



RIVER VALLEY HIGH SCHOOL

YEAR 6

PRELIMINARY EXAMINATION II

CANDIDATE
NAME

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CENTRE
NUMBER

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CLASS

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INDEX
NUMBER

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H1 BIOLOGY

8875/02

Paper 2 Core Paper

11 Sep 2017

2 hours

Additional Materials: Answer Paper

READ THESE INSTRUCTIONS FIRST

Write your Centre number, index number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Section A

Answer **all** questions.

Section B

Answer **one** question.

Circle the question attempted on the cover page.

The use of an approved scientific calculator is expected, where appropriate. You may lose marks if you do not show your working or if you do not use appropriate units.

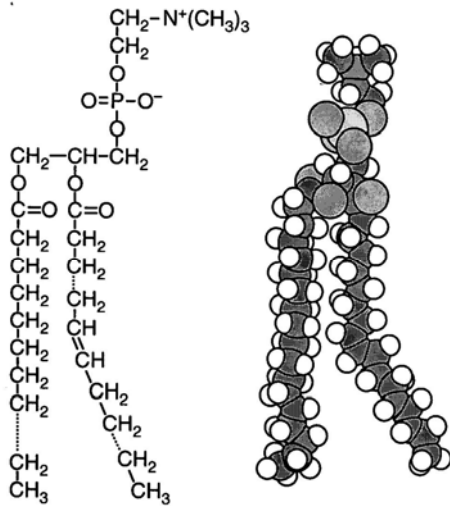
At the end of the examination, fasten all your work securely together. The number of marks is given in brackets [] at the end of each question or part question.

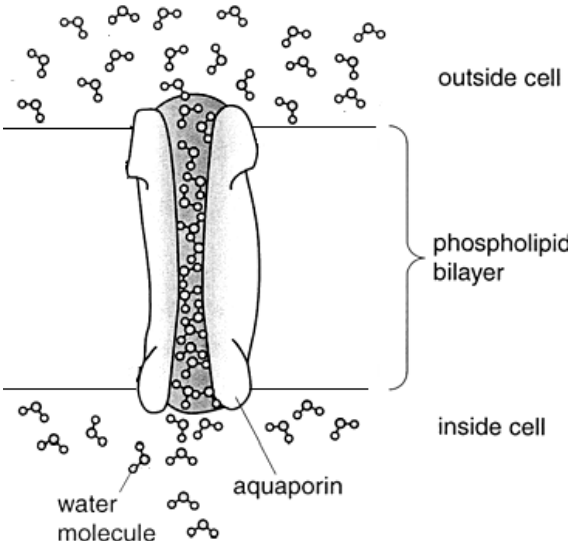
For Examiner's Use	
Section A	
1	/ 12
2	/ 8
3	/ 9
4	/ 11
Section B	
5 or 6*	/ 20
Total	/ 60

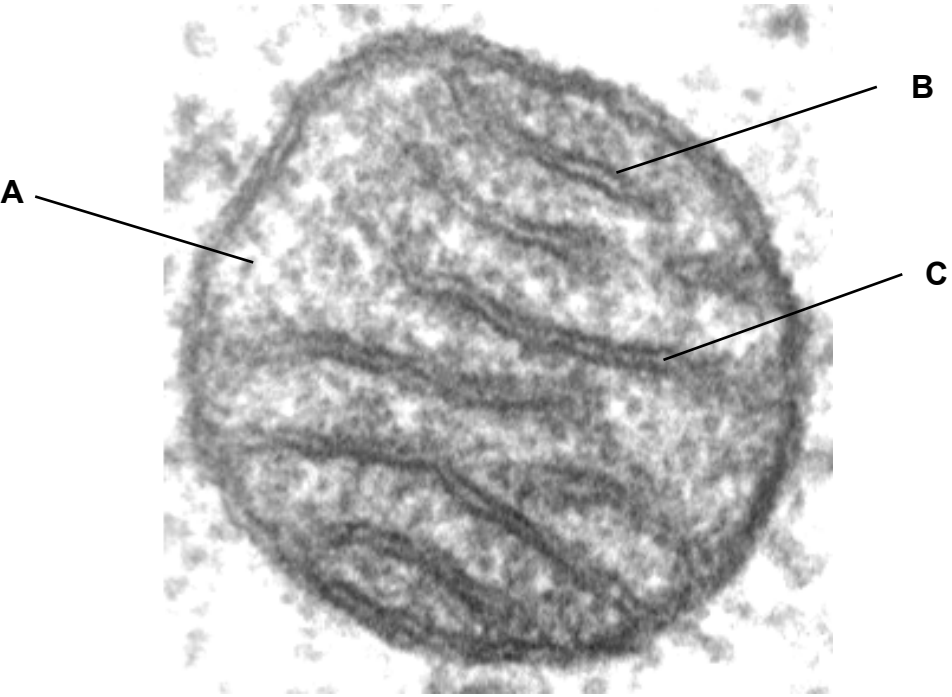
This Question Paper consists of **12** printed pages.

SECTION A

Answer **all** questions.




























1	<p>Fig. 1.1 represents the molecular structure of a type of phospholipid.</p> <div style="text-align: center;">  <p>Fig. 1.1</p> </div>		
(a)	(i)	Describe the arrangement of phospholipids in cell membranes.	[2]
		<ol style="list-style-type: none"> 1. Phospholipids arranged into a <u>bilayer</u>;; 2. The (hydrophilic) phosphate heads of the phospholipids <u>face outwards</u> on both sides of the membrane; 3. The (non-polar, hydrophobic) hydrocarbon tails <u>face inwards</u>; 	
(ii)		Explain how the structure of phospholipids is related to this arrangement in cell membranes.	[2]
		<ol style="list-style-type: none"> 1. Phospholipid is <u>amphipathic</u>; 2. The hydrophilic phosphate group of the phospholipid molecule; interact with the aqueous environment on both sides of membrane;; 3. The non-polar/hydrophobic hydrocarbon chains/tail of the phospholipid molecule shielded from the aqueous medium;; 	

<p>Fig 1.1 shows a channel protein, aquaporin, which is necessary for the bulk flow of water molecules.</p> <div></div> <p style="text-align: center;">Fig 1.1</p>		
(b)	With reference to Fig. 1.1, describe how water molecules move across a membrane.	[2]
	<div><div>1. As the cell has a more negative water potential compared to the surrounding water; <i>Reject: concentration of water</i></div><div>2. water molecules from the surrounding move into the cell;</div><div>3. through aquaporin channels;</div><div>4. down water potential gradient;</div></div>	
<p>Diabetes insipidus is a condition characterised by large amounts of diluted urine. Fluid is not reabsorbed by the cells in the kidney due to changes in permeability of their surface membrane. Reduction of fluid intake by patients has little effect on the concentration of urine.</p> <p>Diabetes insipidus is a result of mutation in the gene coding for aquaporin channels.</p> <p>A clinician studied the surface membrane of kidney cells involved in reabsorption of fluid in individuals with diabetes insipidus and found that aquaporin channels are absent.</p>		
(c)	Suggest how mutant aquaporin channels leads to diluted urine in individuals with diabetes insipidus.	[2]
	<div><div>1. Mutation leads to change in three-dimensional conformation of aquaporin protein;;</div><div>2. Aquaporin not embedded in cell membrane;</div><div>3. Water not reabsorbed into kidney cells;</div></div>	
<div>[Total: 8]</div>		

2	<p>Fig. 2.1 is an electron micrograph of a mitochondrion.</p>  <p style="text-align: center;">Fig. 2.1</p>				
	(a)	(i)	Identify structures A and B .		[2]
			A	(mitochondrial) Matrix;;	
			B	Cristae / inner membrane;;	
		(ii)	Describe how structure A is adapted to its function.		[1]
			Matrix contains enzymes of Krebs cycle;;		
	(b)	(i)	State the role of high concentration of protons at C .		[1]
			proton gradient as a <u>source of potential energy for the synthesis of ATP</u> ;;		
		(ii)	Explain how the high concentration of protons is generated at C .		[3]
			<ol style="list-style-type: none"> 1. electrons from NADH / FADH₂; 2. passes along a chain of electron carriers (releasing energy in a series of small steps); 3. <u>free</u> energy released; 4. is used to pump protons; 5. from matrix into intermembrane space; 		

			6. inner mitochondrial membrane is impermeable to ions;																					
		In an investigation to determine the effect of chemical M on respiration, mitochondria were incubated in four ways: <div><div>1. with glucose</div><div>2. with pyruvate</div><div>3. with glucose and chemical M</div><div>4. with pyruvate and chemical M</div></div> After incubation, the results are summarised in Table 1.1. <div><div>Table 1.1</div><table><tr><td></td><td>CO₂ evolution</td><td>O₂ consumption</td><td>ATP production by oxidative phosphorylation</td></tr><tr><td>Glucose</td><td>x</td><td>x</td><td>x</td></tr><tr><td>Pyruvate</td><td>✓</td><td>✓</td><td>✓</td></tr><tr><td>Glucose + chemical M</td><td>x</td><td>x</td><td>x</td></tr><tr><td>Pyruvate + chemical M</td><td>✓</td><td>✓</td><td>x</td></tr></table></div>				CO ₂ evolution	O ₂ consumption	ATP production by oxidative phosphorylation	Glucose	x	x	x	Pyruvate	✓	✓	✓	Glucose + chemical M	x	x	x	Pyruvate + chemical M	✓	✓	x
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Pyruvate	✓	✓	✓																					
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Pyruvate + chemical M	✓	✓	x																					
	(c)	(i)	Explain why carbon dioxide is produced when mitochondria are incubated with pyruvate but not when incubated with glucose.	[3]																				
			<div><div>1. no glycolytic enzymes in mitochondria;</div><div>2. glycolysis does not occur in the mitochondria / glycolysis can only occur in the cytosol;</div><div>3. glucose cannot be oxidised to form pyruvate;</div><div>4. pyruvate can enter mitochondria but glucose cannot;</div><div>5. CO₂ produced by decarboxylation in link reaction;</div><div>6. and Krebs cycle;</div></div>																					
		(ii)	Suggest why when mitochondria are incubated with chemical M , oxygen consumption occurs but not ATP production.	[2]																				
			<div><div>1. Chemical M only block ATP synthase so no phosphorylation of ADP/no flow of H⁺ down concentration gradient (through ATP synthase);;</div><div>2. Chemical M does not affect ETC to transfer electrons to oxygen;;</div></div>																					
			[Total: 12]																					

3	In lizard, a recessive mutant allele leads to black body colour as opposed to the normal brown body colour. A second recessive mutant allele at a separate locus leads to grey spots as opposed to normal white spots on the body. A test cross was conducted for these loci. This test cross took F1 females from a standard dihybrid cross and crossed them with a male pure breeding for black body with grey spots. The following offspring were produced: <table><tr><td>Brown body with white spots</td><td>160</td></tr><tr><td>Brown body with grey spots</td><td>155</td></tr><tr><td>Black body with white spots</td><td>156</td></tr><tr><td>Black body with grey spots</td><td>162</td></tr></table>			Brown body with white spots	160	Brown body with grey spots	155	Black body with white spots	156	Black body with grey spots	162				
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Black body with grey spots	162														
	(a)	Define the term <i>locus</i> .	[1]												
		Locus refers to the <u>position of a gene/allele on a chromosome or within a DNA molecule</u> ;;													
	(b)	Draw a genetic diagram to explain the observed results of this test cross.	[4]												
		<p>F1 Parental phenotype Brown body white spots x Black body grey spots F1 Parental genotypes BbWw x bbww ;;</p> <p>Gametes (BW) (bW) x (bw) ;</p> <p> (Bw) (bw)</p> <table><tr><td></td><td>(BW)</td><td>(Bw)</td><td>(bW)</td><td>(bw)</td><td></td></tr><tr><td>(bw)</td><td>BbWw Brown body white spots</td><td>Bbww Brown body grey spots</td><td>bbWw black body white spots</td><td>bbww brown body grey spots</td><td>Correct genotype;; Correct corresponding phenotypes;;</td></tr></table> <p>F2 phenotypic ratio 1 Brown body white spots: 1 Brown body grey spots: black body white spots: 1 brown body grey spots ;</p>		(BW)	(Bw)	(bW)	(bw)		(bw)	BbWw Brown body white spots	Bbww Brown body grey spots	bbWw black body white spots	bbww brown body grey spots	Correct genotype;; Correct corresponding phenotypes;;	
	(BW)	(Bw)	(bW)	(bw)											
(bw)	BbWw Brown body white spots	Bbww Brown body grey spots	bbWw black body white spots	bbww brown body grey spots	Correct genotype;; Correct corresponding phenotypes;;										

(b)	<p>A mutation occurs to the gene locus determining body colour and a new body colour red appeared in the population of lizards.</p> <p>Table 3.1 shows the change in the frequency of the three different phenotypes.</p> <table><tr><td></td><td>Initial Population</td><td>Generation 10</td><td>Generation 20</td><td>Generation 30</td></tr><tr><td>Brown colour</td><td> 80%</td><td> 80%</td><td> 70%</td><td> 40%</td></tr><tr><td>Red colour</td><td> 10%</td><td>0%</td><td>0%</td><td>0%</td></tr><tr><td>Black colour</td><td> 10%</td><td> 20%</td><td> 30%</td><td> 60%</td></tr></table>		Initial Population	Generation 10	Generation 20	Generation 30	Brown colour	 80%	 80%	 70%	 40%	Red colour	 10%	0%	0%	0%	Black colour	 10%	 20%	 30%	 60%	
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	Using Table 3.1 and your knowledge of natural selection, explains the results.	[4]																				
	<ol style="list-style-type: none">1. Mutations leads to variations;2. appearance of red phenotype;3. Red phenotype and brown phenotypes are selected against;4. Red phenotype disappeared after 10 generations;5. Brown phenotype decreased in frequency;6. Black phenotype is favoured;7. Survive and reproduce;8. Pass on the allele to the offspring;9. Population size of black phenotype greater than brown phenotype after 30 generations;10. Quote values: 60% black phenotype vs 40% brown phenotypes;																					
		[Total: 9]																				

4 Genetically modified maize was widely grown in the maize-growing areas of the USA. One of the genetically modified varieties of maize contains a gene (*Bt*) from a bacterium, *Bacillus thuringiensis*. The gene codes for a toxin, which is expressed in the leaves and acts as an insecticide.

In USA, milkweed frequently grows around the edge of maize fields and is fed upon by caterpillars of the Monarch butterfly. In an investigation on the environmental effects of *Bt* maize, leaves of milkweed were divided into three groups, **A**, **B** and **C**, and treated as shown in **Table 4.1**.

Table 4.1

Treatment group	Treatment
A	dusted with pollen from genetically modified maize carrying the <i>Bt</i> gene;
B	dusted with pollen from maize that had not been genetically modified;
C	not dusted with pollen.

Monarch caterpillars were then placed on the leaves and the survival of the caterpillars was measured over four days. The results of the experiment are shown in Fig. 4.1.

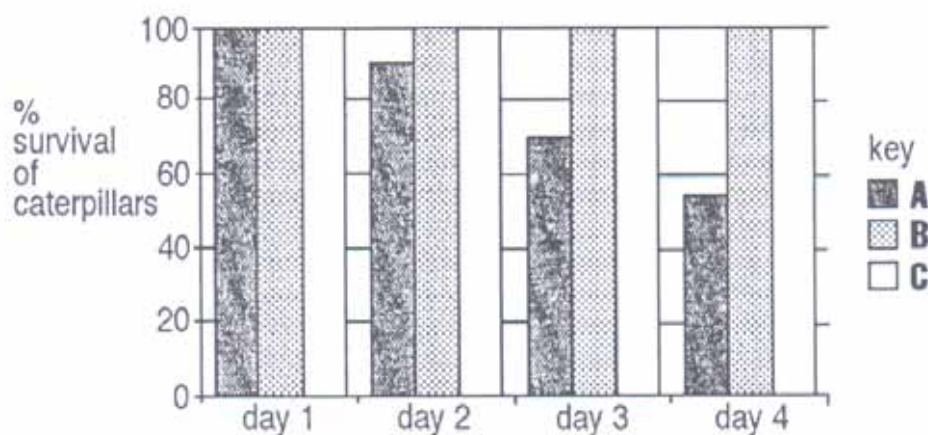


Fig. 4.1

(a)	Explain why farmers in the USA grow maize carrying the <i>Bt</i> gene.	[2]
	<ol style="list-style-type: none"> maize carrying <i>Bt</i> gene produces a toxin in its leaves which kills insects that attack them;; reduce use of insecticides which are harmful to humans / environment; higher yield of crop; 	

	(b)	With reference to Fig. 4.1, comment on the effect of eating pollen from different maize plants on the survival of Monarch butterfly caterpillars.	[2]
		<ol style="list-style-type: none"> 1. caterpillars that consumed pollens from non-genetically modified and leaves without pollen were unaffected; 2. 100% survival of caterpillars throughout the 4 days; 3. caterpillars that consumed pollens from <i>Bt</i> maize decreased with time; 4. % survival of caterpillars decreased from 100% to 55%; 	
		Plasmids are small circles of DNA, found in many bacteria, which can be used for genetic engineering of crop plants such as <i>Bt</i> corn.	
	(c)	State and explain which one feature of plasmids means that they may be used for intermediate steps in gene cloning involving any species of organism.	[2]
		<ol style="list-style-type: none"> 1. Plasmids have <u>multiple</u> restriction sites; 2. that can be recognized and <u>cleaved</u> by <u>different</u> restriction enzymes; 3. a wide range of DNA fragment isolated from any species by restriction digestion; 4. can be inserted into the plasmid if cut with the same restriction enzyme; 	
		<p>Fig. 4.2 shows a length of DNA from <i>Bt</i> maize. The DNA is cut with restriction enzyme, <i>Hae</i>III.</p> <div style="text-align: center;"> <p><i>Bt</i> gene</p> <p>1kb TTCGGGGCCG 2kb GGCCGGAATTCGGCATAACAATTCAGTGGCCG 0.5kb 1kb AAGCCGGCCC 2kb CCGGCCTTAAGCCGTATGTTAAGTGACCGGC 0.5kb</p> </div> <p>Fig. 4.2</p> <p>Target site of <i>Hae</i>III</p> <p>GGCC CCGG</p>	

	(d)	Explain what is meant by a restriction enzyme.	[2]
		A restriction enzyme: <ol style="list-style-type: none"> 1. recognises and binds a specific palindromic DNA base sequence / restriction site;; 2. cuts double-stranded DNA molecules by breaking internal phosphoester bonds;; 	
	(e)	With reference to Fig. 4.2, state how many fragments of DNA are produced after digestion with <i>Hae</i> III.	[1]
		4;;	
<p>Some companies claimed they have successfully introduced the <i>Bt</i> gene into the maize that they sell to the farmers. DNA from the maize plants were analysed using restriction enzymes <i>Hae</i>III and electrophoresis as shown in Fig. 4.3.</p> <div data-bbox="250 922 1069 1552" data-label="Figure"> <p>Figure 4.3 shows a gel electrophoresis result with five lanes labeled 1 to 5. Lane 1 is a DNA marker with bands at 3kb, 2kb, 1kb, 0.8kb, 0.6kb, and 0.4kb. Lane 2 (Bt maize) shows bands at 2kb, 1kb, and 0.4kb. Lane 3 (maize from company X) shows bands at 1kb and 0.4kb. Lane 4 (maize from company Y) shows bands at 2kb, 1kb, and 0.4kb. Lane 5 (maize from company Z) shows bands at 2kb, 1kb, and 0.4kb.</p> </div> <p>Fig. 4.3</p> <p>1: Marker 2: <i>Bt</i> maize 3: maize from company X 4: maize from company Y 5: maize from company Z</p>			
	(f)	Identify and explain which company is likely to have sold non-genetically modified maize.	[2]
		<ol style="list-style-type: none"> 1. Company X;; 2. 2kb band is missing which means the <i>Bt</i> gene is not incorporated into the DNA of the maize;; 	
			[Total: 11]

SECTION B

Answer EITHER 5 or 6.

Write your answers on the separate answer paper provided.

Your answers should be illustrated by large, clearly labelled diagrams, where appropriate.

Your answers must be in continuous prose, where appropriate.

Your answers must be set out in sections **(a)**, **(b)** etc., as indicated in the question.

5	(a)	Using a named example, describe how a gene mutation can lead to a disease phenotype.	[7]
		<ol style="list-style-type: none"> 1. Sickle cell anemia;; 2. Base pair substitution; 3. thymine replaced by adenine; 4. of β globin gene; 5. This changes <u>codon 6</u> on mRNA; 6. GAA to GUA; 7. resulting in missense mutation; 8. that changes glutamic acid to valine; 9. from a negatively charged/hydrophilic amino acid; 10. to a neutral/hydrophobic amino acid; 11. This changes the folding / three dimensional conformation of haemoglobin / β globin; 12. generating a sticky patch; 13. on the <u>surface</u> of haemoglobin; 14. The <u>deoxygenated form</u> of mutant haemoglobin; 15. is insoluble in <u>red blood cells</u>; 16. forming crystalline arrays; 17. This causes red blood cells to form a sickle shape; 18. Sickle-shaped red blood cells are rigid; 	
	(b)	Explain how temperature affects the rate of an enzyme-catalysed reaction.	[7]
		<ol style="list-style-type: none"> 1. at low temperature, enzyme is inactive; 2. the rate of reaction increases with temperature until the optimum temperature is reached; 3. the rate of reaction is doubled for every increase of 10°C; 4. increasing temperature increases the kinetic energy of the enzyme and substrate molecules; 	

		<p>5. increase in the frequency of effective collisions between the enzyme and substrate molecules;</p> <p>6. more enzyme/substrate complexes are formed per unit time, rate of reaction increases;</p> <p>7. optimum temperature is the temperature at which the enzyme is functioning at its maximum rate;</p> <p>8. above optimum temperature, the rate of reaction decreases rapidly</p> <p>9. the enzyme are denatured;</p> <p>10. atoms which make up the enzyme molecule vibrate vigorously;</p> <p>11. bonds (hydrogen and hydrophobic interactions) holding the enzyme molecule in its precise shape begin to break;</p> <p>12. change in active site conformation;</p> <p>13. substrate unable to fit into the active site of the enzyme;</p> <p>14. less successful enzyme-substrate complexes formed per unit time;</p> <p>15. graph;</p>																																					
	(c)	Describe the main ways in which an enzyme differs from DNA.	[6]																																				
		<table> <tr> <th></th><th>Features</th><th>Enzyme</th><th>DNA</th></tr> <tr> <td>1</td><td>Monomer</td><td>Amino acid</td><td>Deoxyribonucleotide</td></tr> <tr> <td>2</td><td>Choice of monomers</td><td>Twenty types, dependent on R-groups</td><td>Four types, dependent on nitrogenous bases</td></tr> <tr> <td>3</td><td>Links between monomers</td><td>Peptide linkage</td><td>Phosphoester linkage</td></tr> <tr> <td>4</td><td>Secondary structure</td><td>Single polypeptide chain</td><td>Double polynucleotide chains</td></tr> <tr> <td>5</td><td>Higher order structures</td><td>Folding of single polypeptide chain Conjugation of various polypeptide chains</td><td>Coiling of double helix around histones</td></tr> <tr> <td>6</td><td>Bonds responsible</td><td>Hydrogen, disulphide, ionic bonds, hydrophobic interactions</td><td>Hydrogen bonds between complementary bases</td></tr> <tr> <td>7</td><td>Location of synthesis</td><td>Cytoplasm</td><td>Nucleus, chloroplast, mitochondria</td></tr> <tr> <td>8</td><td>Function</td><td>Catalysis of reaction</td><td>Transmission of genetic information</td></tr> </table>		Features	Enzyme	DNA	1	Monomer	Amino acid	Deoxyribonucleotide	2	Choice of monomers	Twenty types, dependent on R-groups	Four types, dependent on nitrogenous bases	3	Links between monomers	Peptide linkage	Phosphoester linkage	4	Secondary structure	Single polypeptide chain	Double polynucleotide chains	5	Higher order structures	Folding of single polypeptide chain Conjugation of various polypeptide chains	Coiling of double helix around histones	6	Bonds responsible	Hydrogen, disulphide, ionic bonds, hydrophobic interactions	Hydrogen bonds between complementary bases	7	Location of synthesis	Cytoplasm	Nucleus, chloroplast, mitochondria	8	Function	Catalysis of reaction	Transmission of genetic information	
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		[Total: 20]
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6	(a)	Describe how mitosis maintains genetic stability and its importance in growth, repair and asexual reproduction.	[7]
		<ol style="list-style-type: none"> 1. Mitosis forms 2 daughter nuclei ; 2. Which are <u>genetically identical</u> to the parent cell; 3. With the <u>same number of chromosomes</u> as the parent cell; 4. S phase of interphase ; 5. amount of DNA is doubled; 6. <u>Semi-conservative replication</u> ensures that all genetic information is retained; 7. Crossing over or pairing up of homologous chromosomes do not occur; 8. Ensures that there is no genetic variation / maintains genetic stability; <p><u>Growth</u></p> <ol style="list-style-type: none"> 9. Mitosis plays a role in the <u>growth</u> in tissues; 10. <u>Increase in cell numbers</u>; 11. results in increase in size of organisms (growth) in multicellular organisms; 12. New cells are <u>identical</u> with existing cells so that they carry out the <u>same function</u>; <p><u>Repair</u></p> <ol style="list-style-type: none"> 13. Mitosis is important for the <u>repair / replacement of worn-out parts</u> of the body; 14. Important for tissues that replaced damaged cells with <u>exact copies of the original cells</u> in order for the tissue to <u>function properly</u>; <p><u>Asexual reproduction</u></p> <ol style="list-style-type: none"> 15. Mitosis forms the basis of <u>asexual reproduction</u> as the separated cells / plant parts become new offspring; 16. Forms clones that are genetically identical with parents facilitates <u>successful colonization of habitats</u> by species; 	
	(b)	Describe the structure of an amino acid and how a peptide bond is formed with another amino acid.	[6]
		<ol style="list-style-type: none"> 1. reference to a <u>central carbon atom</u> (i.e. the <u>α-carbon atom</u>); to which is bonded: 2. an <u>amino group</u> (-NH₂); 3. a <u>carboxyl group</u> (-COOH); <div style="text-align: center;"> </div>	

			monomers	<u>phosphate group of one nucleotide and carbon atom 3 of ribose of the next nucleotide</u>	<u>group of one amino acid and the amino group of the next amino acid</u>
		5	Reading of genetic message	RNA polymerase moves along DNA template	Ribosome moves along mRNA
		6	Involved of tRNA	Not involved	tRNA carries amino acids to ribosomes
		7	Raw materials	Free ribonucleotides	Amino acids attached to tRNA
		8	Products	mRNA, rRNA and tRNA	polypeptide
		9	Fate of products	Products exit nucleus and migrate to the cytoplasm	Polypeptide chain remain in the cytoplasm or secreted out of the cell
		10	AVP: Involvement of ribosome	Not involved	Ribosome is the binding site for mRNA and amino acid tRNA complex
		1 mark for each comparative statement			
		[Total: 20]			