1(a). Asparaginase is an enzyme used in the treatment of some cancers.

Asparaginase breaks down asparagine, an amino acid needed by tumour cells to make proteins.

Explain how the structure of asparaginase enables it to break down asparagine.

[3]

(b). Suggest why enzymes such as asparaginase must be modified before being injected into the bloodstream.

[1]

2. **Table 2.1** shows some components which can be found in phloem sap.

Component	Concentration (mg cm^{-3})
Sucrose	80–160
Protein	1.45–2.20
Amino acids	5.20
Phosphate ions	0.35–0.55
Potassium ions	2.30–4.40

A student tested a sample of phloem sap by placing the sample in a test tube and carrying out a Benedict's test. The result of the Benedict's test was negative.

(i) Describe the appearance of the test tube when a negative result is obtained in a Benedict's test.

---

[1]

(ii) The student observed that, following the Benedict's test, the tube appeared cloudy. Using your knowledge of the Benedict's test and the information in **Table 2.1**, suggest why the tube content appeared cloudy after the test.

---

[2]

3. Cell theory is one of the unifying concepts in biology. All cells are bounded by a plasma membrane. Animal cells also have intracellular membranes that form organelles. The chemical composition of these membranes is very similar to that of the plasma membrane.

Fig.3.1 is an electron micrograph of a section through a liver cell showing some membrane-bound organelles.

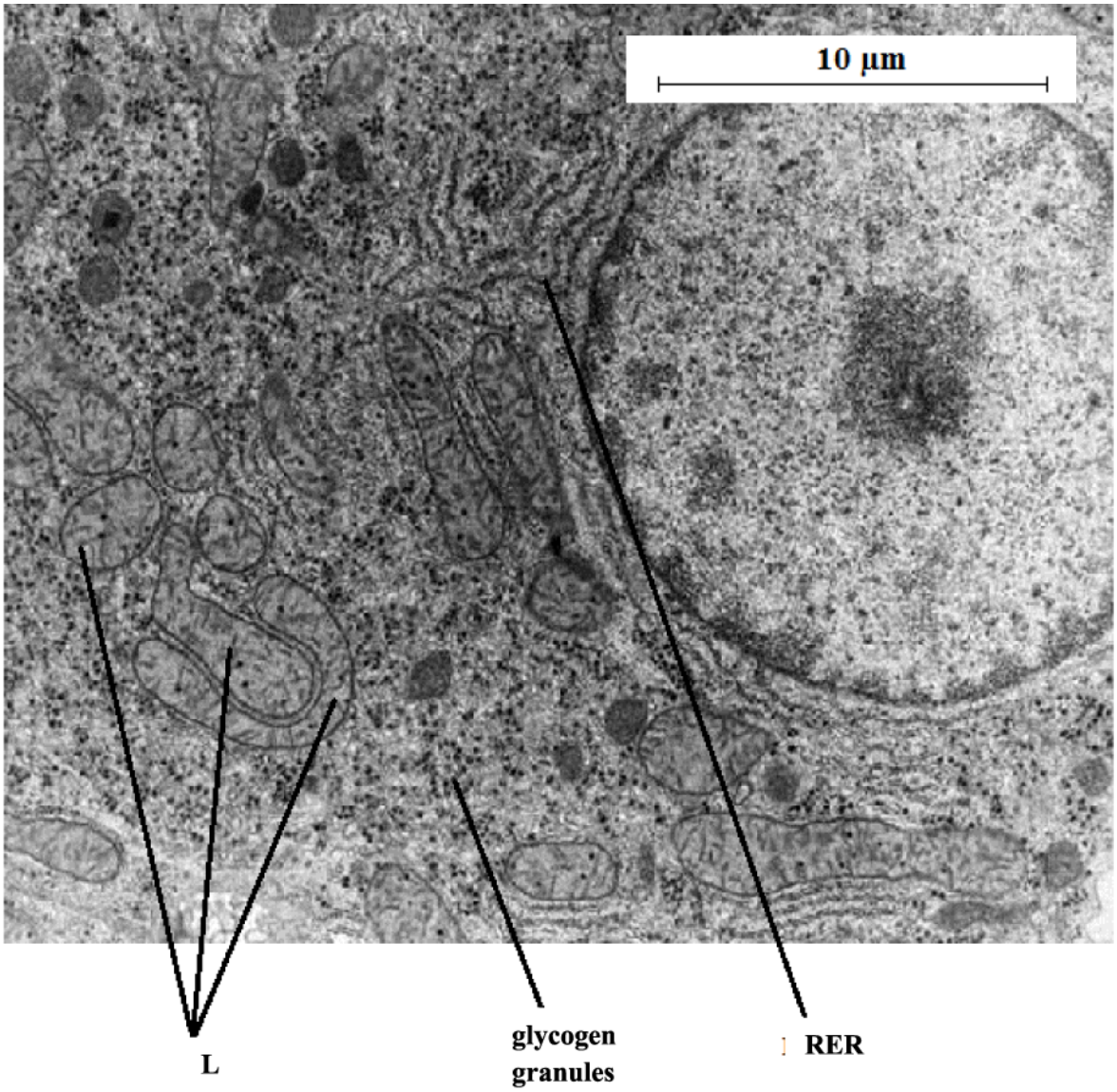


Fig. 3.1

(i) Cell theory states that metabolic reactions occur inside cells.

State one metabolic reaction that occurs in organelles such as **L**.

---

[1]

(ii) Using the information in Fig. 3.1, calculate the magnification of the electron micrograph in Fig. 3.1.

Show the steps in your calculation.

Answer _____ [2]

(iii) Rough endoplasmic reticulum (RER) consists of a series of membranes within the cytoplasm of the cell, to which ribosomes are bound.

Suggest the molecular composition and structure of the membranes to which the ribosomes are bound.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____ [3]

(iv) * Ribosomes are chemically different from the membranes to which they are bound. Each ribosome is made of two sub-units. Each sub-unit consists of protein molecules associated with another polymer.

Compare the structure of the other polymer with that of a protein molecule.

_____

_____

_____

_____

_____

_____

[6]

4. Haemoglobin is a molecule that is found in most vertebrate species.

A student outlined the structure of haemoglobin using the description below.

A molecule of haemoglobin consists of two alpha and two beta chains. Each polypeptide chain has a coenzyme called haem associated with it. The four polypeptide chains form a 3D tertiary structure consisting of 574 amino acids.

State **two** errors the student has made in their description above and suggest how the student should correct his statement.

Error 1:

Correction 1:

Error 2:

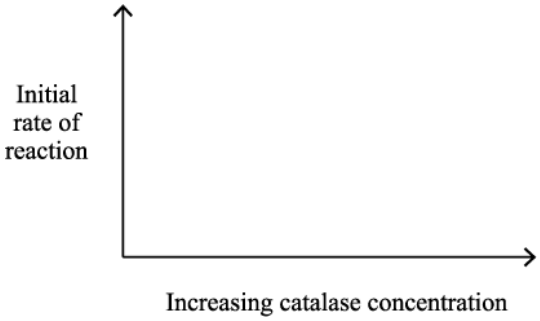
Correction 2:

[2]

5(a). Catalase is an enzyme that is often used in school laboratories. Catalase acts on hydrogen peroxide.

On the axes below, sketch the curve you would expect if a reaction was carried out in optimum conditions with catalase and hydrogen peroxide.

Excess substrate is available.



[1]

(b). A student wanted to investigate the effect of substrate concentration on the rate of hydrogen peroxide breakdown.

There are many different sources of catalase, including ground liver and blended celery stalk. Both of these tissues could be used but each has advantages and disadvantages.

Evaluate the suitability of each of the tissues and justify which tissue is best for the student to use.

---

[3]

(c). The student set up the investigation using a source of catalase as shown in Fig. 1.1.

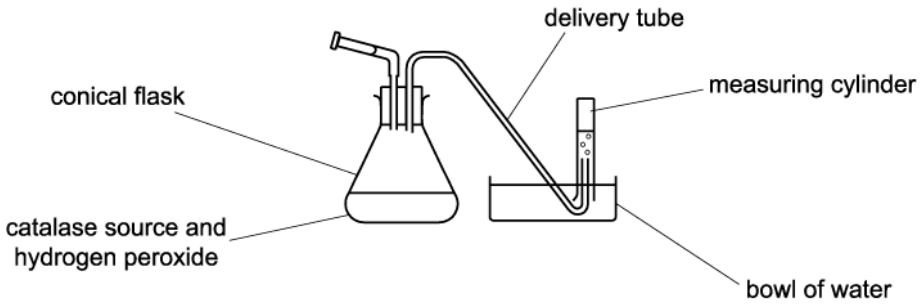


Fig. 1.1

The oxygen gas produced is collected in a 100 cm^3 measuring cylinder. The gas produced was measured at two minute intervals.

The student collected data for two different concentrations of hydrogen peroxide (H_2O_2):

- 2 arbitrary units H_2O_2
- 4 arbitrary units H_2O_2.

At the start of each test, 5.0 cm^3 of air was already present in the measuring cylinder.

Fig. 1.2 shows the results seen by the student.

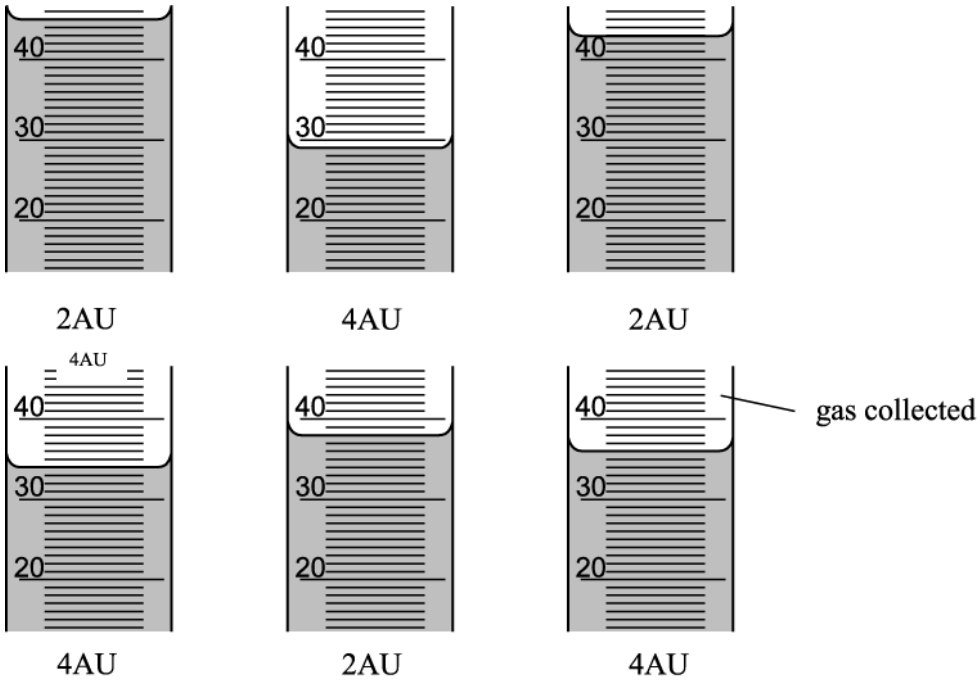


Fig. 1.2

Construct an appropriate table and enter:

- the **raw** data to the most appropriate level of precision for this apparatus
- the **mean values**.

[3]

6(a). A group of students were investigating the protein content of a sports drink used by athletes.

Describe a method the students could use to confirm the presence of protein in the sports drink.

---

[2]

(b). The students added a protease enzyme to the sports drink to produce a solution containing amino acids.

Name the **type** of reaction catalysed by the protease enzyme.

---

[1]

(c). The students then separated the amino acids in the solution using chromatography.

Fig. 2 shows the chromatogram obtained by the students.

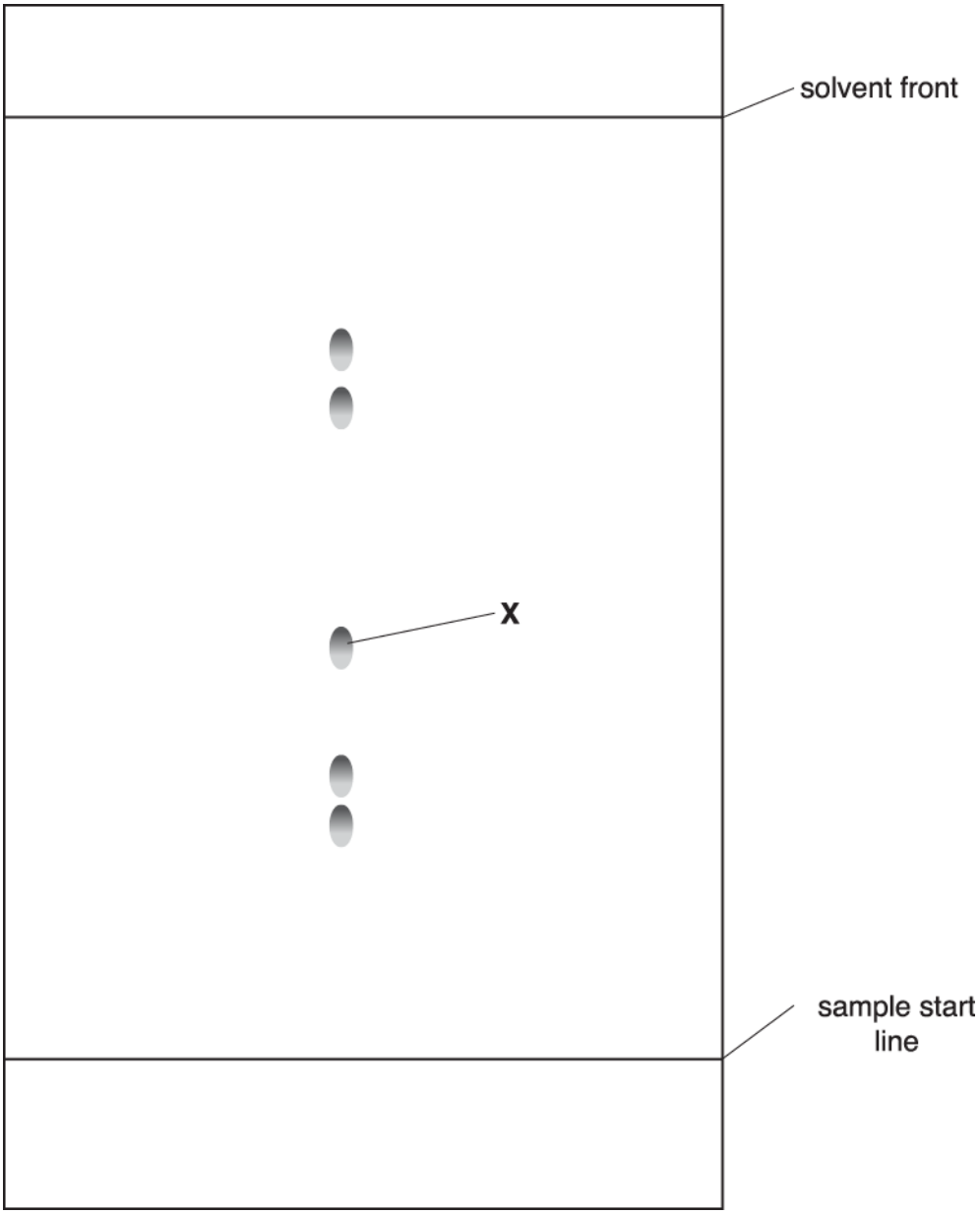


Fig. 2

Table 2 shows Rf values for six amino acids.

Amino acid	Rf value
asparagine	0.24
aspartic acid	0.29
isoleucine	0.73
phenylalanine	0.68

tryptophan	0.66
tyrosine	0.44

Table 2

(i) Using Fig. 2, which of the amino acids named in Table 2 could be **X**?

Show working to support your answer.

X =_____ **[3]**

(ii) The students were concerned that they may not be able to distinguish between the amino acids phenylalanine and tryptophan on their chromatogram.

Using the information in Table 2, suggest **one** way the procedure could be modified to determine whether both phenylalanine and tryptophan were present.

Give a reason(s) for your suggestion.

_____

_____

_____

_____ **[2]**

7(a). Blood clotting involves a series of enzyme-controlled reactions.

Complete the table below for two of the enzyme-controlled reactions involved in blood clotting.

Enzyme	Substrate	Product
	prothrombin	
thrombin		

[2]

(b). Enzymes control the rate of metabolic reactions, such as blood clotting, by affecting the activation energy of reactions.

The activation energy is the minimum energy needed for a reaction to start.

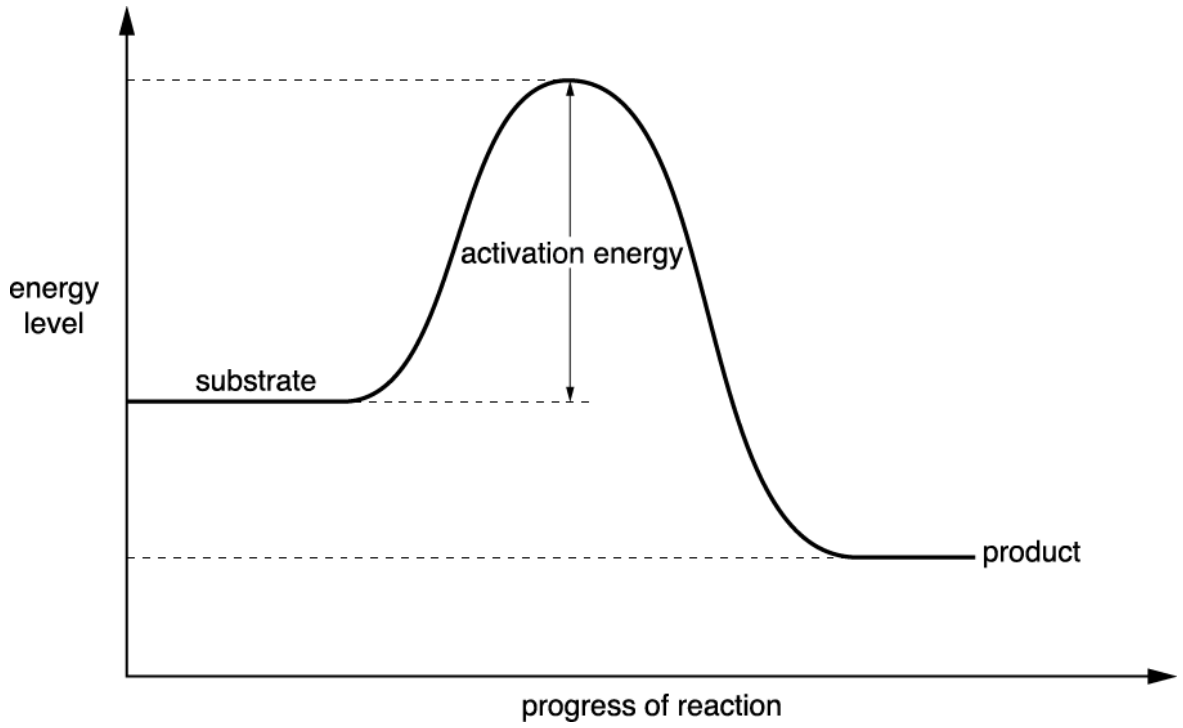


Fig. 3.1

Fig. 3.1 shows changes in energy level of a reaction taking place **without** an enzyme catalyst.

Describe **and** explain how the appearance of Fig. 3.1 would change if this reaction were catalysed by an enzyme.

In your answer, you should use appropriate technical terms, spelled correctly.

[5]

(c). Blood clots may develop following a heart attack. Drugs called anticoagulants are used to prevent blood clots from forming.

Warfarin is an anticoagulant drug. It prevents blood clots from forming by interfering with the action of vitamin K, a cofactor involved in blood-clotting reactions.

(i) What is the role of a cofactor in an enzyme-controlled reaction?

---[1]

(ii) Suggest **one** way in which warfarin could interfere with the action of vitamin K in blood-clotting reactions.

---[1]

(d). Proteases are a class of enzyme that break down proteins.

Name the products resulting from the **complete** break down of aprotein molecule.

---[1]

(e). As humans have evolved, enzymes have also evolved, resulting in greater control over metabolic pathways. For example, some protease enzymes have evolved from a single enzyme called a *promiscuous ancestral* enzyme.

Fig. 3.2 is a diagram that shows how **two** enzymes may have evolved from **one** promiscuous ancestral enzyme.

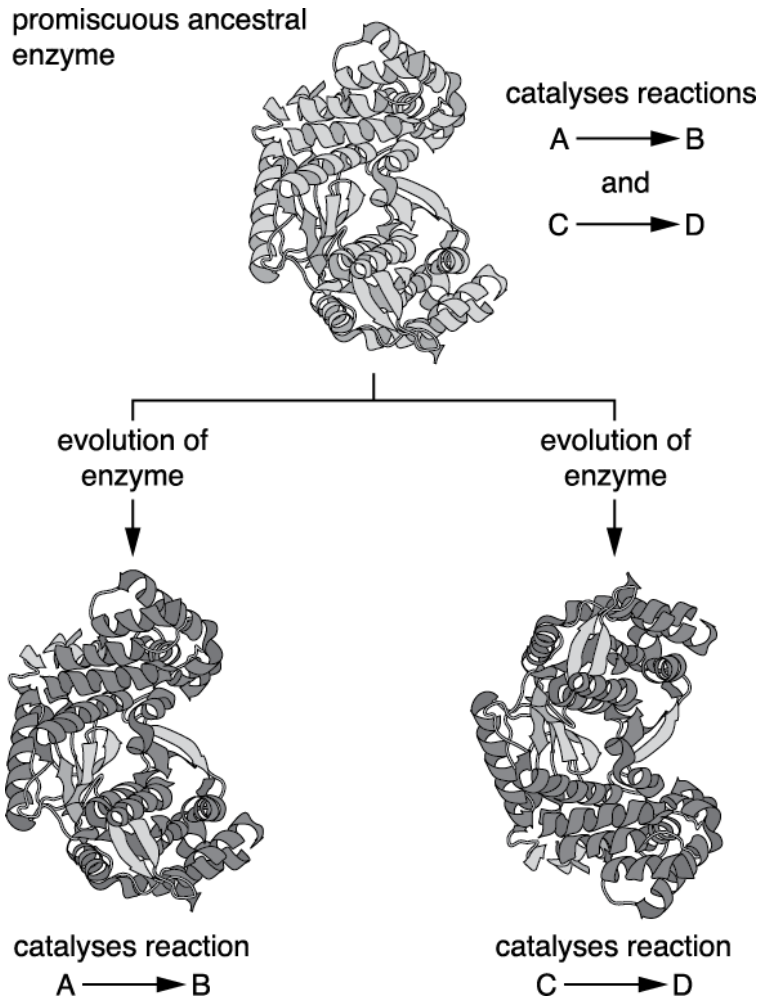


Fig. 3.2

Using Fig. 3.2 and your knowledge of enzyme action, suggest why enzyme activity has changed as the enzymes have evolved.

[2]

8. Organs that contain muscle cells, such as the heart, need large quantities of oxygen for aerobic respiration.

- Haemoglobin and myoglobin are protein molecules that are involved in supplying oxygen to cells.
- Haemoglobin is found in erythrocytes (red blood cells), enabling them to transport oxygen to respiring heart muscle.
- Myoglobin is found in heart muscle cells as an oxygen store.

(i) Explain why the heart is described as an organ.

---

[1]

(ii) Outline how the structure of haemoglobin enables it to transport oxygen.

---

[3]

(iii) Myoglobin is described as having a tertiary structure.

What is meant by *tertiary structure*?

---

[2]

9. Blood products including platelets can be obtained from donated whole blood and stored for future use.

Describe the different types of stored blood products.

Do **not** include whole blood or platelets in your answer.

In your answer, you should use appropriate technical terms, spelled correctly.

[4]

10. During the formation of glycogen in the liver, large numbers of glucose molecules are joined together to form polysaccharide chains.

(i) Describe the reaction in which glucose molecules are joined together to form the polysaccharide chains.

---

[3]

(ii) The formation of glycogen in liver cells is catalysed by glycogen synthase.

Suggest how the structure of glycogen synthase enables it to function as an enzyme in the formation of glycogen.

---

[3]

11. People with diabetes can use biosensors to monitor their blood glucose concentration.

(i) Explain why it is important for diabetics to monitor their blood glucose concentration.

---[2]

(ii) Complete the following passage by inserting the **most appropriate word** into each gap to explain how a biosensor works.

A person's blood is placed on a test strip on the biosensor. The test strip contains a molecule called glucose . This molecule is an that converts glucose in the blood into .

An electrode detects the small electric current generated by this chemical reaction. The current is converted by a into a digital reading of the person's blood glucose concentration.

[4]

12. **GABA** (gamma-aminobutyric acid) is one of the most common neurotransmitters in the human central nervous system.

GABA is synthesised from the amino acid glutamate.

Fig. 3.1 is a diagram of GABA.

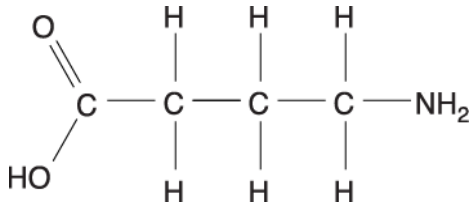


Fig. 3.1

GABA could also be described as an amino acid.

On Fig. 3.1, circle and name the **two** chemical groups on the GABA molecule which indicate that it is also an amino acid.

_____ *the answer must be drawn on Fig. 3.1* _____

[1]

13. This question is based on the Advance Notice article **CATALASE**.

Electrophoresis can be used to separate proteins. This technique has been used to investigate the different catalase isoenzymes present in some plant tissues.

Fig. 1.3 shows the appearance of a gel following the electrophoresis of a catalase isoenzyme purified from plant tissue.

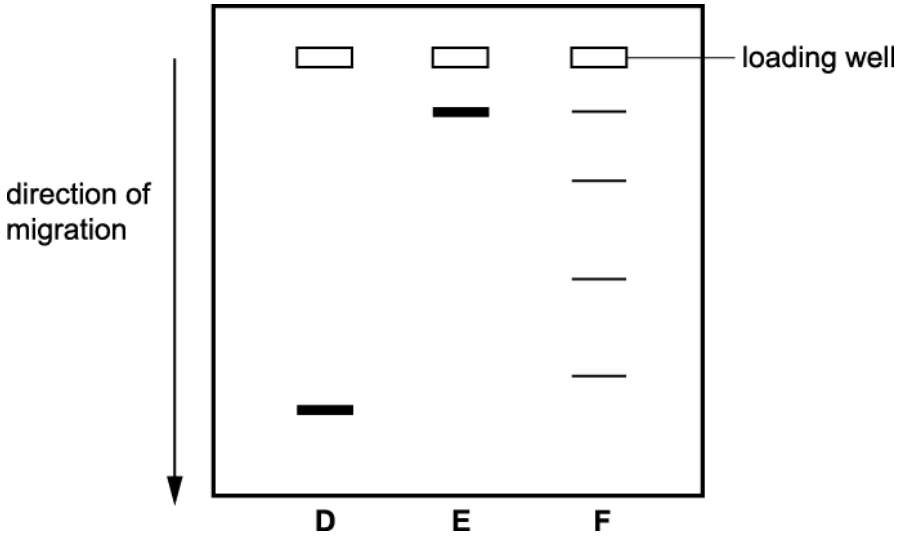


Fig. 1.3

- The distance moved by protein molecules depends on both the charge on the molecule and its size.
- The proteins are first treated with a detergent.
- The detergent covers the protein molecule, which denatures the protein and gives it a negative charge.
- The denatured proteins are loaded onto a gel and placed in an electric field and the molecules migrate.
- The gel is stained and molecules appear as separate bands.

Using this information, suggest which of the three tracks, **D**, **E** or **F**, represents the result obtained following the detergent treatment and electrophoresis of this catalase isoenzyme.

Explain your choice.

track _____

explanation _____

---

[3]

14.

Loss of blood can lead to anaemia if left untreated. In cases of severe anaemia, patients may need a blood transfusion.

Before a blood transfusion is given, the patient's blood group must be tested.

The patient's blood is mixed with anti-A antibodies and anti-B antibodies. The result of the test is visible by eye.

An example result is shown in Fig. 37.2.

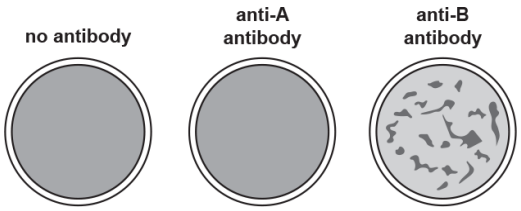


Fig. 37.2

(i) State which type of stored blood product would be required for a blood transfusion to treat severe anaemia.

_____ [1]

(ii) Identify the blood group of the patient tested in Fig. 37.2 and state which donor blood group(s) can be safely transfused to this patient.

blood group of patient _____

blood group(s) for transfusion _____

[2]

15.

Studies have shown that HIV might increase the probability of clots forming inside blood vessels.

A student wrote the following notes about the process of blood clotting.

Complete the gaps in the student's notes using the most appropriate word or term.

Most clotting factors are …… that convert an inactive clotting factor into an active clotting factor. For example, …… converts prothrombin to thrombin, which then hydrolyses …… to form the protein fibrin. Because fibrin is a …… protein the molecules become entangled with red blood cells and form a clot.

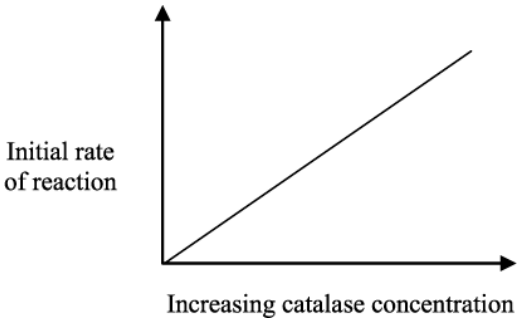
[4]

END OF QUESTION PAPER

Question			Answer/Indicative content	Marks	Guidance
1	a		**Any 3 from:** tertiary structure gives specific shape of active site (1) asparagine has complementary shape to active site (1) enzyme-substrate complex can be formed (1) lowers activation energy (1)	3	
	b		**Any 1 from:** acts as antigen (1) destroyed by cell's immune system (1)	1	
			Total	**4**	
2		i	(solution remains) blue	1	
		ii	**Any 2 from:** precipitate is produced (1) copper oxide is insoluble (1) high temperatures / boiling, required in the Benedict's test (1) boiling / high temperatures, denature the protein in the phloem sap (1)	2	
			Total	**3**	
3		i	aerobic respiration **OR** synthesis of ATP	1	**ALLOW** Krebs cycle, link reaction, oxidative phosphorylation, protein synthesis, (mitochondrial) DNA replication
		ii	× 5150 (1) (1)	2	**Correct answer = 2 marks** **ALLOW** × 5100 to × 5200 **If answer is incorrect look for:** 51 to 52 mm OR 5.1 to 5.2 cm (from scale bar) converted to μm Answer divided by 10

Question			Answer/Indicative content	Marks	Guidance
		iii	(membranes have) phospholipids **and** proteins **and** cholesterol (1) (phospholipids) arranged as a bilayer (1) (proteins) free to move / AW, within bilayer (1) ref to intrinsic and extrinsic proteins (1) ref to cholesterol (molecules), spanning bilayer (1)	3	IGNORE ref to glycoprotein or glycolipids
		iv	Read through the whole answer from start to finish, concentrating on features that make it a stronger or weaker answer using the indicative scientific content as guidance. The indicative scientific content indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance. Using a 'best-fit' approach based on the science content of the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, **best** describes the overall quality of the answer using the guidelines described in the level descriptors in the mark scheme. Once the level is located, award the higher or lower mark. **The higher mark** should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met. **The lower mark** should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing. **In summary:** • **The science content determines the level.** • **The communication statement determines the mark within a level.**	6	

Question			Answer/Indicative content	Marks	Guidance
			Level 3 (5–6 marks) A comparison of proteins and RNA which is chemically detailed and includes reference to the bonds in the molecules. *There is a well developed description of monomers polymers and bonds for both molecules which is clear and structured to give a comparison. The information presented is relevant.* **Level 2 (3–4 marks)** A comparison of proteins and RNA with some chemical detail. *There is a description of monomers polymers and bonds for both molecules which is clear and logically structured. The information presented is relevant.* **Level 1 (1–2 marks)** An outline of the structure of RNA or protein with limited comparative statements. *There is a general description of both monomers and polymers which may be unstructured. Some irrelevant or incorrect information may be presented.* **0 marks** No response or no response worthy of credit.		**Indicative scientific points may include:** FOR RNA • nucleotide as the monomer • nucleotide structure as a pentose sugar, a phosphate and a (nitrogenous) base • RNA nucleotide sugar is ribose • 4 RNA bases • RNA bases are adenine, uracil, cytosine and guanine. • adenine and guanine are purines • cytosine and uracil are pyrimidines • condensation reactions (between nucleotides) • formation of phosphodiester bonds FOR PROTEIN • amino acid as monomer • 20 different amino acids • joined by condensation reactions • formation of peptide bonds • carboxyl groups and amine groups • secondary structure / alpha helix / beta pleated sheet • hydrogen bonding • tertiary structure with bonds between R groups • ionic bonding • disulphide bonding • hydrophobic and hydrophilic interactions.
			Total	12	
4			error = coenzyme, correction = prosthetic group error = tertiary, correction = quaternary	2	**ALLOW** ‘cofactor’ for ‘prosthetic group’ **ALLOW** ‘3°’ for ‘tertiary’ and ‘4°’ for ‘quaternary’
			Total	2	

Question			Answer/Indicative content	Marks	Guidance
5	a			1	
	b		*Award 1 mark for an advantage of either tissue and 1 mark for a disadvantage of either tissue to a maximum of 2 marks.* *Advantages of using liver* *idea of* more enzyme per gram OR easier to grind / blend (1) *Advantages of using celery* cheaper OR slower activity may give more accurate results (1) *Disadvantages of using liver* religious objections depending on animal source OR messy to prepare / AW (1) *Disadvantages of using celery* may be out of season OR different parts of the plant have different activity levels (1)	3	In the absence of a justified decision regarding tissue choice award a maximum of 2 marks **DO NOT** award double marks for statements simply reversed for the other tissue

Question			Answer/Indicative content	Marks	Guidance
	c		Student gives reasoned argument / justification for final choice (1) concentration of, hydrogen peroxide / H_2O_2, (AU) in first column **AND** volume of water displaced (cm^3) to the right of the IV, with each concentration of hydrogen peroxide recorded in separate row **AND** all cells surrounded by straight ruled lines (1) all data for 2AU recorded correctly **AND** all data for 4AU recorded correctly (1) both mean values calculated correctly **AND** recorded to, the same / one more decimal place, than raw data (1)	3	*Table should resemble:* Concentration of hydrogen peroxide (AU) | Volume of water displaced (cm^3) 1 | 2 | 3 | Mean 2 4 **OR** Concentration of hydrogen peroxide (AU) | Initial level of meniscus (cm^3) | End level of meniscus (cm^3) | Volume of water displaced (cm^3) | Mean volume of water displaced (cm^3) 2 4 Figures to be checked on a printed paper at standardisation.
			Total	7	

Question			Answer/Indicative content	Marks	Guidance
6	a		add, biuret solution ✓ observe a colour change (from blue) to lilac ✓	2	ACCEPT add, NaOH **and** copper sulphate solution ACCEPT purple, mauve for end colour
	b		hydrolysis ✓	1	
	c				Examiner's Comments Many candidates incorrectly wrote about repeating the test or doing them on separate papers as a reference for (ii). Quite a few candidates suggested using a different solvent but found it hard to justify this and get the second mark.
		i	distance travelled by amino acid = 52 – 58mm **and** distance travelled by solvent front = 125 – 127mm ✓ 0.42 – 0.46 calculated ✓	2	Examiner's Comments Many candidates scored highly in (i) and correctly got all three mark points. The candidates that didn't had tended to guess from the rf values and spots that the answer was tyrosine and did not get the mark point for the calculation.
		ii	tyrosine ✓	1	
		iii	use longer chromatography paper ✓ *idea of* longer paper gives better resolution ✓	2	CREDIT alternative methods suitably justified e.g. two–way chromatography / different solvent
			Total	8	

Question			Answer/Indicative content	Marks	Guidance
7	a		<table><tr><th>enzyme</th><th>substrate</th><th>product</th><th></th></tr><tr><td>thromboplastin</td><td></td><td>thrombin</td><td>;</td></tr><tr><td></td><td>fibrinogen</td><td>fibrin</td><td>;</td></tr></table>	2	1 mark for each row **BOTH** answers in each row required for 1 mark **DO NOT CREDIT** fibrogen **Examiner's Comments** This was probably the most straightforward question on the paper with the majority of candidates achieving full marks.
	b		*description* 1 activation energy (peak) is lowered; 2 substrate and product energy levels stay the same; *explanation* 3 enzymes have **specific**, 3D shape / **tertiary** structure; 4 substrate fits into **active site** to form **enzyme-substrate complex** (ESC); 5 force exerted on (bonds in) substrate so lowers activation energy; QWC;	4 max 1	**CREDIT** mp 1 from diagram / Fig.3.1 **IGNORE** references to rate or time as X axis label is progress of reaction **Two** of the following terms, used in the appropriate context with correct spelling: **specific tertiary active site enzyme-substrate complex** **Examiner's Comments** Only the better candidates went on to use their knowledge of enzymes and the formation of enzyme substrate complexes to explain the pattern shown on the graph. Weaker candidates concentrated on the graph alone and gave a descriptive answer about lowering activation energy.
	c	i	*idea that* it is necessary for. enzyme substrate complexes to form / substrate to bind to active site;	1	**CREDIT** (cofactor) must be present for enzyme to catalyse reaction **DO NOT CREDIT** 'to facilitate the reaction between the enzyme and substrate'

Question			Answer/Indicative content	Marks	Guidance
		ii	*idea that* it may prevent vitamin K from binding to enzyme OR bind to vitamin K; reduce the, concentration / AW of vitamin K;	1 max	Examiner's Comments (i) There was real confusion about the role of enzyme co-factors in answers to this question, with some candidates describing them as if they were enzymes. Many students gave an example of a co-factor - mostly calcium ions - ignoring the context of the question and not going on to describe the role of co-factors other than in very general terms such as 'needed for blood clotting'. Similarly in (ii) many candidates described warfarin as if it were an enzyme inhibitor and vitamin K was the enzyme.
	d		amino acid(s);	1	IGNORE peptide or dipeptide ACCEPT C, H, O, N, S (as question is asking for complete breakdown. Examiner's Comments Some candidates failed to take note of the question stem and answered in terms of the elements present in proteins or the groups present in amino acids.

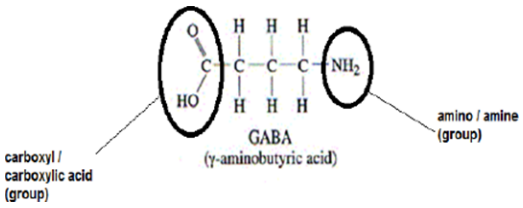
Question			Answer/Indicative content	Marks	Guidance
	e		*for evolved enzymes* *idea that* (because) active site has changed; (so) *idea that* active site is only complementary to / specific for, one substrate / A or C; *idea that* splitting the reaction into two allows for greater control; AVP;	2 max	CREDIT changes in protein structure changes active site CREDIT reverse argument for ancestral enzyme e.g. role of cofactors with evolved enzymes Examiner's Comments In this part, it was pleasing to see how many candidates realised that the change in the enzyme would lead to a change in the specificity of the active site although relatively few went on to use the information in the diagram and refer to the substrates. Very few candidates answered in terms of controlling metabolism and weaker candidates described the change in terms of increasing the concentration of the enzyme as now there would be twice as much.
			Total	12	

Question			Answer/Indicative content	Marks	Guidance
8		i	made of different types of tissue;	1	CREDIT named tissues Examiner's Comments (i) was well answered but the remainder of this question proved to be more challenging, as have biochemical questions in previous sessions.
		ii	has four polypeptide chains AND (4) haem / iron-containing (prosthetic) groups; each haem group can carry, one oxygen molecule / O_2 OR each haemoglobin molecule can carry four oxygen molecules; *idea of* reversible binding / AW OR cooperative binding / AW;	3	ACCEPT Fe^{2+} for 'iron' LOOK FOR descriptions of reversible binding e.g. 'binds ....released' OR descriptions of cooperative binding. Examiner's Comments In part (ii), only a small number of candidates achieved full marks with very few references to either cooperative binding or to reversible binding of oxygen molecules. Weaker candidates referred to oxygen atoms or simply to oxygen. Some good descriptions of tertiary structure were seen although some candidates just listed the bonds involved without saying what these actually did to the protein molecule.
		iii	*idea of* further, folding / twisting , of secondary structure / polypeptide; into (specific) 3D shape; held by, **named** bond(s) / bonds between R groups;	2 max	e.g. ionic, disulfide, hydrophobic / hydrophilic interactions IGNORE hydrogen unless it is bonding between R groups as hydrogen bonds appears in different levels of structure.
			Total	6	

Question			Answer/Indicative content	Marks	Guidance
9			1 **leuco-depleted** blood **AND** (most) **leucocyte**(s) have been removed from the blood / AW; 2 packed, red cells / erythrocyte(s) **AND** red blood cells separated from rest of the blood / AW; 3 **clotting factors AND** processed from plasma / AW; 4 (fresh frozen) **plasma AND** all cells have been removed / AW; 5 AVP; QWC;	3 max 1	**CREDIT** for **one** mark any named blood product **AND** the description e.g. serum **AND** clotting factors removed **Two** of the following terms, used in the appropriate context with correct spelling: **leuco-depleted** **leucocyte** **clotting factors** **plasma** **Examiner's Comments** First Aid procedure for blood loss and blood products provided the theme for this question which offered candidates a variety of question styles including 'tick box completion' and 'quality of written communication' to address both **AO1** and **AO2**. For this part, candidates either performed very well and were able to gain maximum marks, or they failed to read the question stem correctly and gave examples of use for the blood products rather than described them; thereby only gaining the 'quality of written communication' (QWC) marking point.
			Total	**4**	

Question			Answer/Indicative content	Marks	Guidance
10		i	condensation reaction / removal of water molecule; glycosidic links formed; (α)1-4 links;	3	CREDIT correctly annotated diagram Examiner's Comments This question included more biochemical aspects by linking polysaccharide formation with enzyme structure within the context of liver function. The AO2 'suggest' style questions were, as in previous sessions, a good discriminator across the ability range with this part needing application of knowledge about the effects of glycogen and glucose within cells. For **(i)**, most candidates could correctly identify the type of reaction with some going onto name the glycosidic bond for two marks. Stronger candidates extended their responses further by offering the correct type of glycosidic bond thereby gaining maximum marks.
		ii	(enzymes are) globular proteins; (enzymes have) tertiary structure / specific 3D shape; (enzymes have) active site which has <u>complementary</u> shape to substrate;	3	ACCEPT active site is complementary to glycogen or glucose or UDP-glucose Examiner's Comments This question included more biochemical aspects by linking polysaccharide formation with enzyme structure within the context of liver function. The AO2 'suggest' style questions were, as in previous sessions, a good discriminator across the ability range with this part needing application of knowledge about the effects of glycogen and glucose within cells. The question then moved onto enzyme structure for **(ii)** and whilst there were some good responses for marking points two and three, very few candidates gained maximum marks. Some candidates failed to notice that the question referred to the enzyme, glycogen synthase and modelled their responses around the structure of glycogen.
			Total	6	

Question			Answer/Indicative content	Marks	Guidance
11		i	*idea that* you can, check / see / know, if glucose concentrations are too, high / low; (if untreated) high blood glucose may cause named condition; (if untreated) low blood glucose may cause, faint / coma / death; so the person can adjust their insulin dose / carbohydrate intake (if necessary);	2	ACCEPT to check levels are within limits DO NOT CREDIT 'to ensure' ACCEPT to detect hypoglycemia / hyperglycemia e.g. blindness / foot amputation / nerve damage / kidney failure / high blood pressure / heart disease / strokes / chronic infections / shortening of life Examiner's Comments This question also mainly addressed AO3 but had some elements of AO1 and AO2 Candidates failed to appreciate the difference between checking to see if blood glucose was too high or too low (which was what was required), and ensuring it didn't get too high or too low(which is what they were saying, implying a control mechanism) . Some candidates were not specific about the direction of blood glucose concentration (too high / too low) and the correct consequence. A good analogy would be that a thermometer tells you what the temperature is so you know if it is changing, but the water bath keeps it constant. There were too many 'water bath' answers, and not enough 'thermometer' answers.
		ii	oxidase / dehydrogenase; enzyme; gluconolactone; transducer;	4	Examiner's Comments This question also mainly addressed AO3 but had some elements of AO1 and AO2 Most candidates gained a mark for 'enzyme, and several for 'oxidase' or 'dehydrogenase'. Gluconolactone was often incorrectly spelled. Very few candidates identified the transducer.
			Total	6	

Question			Answer/Indicative content	Marks	Guidance
12			complete carboxyl group circled and labelled AND complete amine group circled and labelled; OR Both groups circled AND carboxyl, amino on dotted lines in that order;	1	 **Examiner's Comments** A few candidates circled the relevant parts of the molecule but failed to add names. Other candidates inserted the names in the dotted lines. This was credited if the correct parts were circled and if the order corresponded to the order on the diagram. Some candidates circled incorrect areas on the diagrams. Others circled correctly but used incorrect names. Some responses seen included naming the NH_2 group as 'nitrogen', 'nitrate' or 'nitrogenous base'. Other candidates referred to it as the 'R' group.
			Total	1	
13			(track) D ✓ *explanation - up to 2 marks* detergent destroys (secondary, tertiary and) quarternary structure ✓ (4) subunits smaller so migrate lower down gel ✓ all subunits are, same / a similar size / 492 amino acids ✓	max 3	If incorrect track identified then award up to two marks
			Total	3	

Question			Answer/Indicative content	Marks	Guidance
14		i	packed, red (blood) cells / erythrocytes ✓	1	ALLOW red (blood) cell / erythrocyte, concentrate **Examiner's Comments** **(c)(i)** was a straightforward recall question but many candidates did not refer to **concentrated** or **packed** red blood cells.
		ii	B ✓ B **AND** O ✓	2	 ALLOW ECF **Examiner's Comments** Blood group O was often identified as a donor in **(c)(ii)** but identifying the blood group of the patient was more demanding.
			Total	3	
15			enzymes ✓ thromboplastin ✓ fibrinogen ✓ fibrous ✓	4	 ALLOW 'insoluble' **OR** 'filamentous' for 'fibrous' Examiner's Comments This was well answered with 'fibrinogen' and 'fibrous' the most common, correct answers.
			Total	4	