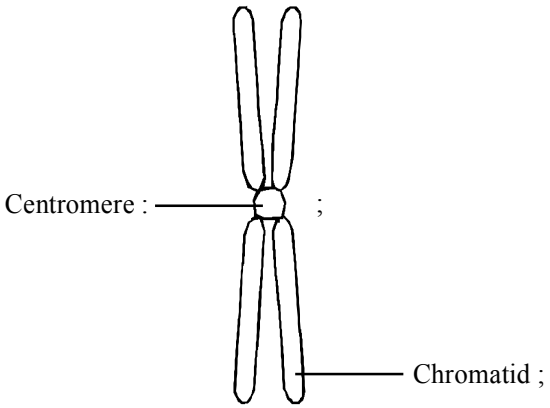
[7]

132. (a) Breaks the hydrogen bonds (between the strands) ; 1

(b) Condensation / polymerisation ; 1

(c) Interphase / S phase / synthesis phase ; 1

(d) Correct diagram, as below ; 3



[accept constriction for centromere]
[accept single line for chromatid]

[6]

133. (a) {Fatty acid / tails} are {hydrophobic / non-polar} ;
(so orientate themselves) away from {water / polar environment} ;
{Phosphate / heads} are {hydrophilic / polar} ;
(so can) interact with {water / polar environment} ; 3

(b) Correct measurement ; [27 mm or 37 / 38 mm]
Divide by magnification ;
Correct conversion to μm ; [answer = 0.009 or 0.012 / 0.013] 3

(c) Carbohydrate: <u>Cell</u> recognition / cell adhesion / eq ; 1

Protein: Transport of molecules / eq OR
receptor for hormone / eq OR enzymes ; 1

[8]

134. (a) (i) (single) membrane ;
Contains {hydrolytic / digestive / zymogen} enzymes ;
[accept suitable named enzyme]

Reference to size (accept up to 1 μm) ; 2

(ii) Isolation of enzymes ;
Break down / eq of {ingested material / bacteria} ;
Autolysis / self-digestion ;

Breakdown of (old) organelles ; 2

(b)

0 – 10 hours	Increase in radioactivity ;
10 – 12 hours	Amount of radioactivity remains constant ;
After 12 hours	Fall in amount of radioactivity ;
OR	
0 – 8 hours	Increase in radioactivity ;
8 – 14 hours	Amount of radioactivity remains relatively constant ;
After 14 hours	Fall in amount of radioactivity ;

No radioactivity present in white blood cells at the beginning and some remaining inside white blood cells at the end ; 3

(c) (hydrolytic enzymes) digesting the bacteria ; 1

(d) Degraded bacteria are expelled from cell / eq ;
By exocytosis ;
Digested molecules are (still) radioactively-labelled ; 2

(e) Not all bacteria engulfed / some {radioactivity / labelled amino acids} still present in supernatant / eq ; 1

[11]

135. (a) Less active after inhibitor is added ;
Comparative use of figures (calculation of rates) ; 2

(b) Inhibitor attaches to part of enzyme molecule {other than active site / allosteric site} ;
Alters shape of active site / eq ;
So substrate cannot bind / enzyme-substrate complex cannot form / eq ;
Slows rate of reaction ; 3

(c) Decrease rate further ;
Because it will affect <u>more</u> of the enzyme molecules ;
OR
Stop reaction ;
Because it will affect <u>all</u> of the enzyme molecules ; 2

(d) So that rate of reaction without the inhibitor was known /
{acclimatisation / equilibration idea} /
to compare results before and after inhibitor was added ; 1

(e) {Suitable / optimum} temperature for the activity of the enzyme ;
(fluctuations) would alter rate of oxygen uptake ;
(fluctuations) would alter (rate of) enzyme activity ; 2

(f) To keep the pH constant ;
Fluctuations in pH could affect enzyme activity ;
Variations in pH could alter the ionic charges ;
Substrate molecules could be prevented from binding at the active site ; 2

(g) The concentration of the enzyme in the root tips might not be the same / difficult to make sure that the enzyme concentration is the same in all the samples / size of root tips vary / different stages of development / different metabolic rates / different quantities of stored energy / reference to different genotypes / kept in different conditions before experiment ; 1

[13]

136. Points accepted in correct context only

1. Polysaccharides are {polymers / eq} of monosaccharides / correct general formula $(C_6H_{10}O_5)_n$;
2. Linked by glycosidic bonds ;

3. (monomers are) α-glucose in {starch / glycogen} ;
4. β-glucose in cellulose ;
5. Starch made up of amylose and amylopectin ;
6. Credit reference to structure of {amylose / amylopectin} ;
7. Glycogen branched chains ;
8. Cellulose unbranched ;
9. Starch is an energy store in plants ;
10. Glycogen is an energy store in animals ;
11. (Starch or glycogen) broken down to glucose for respiration ;
12. Cellulose in plant cell walls ;
13. Hydrogen bonding between (adjacent) {chains / molecules} ;
14. Forms microfibrils ;
15. With high tensile strength / reference to turgor ;

[10]

137. Catalysts ;

Activation energy ;

Substrate ;

Active site ;

Temperature / non-active site-directed inhibitors ;

Change / increase or decrease ;
[only accept decrease if referring to inhibitor]

[6]

138. (a)

	Cellulose	Glycogen
1.	β-glucose	α-glucose
2.	4 glycosidic bonds	1, 4 and 1, 6 glycosidic bonds
3.	Unbranched / straight / linear	Branched / compact / eq

2

(b)

	Collagen	Insulin
1.	Fibrous	Globular
2.	Three (polypeptide) chains / triple helix	Two (polypeptide) chains / eq
3.	Chains held together by hydrogen bonds / chains not held together by di-sulphide bonds	Chains held together by di-sulphide bonds / eq
4.	Large / about 1000 amino acids OR length can be variable	Small / 51 amino acids OR fixed / precise length
5.	Repetitive / repeating sequence	No repetitive sequence
6.	Sequence of amino acids may vary between molecules	Sequence of amino acids does not vary between molecules

2

[4]

139. (a) (i) Red ; 1

(ii) Test 1 shows no reducing sugar (in solution B) ;

In test 2 sugar is hydrolysed / eq ;

In test 2 solution (B) was positive ; 2

(b) 1. Add equal volumes of each solution ;

2. To equal volumes of biuret reagent ;

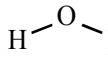
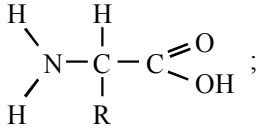
3. {Purple / lilac} colour produced ;

4. Compare intensity of colour / use a colorimeter ;

5. After same period of time ; 3

[6]

140.

Name of molecule	Formula	Structure
		 ;
Amino acid		 ;
	$CH_3 (CH_2)_4 COOH$ OR $C_5 H_{11} COOH$;	
(α) Glucose / hexose ;	$C_6 H_{12} O_6$;	

[6]

141. (a) 1. Enzyme is {attached to / trapped in} (material) ;

2. An insoluble (material)

3. Such as {agar gel / cellulose / polyacrylamide} / reference to alginate beads / eq ; 2

(b) 1. Can be re-used ;

Which reduces overall cost / more economical / eq ;

2. Process is continuous ;

Saves time / can be automated / reduces cost ;

3. Enzymes more stable ;

Less likely to be {denatured / affected by temperature changes / affected by pH changes} ;

OR

Enzymes can be used at higher temperatures ;

Faster reaction / saves time ;

4. Enzyme does not have to be separated from product ;

Reduces cost / saves time ;

5. More than one enzyme can be fixed in an order ;

Greater control over process / saves time / more efficient ; 4

[6]

142. (a) DNA increases: in interphase / synthesis / S stage / phase ;

Synthesis of new DNA / replication of DNA / eq ;

DNA decreases: in cytokinesis ;

Daughter cells formed ; 4

(b) (i) mRNA is made ;

It is complementary to DNA OR DNA code is copied ; 2

(ii) Tyr Leu Phe Ser ; ;
[one error = 1 mark, 2 errors = 0 mark] 2

[8]

143. (a) Correct measurement – 78 / 79 ;

Measurement × 1000 (to give μm) ;

÷ 50 ;

[if final answer is incorrect maximum marks = 2] 3

(b) **Drawing marks:**

D1 Chromosomes drawn correctly ;

D2 Centrioles drawn correctly ;

Label marks:

Chromosomes ;

Centrioles ;

Spindle fibres ; 5

(c) Anaphase ; [ignore reference to I or II] 1

(d) Spindle fibres: Pull {centromeres / chromatids / chromosomes} {apart / to opposite poles}
OR
{Pull / hold} chromosomes into position ;

Centrioles: {Produce / organise / assemble} spindle (fibres) / microtubules ;
OR
{ Organise / assemble} tubulin ; 2

[11]

144. (a) 1. Uptake of A increases throughout 6 hour period ;

2. Uptake of A is {proportional to time / linear} / rate of uptake of A is constant ;

3. Uptake of B increases then {plateaus / levels off} / rate of uptake of B decreases ;

4. {Uptake / rate of uptake} of A greater than of B ;

5. Credit manipulation of figures ; 3

(b) 1. Rate of uptake greater at start of experiment as diffusion gradient is high ;

2. Rate of uptake decreases as diffusion gradients lower ;

3. {Line / rate / uptake} plateaus out when concentration of substance B inside cell is same as concentration outside cell ;

4. Concentration inside cell doesn't decrease ; 3

(c) (increase in temperature) increases kinetic energy (of molecules) ;

Therefore molecules move faster ; 2

(d) 1. Movement (of molecules) against concentration gradient / eq ;

2. Requires {energy / ATP} ;

3. Occurs in one direction ;

4. Involves {carrier / transporter} proteins ;

5. Which span the membrane / eq ;

6. Molecule binds to {protein / carrier} ;

7. {Protein / carrier} changes shape ;

8. Reference to {sodium / proton} pump or other named example ; 5

[13]

145.

Carbohydrate	**One** role in living organisms
Glucose;	
	Form in which plants transport carbohydrate / energy source;
Glycogen;	
	In plant cell walls;

[4]

146. (a) Tissues are groups of (similar) cells performing similar functions;

Organs are a number of tissues that perform a function 2

(b) Magnification is the number of times bigger an image is than the {specimen / original};

Resolution is the {ability to distinguish two points as separate points / degree of detail visible} 2

[4]

147. (a) (i) Glycerol / propan 1, 2, 3 triol 1

(ii) Ester 1

(b) (Stearic acid / saturated fatty acids} have more hydrogen atoms;
{Stearic acid / saturated fatty acids} have no double carbon-carbon bonds;
{Stearic acid / saturated fatty acids} have no kinks;
[allow converse statements about unsaturated fatty acids] 2

(c) 1. Energy stores;
Qualification: {More than / twice as much as) carbohydrate
OR Insoluble / compact / minimise mass
OR Subcutaneous / adipose / blubber;

2. Protection / mechanical insulation;
Qualification: Around {organs / named organ}
OR Reference to adipose tissue
OR Ear wax giving protection against infection;

3. Waterproofing;
Qualification: Of skin / fur / feathers / insect cuticle / ear wax
OR Hydrophobic / insoluble / repels water;

4. Electrical insulation;
Qualification: Reference to myelin sheath / nerve cells / neurones / axons / dendrons
OR Non-polar;

5. Heat insulation;
   Qualification: Subcutaneous / adipose / blubber
   OR Prevents heat loss from body;

6. Buoyancy;
   Qualification: Less dense than {water / muscle};

7. Making beeswax;
   Qualification: Formation of honeycomb;

8. Membrane fluidity;
   Qualification: Reference to cholesterol;

9. Cell membrane structure;
   Qualification: Reference to phospholipids;

10. Reference to hormones;
    Qualification: As steroids;

11. Source of metabolic water;
    Qualification: Reference to respiration
    OR Desert adaptation 2 x 2 mark

[8]

148. (a) 1. Contains (r)RNA;

2. And protein;

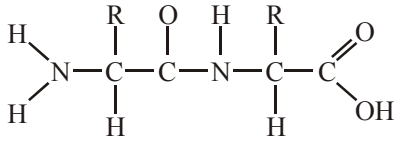
3. Has two (sub-)units;

4. Binding{site/groove} to accept RNA;

5. 20-30 nm in size; 2

(b) Glycine;
Lysine; 2

(c) (i)



Correct amino acid parts on either side;;
Carbon nitrogen back bone; 3

(ii) Condensation 1

[8]

149. (a) (i) BDAC; 1

(ii) Metaphase; [ignore I and II] 1

(b) (i) DNA replicates;
Cell division / cytokinesis; 2

(ii) Mitosis / G_2 and mitosis; 1

(iii) {l5/20} hours; 1

[6]

150. (a) A Nucleus/chromatin/nucleoplasm;
B Mitochondrion; 2

(b) Correctly measured length;
(Length) ÷ 5000;
Correct answer in μm; 3

(c) 1. (molecules/proteins) pass into the{cisternae/eq}of the RER;
2. Vesicles {break off (from cisternae) / form};
3. (molecules) carried to Golgi / (vesicles) fuse with Golgi;
4. (proteins) concentrated;
5. Modified / carbohydrate added / become glycoproteins;
6. Vesicles {break away (from Golgi) / move to cell membrane};
7. (vesicles) fuse (with cell membrane);
8. Reference to exocytosis; 5

[10]

151. (a) (i) Sucrose is a non-reducing sugar therefore gives negative result {with Benedict's reagent / in table 1};
It is hydrolysed into {monosaccharides / glucose and fructose / reducing sugars);
The orange precipitate in table 2 indicates a higher concentration of sucrose / eq; 2

(ii) 1. Maltose is {detected / eq} at a lower concentration;
2. Maltose is a disaccharide;
3. Therefore twice as much glucose after being hydrolysed;
4. Compared to a glucose solution of same (molarity / concentration} eq; 2

(b) 1. Add {biuret solution (at room temperature) / KOH and $CuSO_4$};
2. {Stated / equal) volumes of both protein solutions;
3. Control of one other variable (e.g. time, temperature, volume of biuret);
4. Purple / lilac / violet / eq;
5. Intensity comparison / {darker / eq} colour means more protein / reference to use of calorimeter; 4

[8]

152. (a) Catalyst: 1. (Chemical that) {speeds up / increases rate of} a reaction;
2. Without itself being changed / used over and over again / not used up;
Activation energy: 3. Energy needed for a chemical reaction to begin;
4. Enzymes reduce it; 4

(b) (i) Hydrolysis; 1

(ii) Glycosidic (β-1,4) 1

(iii) 1. Use water as basis to compare effect;

2. Copper sulphate decreases rate of cellulose breakdown;

3. {Increase in concentration / higher concentrations) decreases rate of breakdown even more;

4. After six days more cellulose broken down at lower concentrations;

5. Credit manipulations of data to compare breakdown of solutions at different concentrations 3

(iv) 1. Disulphide bonds maintain {(tertiary/3D)structure/shape};

2. If disulphide bonds break, the active site will be altered;

3. Cellulose will no longer fit into the active site / eq;

4. Cellulose will not be digested;

5. As copper ions increase more enzymes are affected;

6. Reference to non-active site directed inhibitor; 3

[12]

153.

Name of organelle	Two features of structure	One function
Golgi (apparatus / body);		
	Cisternae / {flattened / membranous / network} {sacs / tubules}; Ribosomes;	{Transport / storage} of proteins / synthesise proteins / translation;
	(Contains) {thylakoids / lamellae / grana}; (Contains) {stroma / chlorophyll / DNA / starch granules}; (surrounded by) two membranes / double membrane / envelope;	

[6]

154. (a) Hydrogen / H 1

(b) Charge is not equally distributed throughout molecule / one part is positive and the other part is negative};
Hydrogen (atoms) have (slight) positive charges;
Oxygen (atom) has a (slight) negative charge ; 2

(c) Idea that a lot of {energy / heat} is needed to change temperature ;
Temperature of their {environment / habitat} does not {fluctuate / change} much / reference to {thermostable / thermobuffer};
Reference to effect on metabolic {rate / reactions}; 2

[5]

155. (a) Ribose;
Lactose;
Sucrose; 3

(b) Unbranched chains;
Made up of β glucose (molecules);
(Linked by) glycosidic bonds;
1, 4 linkages;
Reference to hydrogen bonds cross-linking chains; 3

[6]

156. (a) Four layers shown with no cells drawn;
Palisade layer narrower than spongy layer;
Epidermal layers similar width to each other and both much narrower than mesophyll layers; 3

(b) (i) Palisade (mesophyll layer);
Mesophyll = 1 mark
Spongy (mesophyll layer);
Epidermis (upper or tower);
Xylem;
Vascular = 1 mark
Phloem; 2

(ii) It is made up of {several / more than one} tissue; 1

[6]

157. (a) Root tip / shoot tip;
Dividing cells / meristem; 2

(b) (i) To make the {chromosomes / chromatids / DNA} visible; 1

(ii) Acetic orcein / acetocarmine / Feulgens / Schiffs / any other correctly named stain; 1

(c) To {get a single layer of cells / spread out cells}; 1

[5]

158. (a) (i) Nucleus / nucleoplasm; [allow nucleolus] 1

(ii) Condensation / polymerisation 1

(b) (i) 6; 1

(ii) GCT TGG CGG GCT TAG TGG;;
[all correct = 2 marks, one error = 1 mark, more than one error = 0 marks] 2

(c) Reference to start codon;
Reference to stop codon;
Reference to post transcription modification; 2

(d) 1. Occurs {on / in} ribosome;

2. Two tRNA molecules (held in position in ribosome);

3. Each carrying a specific amino acid;

4. Anticodons on tRNA;

5. Reference to binding of tRNA to complementary bases on mRNA;

6. Peptide bonds form between amino acids;

7. Ribosome moves along mRNA;

8. Until a stop codon is reached 5

[12]

159. (a) Reference to {alginate beads / other named method of immobilisation};
Description of appropriate method (e.g. mixing urease with alginate, beads made by dropping into calcium chloride solution); 2

(b) (i) 100 ÷ 30;
3.3 a.u. per minute; 2

(ii) 1. Optimum pH is pH 7 for both immobilised and non-immobilised urease;

2. The activity of non-immobilised urease is greater than the immobilised at pH 7;

3. Immobilised urease is more active between pH 2 and 6 and between pH 8 and 12 / converse;

4. Immobilised urease is active over a wider range of pHs;

5. Correct manipulation of figures to compare the activity of immobilised urease to non-immobilised urease; 3

(iii) Active over wider range of pH:
Enzyme is more stable;
{Active site / enzyme} less likely to change shape / enzyme less likely to denature;

Lower maximum activity:
Some {active sites / enzymes} less accessible to substrate; 2

[9]

160. (a) 1. Making more DNA;

2. Strands separate ;

3. Idea that each strand acts as a template / eq;

4. Nucleotides line up against complementary base pairs;

5. (Each) new (daughter) molecule contains one old and one new strand;

6. Reference to molecules being identical to {each other / original parent molecule}; 4

(b) (i) DNA in B is lighter (than the DNA in A) converse;
Because A contains all heavy nitrogen;
B contains both heavy and light nitrogen; 2

(ii) 1. (Bacteria) in B have one heavy and one light strand of DNA (in each molecule);

2. All newly synthesised strands will contain light {DNA / nitrogen};

3. Some molecules will consist of only light DNA;

4. Some molecules will consist of one light strand and one heavy strand;

5. Each type of molecule is present in equal proportions; 3

(iii) Two bands shown in correct position;
Lower band is thinner than the one shown in D and upper band is thicker than one shown in D; 2

[11]

¶

161.

Name of biological molecule	Smaller molecules from which it is made	Name of bond joining the smaller molecules
	Fatty acids and glycerol;	Ester;
Cellulose / polysaccharide / disaccharide;		(1, 4) Glycosidic;
		Peptide;

[5]

162. Nuclear {membrane / envelope} / nucleolus;

Centrioles;

Metaphase;

Centromeres / kinetochore / chromosome;

Anaphase;

[5]

163. (a) (i) Hydrogen;
Ionic;
Disulphide; 2

(ii) It has two (polypeptide) chains / an A and a B chain / more than one (polypeptide) chain; 1

(b) (i) {Sequence / order} of amino acids; 1

(ii) 1. Reference to bonds between R groups;

2. The R groups are always in the same position;

3. [Bonds / named bonds} will always form in the same place;

4. Reference to {hydrophilic groups on outside / hydrophobic groups on inside}; 2

[6]

164. (a) (i) A Flagellum;

B DNA / bacterial chromosome; 2

(ii) Glycogen; 1

(iii) Made of {peptidoglycan / murein} / does not contain cellulose; 1

(b) Correct measurement: {80 / 81} mm;

Correct division**:** ÷ 6000**;**

Correct conversion to μm;

[Maximum 2 marks if answer is incorrect, correct answer: 13.3 / 13.5] 3

[7]

165. (a) (i) (Inner) membrane of mitochondrion {is folded / forms cristae};
(Inner) membrane of mitochondrion has {ATPase / stalked particles /

electron carriers};
Nuclear membrane has pores;
(Outer) nuclear membrane is continuous with the endoplasmic reticulum;
(Outer) nuclear membrane has ribosomes; 2

(ii) Chloroplast; 1

(b) 1. Cylindrical;

2. Occur in pairs;

3. Lie at 90° to each other;

4. Made of microtubules;

5. Arranged in {triplets / nine groups};

[Maximum 2 marks from marking points 1-5]

6. Reference to spindle formation / organisation;

7. Reference to {microtubule organising centre / assembling the tubulin}; 3

[6]

166. (a) (Fluid because) phospholipids move (around membrane);

(Mosaic because) membrane contains {proteins / glycoproteins} (amongst phospholipids);2

(b) To remove the red pigment released by the cells {cut open / damaged} during preparation;1

(c) 1. (Increasing bile salt concentration) results in increase of red coloration;

2. No further increase in red coloration {between 1.6% and 2.0% / after 1.6%};

3. Reference to linear relationship between red coloration and bile salt concentration up to 0.6%;

4. Reference to change in gradient after 0.6%;

5. Manipulation of figures to compare gradients before and after 0. 6 %; 3

(d) 1. Disruption of membrane by bile salts increases its permeability;

2. Bile salts may emulsify lipids (within membrane);

3. Proteins (in membrane) may be affected;

4. Pigment leaks through (plasma) membrane;

5. Pigment leaks through vacuole membrane;

6. By diffusion;

7. More bile salts, {more cells break down / more membrane disrupted};

8. Reference to plateau as all cells have lost pigment / all membranes disrupted;

9. Reference to plateau as there is no longer a diffusion gradient; 4

(e) Any ONE of the following regarding Beetroot 2:
was different age
was stored under warmer conditions
was stored in different conditions
had more cells damaged during preparation
had discs with skin still on them
had discs taken from a different region of the beetroot
was different species
contained different concentrations of pigment
was grown in different conditions 1

[11]

167. (a) Ring drawn around one phosphate, one sugar and one base (linked together); 1

(b) 1. Part of the DNA molecule unwinds;

2. DNA strands {separate / unzips / H-bonds break};

3. (Mono)nucleotides line up against their complementary bases;

4. Against {sense / one} strand;

5. Reference to RNA polymerase;

6. Individual mononucleotides join up by [condensation reactions / (phosphodi)ester bonds};

7. mRNA strands separate from DNA molecule;

8. mRNA migrates into cytoplasm / eq; 5

(c) (i) Ribosomes / rough endoplasmic reticulum; 1

(ii) Ring drawn around U C G; 1

[8]

168. (a) Clarifying {wines / vinegar / fruit juices} / improves colour extraction from fruit skins / peeling fruit skins; 1

(b) (i) Same concentration of enzyme;
Same pH**;**
Same time for incubation;
Same {type / age} apple;
Same temperature for filtering;
Standardisation of apple chopping; 2

(ii) The line goes up / rate increases;
Because of increase in {kinetic energy / collisions};
Reference to optimum at 40 °C 2

(iii) {Rate of production / line} decreases;

Because bonds break;

Therefore the active site changes shape / reference to denaturing of enzyme;

Substrate will not fit / enzyme-substrate complex will not form;

Enzyme is denatured at 60 °C;

Reference to optimum at 40 °C; [only allow once, either here or in (b)(ii)] 3

(c) (i) Mixture D Line drawn between A and B;

Line levels out at the same maximum as curves A, B and C; 2

(ii) 1. The results show that the rate of reaction depends on the relative concentrations of inhibitor and substrate / {B / C} have similar shape curve to A;

2. Faster initial rate at lower concentration of inhibitor;

3. {B / C} give the same yield {as A / when no inhibitor present};

4. This shows the inhibitor must be competitive;

5. Will be binding to active site;

6. Doesn't stop the reaction completely; 2

[12]

169. (a)

Disaccharide	Monosaccharide		
	Galactose	Glucose	Fructose
Sucrose		✓	✓
Maltose		✓	
Lactose	✓	✓	

[One mark for each correct row] 3

(b) Glycosidic; 1

[4]

170. Nitrogen / N;

Peptide;

{Alpha / α} helix;

Hydrogen / H;

R groups / side groups / side chains;

[5]

171. (a) A Nucleus / nucleoplasm / chromatin / nuclear {envelope / membrane};

B Chloroplast / stroma;

C DNA / chromosome / nucleoid; 3

(b) Cell wall of leaf cell is made of cellulose / bacterial cell wall is not made of cellulose / bacterial cell wall is {peptidoglycan / mucopolysaccharide} /plant cell wall is not made of peptidoglycan / mucopolysaccharide; 1

(c) To enable cell to move (through medium);

Rotates / eq;

Any valid reason for movement; 2

[6]

172. (a) (i) A Glycoprotein;

B Phospholipid; [do not allow bilayer] 2

(ii) Cell {recognition / attachment} / {receptor / eq} / antigen; 1

(iii) 1. {Fatty acids / tails} are {hydrophobic / non-polar};

2. Idea that fatty acids are in the middle of the bilayer;

3. {Phosphate / heads} are {hydrophilic / polar};

4. Idea that phosphate groups are on the outside of the bilayer;

5. Reference to {cytoplasm / tissue fluid} being {polar / eq} in nature; 3

(b) 1. The membrane is fluid;

2. (Because) {phospholipids /B} are able to move (within membrane);

3. (Therefore) proteins can move (within membrane / phospholipid bilayer);

4. Idea that there is a new arrangement of proteins; 2

[8]

173. (a) 1. Reference to named stain (acetic orcein / acetocarmine / Feulgens / Schiffs);

2. {Warm / heat} (with the stain / acid);

3. Break open tip (with needle / eq);

4. {Mount / eq} in {stain / acid / water / glycerol};

5. (Gently) squash under coverslip / eq;

6. Warm (gently to intensify stain); 4

(b) 1. Telophase is the longest stage;

2. Anaphase is the shortest stage;

3. Correct manipulation of figures to compare any two phases;

4. Any two actual times given e.g. {prophase 29.16 mins / metaphase 16.80 mins / anaphase 8.40 mins / telophase 33.36 mins}; 3

(c) (Use the equation to) work out actual time of each phase;

Total all four times;

OR

Add up all 4 percentages;

{Substitute into equation / eq} / Multiply by $\frac{1200}{100}$; 2

[9]

174. (a) Magnification How many times bigger the image is than the real size of the specimen / eq;

Resolution The ability to distinguish two points as separate points / the {degree / amount} of detail visible; 2

(b) $\frac{\text{Number of stage microscope units}}{\text{Number of eye piece units}}$;

× 100 (to give correct answer); 2

(c) (i) 300 / 320 (μm); 1

(ii) Two cells drawn with indication of unequal thickening of cell wall;
In correct proportions;
No cell contents shown; 3

[8]

175. (a) (i) (By adding a) buffer (solution);
Using the same area of {cloth / 1 cm^2} / even spraying of cloth; 2

(ii) Starch and iodine on 1 cm^2 square of cloth and 5 cm^3 of buffer;
Add 5 cm^3 of water (instead of enzyme); 2

(b) 1. Change in H+ concentration;
2. (Changes in pH) alter {charges / ionisation} of R groups;
3. Reference to bonds broken / eq;
4. Resulting in change in active site;
5. Reference to {substrate binding / eq} being affected;
6. Reference to (complete) {denaturation / eq} of enzyme at extreme pHs / eq; 3

(c) 1. (It) is a {polymer / polysaccharide / eq};
2. Of α glucose (molecules);
3. (Joined by α) glycosidic links;
4. (It) consists of amylose and amylopectin;
5. Amylose {is unbranched / forms helical shape};
6. Amylopectin is branched (molecule);
7. Amylose has only 1,4 (glycosidic) bonds;
8. Amylopectin contains 1,4 and 1,6 bonds;
9. Starch molecules {can be built up into starch grains / have a compact shape}; 5

[12]

176. (a) Stack of at least three cisternae;
Cisternae curved / showing {budding / fusing} vesicles / eq;
{Cisternae / sacs / vesicles} labelled; 3

(b) (i) Level of radioactivity falls;
Protein moving out (of the RER); 2

(b) (ii) 1. (In first 20 minutes) there were no secretory vesicles / only non-radioactive material in vesicles;

2. (Because) radioactive proteins have not yet reached the vesicles;

3. (Because) {proteins / radioactivity / eq} has yet to pass into Golgi apparatus;

4. From RER (into Golgi);

5. (After 20 minutes) reference to formation of vesicles (from Golgi) now containing (radioactive) protein; 3

[8]