RIVER VALLEY HIGH SCHOOL

JC 2 PRELIMINARY EXAMINATION

CANDIDATE NAME										
CENTRE NUMBER	S					CLASS	22J	INDEX NUMBER		

BIOLOGY **9744/02**

Paper 2 Structured Questions **13 September 2023**

2 hours

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, index number and name in the spaces at the top of this page.
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 ON ANY BARCODES.

Answer **all** questions in the spaces provided on the Question Paper.

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.

The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
1	
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11	
Total	

Answer **all** questions.

1 Collagen is the dominant protein in extracellular tissues such as bone, skin, and other connective tissues.

(a) (i) Name the most common tripeptide repeat in tropocollagen. [1]

Glycine – Proline – Hydroxyproline / Hydroxylysine

(ii) Explain the significance of the most common amino acid in the tripeptide repeat. [2]

1. Glycine is the smallest amino acid;
2. With hydrogen as the R-group;
3. Therefore glycine fits in the central core of the triple helix;
4. Resulting in tight coil / tightly packed helix;

(iii) Compare between the hydrogen bonds within tropocollagen and within an alpha helix of a protein. [3]

Similarities:

1. Both are between N-H and C=O of the polypeptide backbone;;
2. Both are occurring at regular intervals throughout the helix;;

Max. 1m

Differences:

Feature	Triple helix	Alpha helix
1. Location of hydrogen bonds	Between different polypeptide chain	Within the same polypeptide chain;;
2. Amino acids forming the hydrogen bonds	Between glycine & hydroxlysine OR proline	Between any amino acids;;
3. AVP;;		

Max. 1m

Fig 1.1 shows **(a)** diagrams of young and aged epidermal skin tissue and **(b)** the scanning electron micrographs of collagen fibrils under the epidermal layer of young and aged skin.

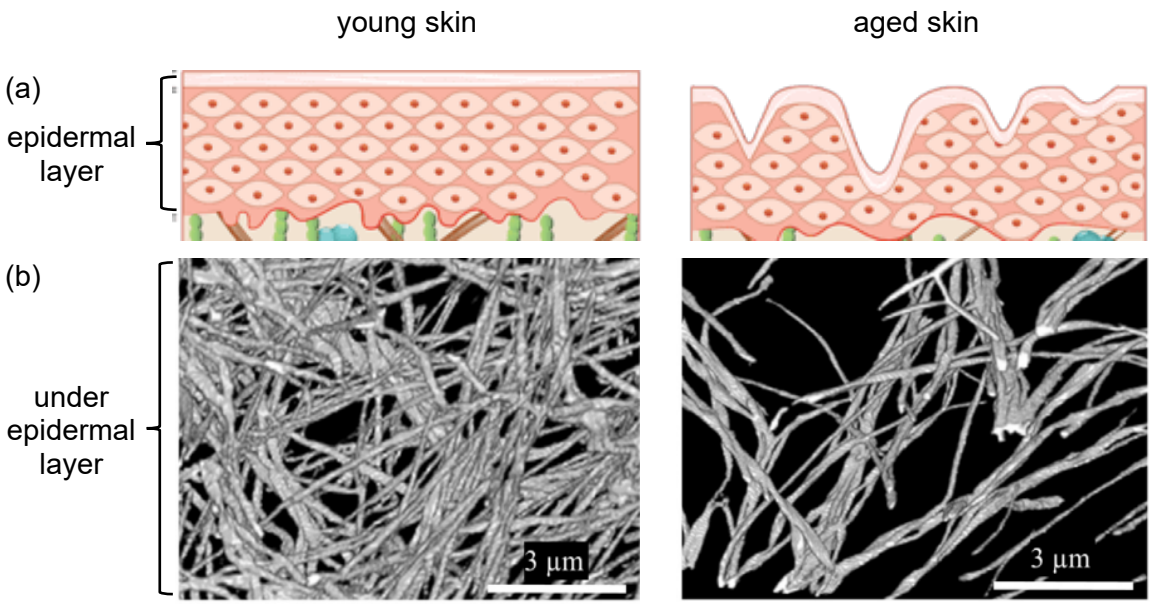
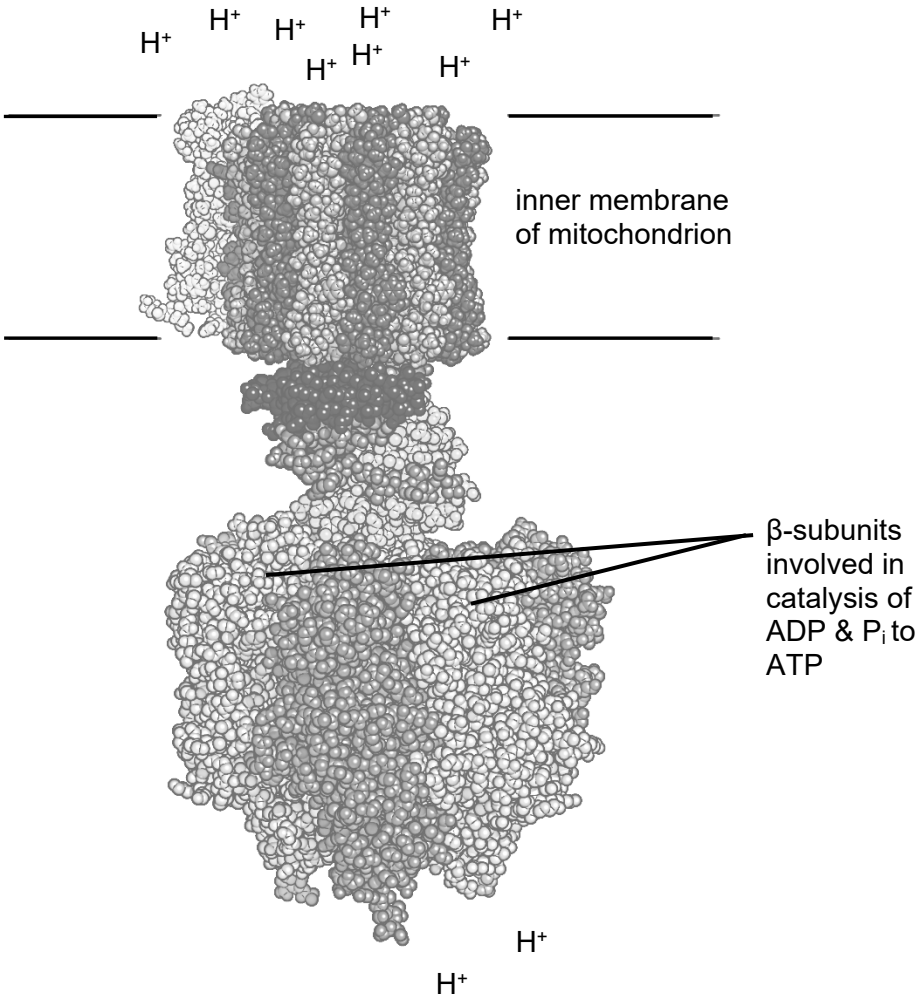
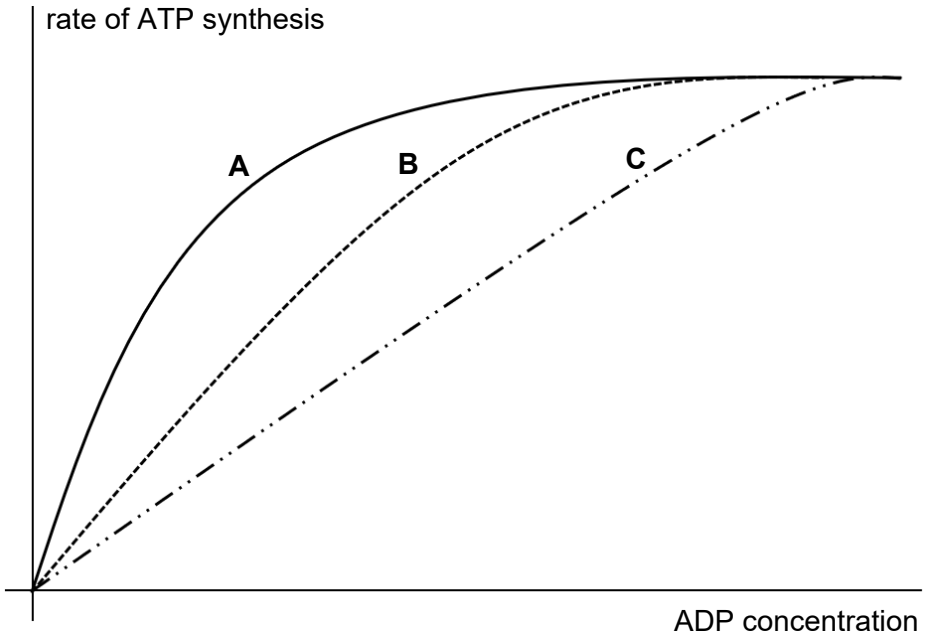


Fig. 1.1

	(b)	**(i)**	Describe how collagen fibres are formed from tropocollagen.	[2]
			1. Staggered arrangement of tropocollagen molecules; 2. Carboxyl (C) and amino (N) ends of different tropocollagen; 3. joined by covalent bonds; 4. Cross-linked to form fibrils; 5. which further assemble into collagen fibres; Max.2	
		(ii)	With reference to Fig. 1.1, explain how changes in collagen affect the skin as a person ages.	[2]
			1. Less dense collagen fibres; 2. Broken collagen fibres; 3. loss of tensile strength / loss of support to skin; 4. Skin is saggy / uneven / folded; R: dark spots on skin as collagen has no effect on colour	
				[Total 10]

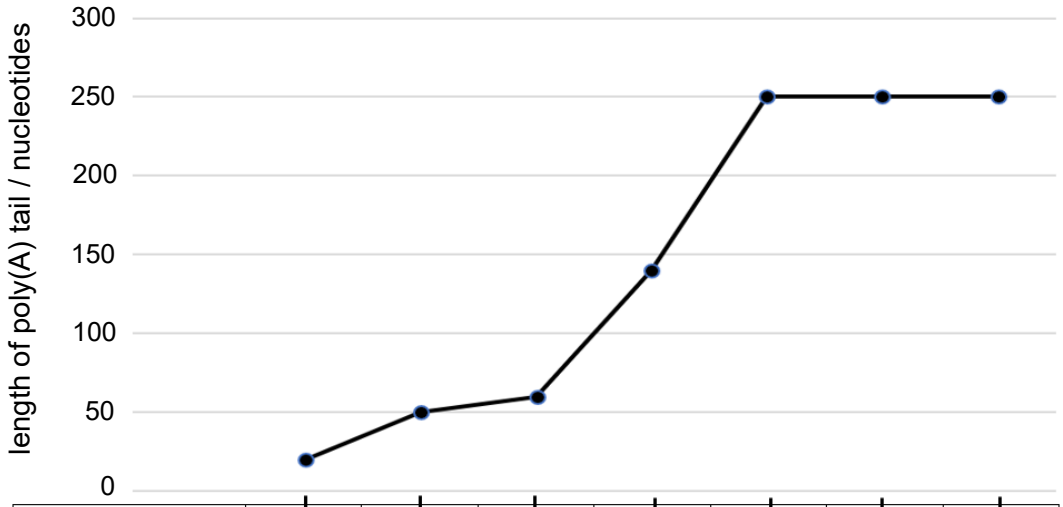
2	**(a)**	Describe the roles of membranes within a cell.	[2]
		1. Selective barrier; 2. Regulating movement of substances in & out of organelles; 3. Site of formation of multi-enzyme complexes; 4. To increase the rate of reaction as enzymes are organised in sequence; 5. Compartmentalisation; 6. Provides localised environment to facilitate metabolic processes occurring simultaneously; 7. Maintain high concentrations of specific enzymes and substrates; 8. Prevents intermediates of one pathway from interacting with another; 9. Isolates harmful substances from the rest of the cell; Max. 2	
	ATP synthesis is catalysed by the enzyme ATP synthase. The process involves the coupling of H^+ ion movement through ATP synthase with the catalysis of ATP formation. Fig. 2.1 shows a diagram of ATP synthase in a mitochondrion.  **Fig. 2.1**	

	(b)	Describe how H^+ ions are moved across the membrane in Fig. 2.1.	[2]
		1. Facilitated diffusion; 2. H^+ ions move from intermembrane space to matrix; 3. Across hydrophilic channel provided by ATP synthase; 4. Down concentration gradient; 5. No expenditure of ATP; Max. 2m	
		ATP synthase is found in all living organisms because ATP synthesis is an essential process for survival. ATP synthase is therefore one of the most conserved proteins in all living organisms including prokaryotes and animals. More than 60% of the amino-acid residues of the β-subunit are the same in all living organisms across Kingdoms. Fig. 2.2 shows the effect of increasing ADP concentration in different mixtures **A**, **B** and **C**. Their contents are shown below: • Mixture **A** contains substrates and ATP synthase from prokaryote or animal. • Mixture **B** contains substrates, an inhibitor and ATP synthase from prokaryote. • Mixture **C** contains substrates, an inhibitor and ATP synthase from animal. The inhibitor used for **B** and **C** are the same. Data used to plot the graphs were normalised to allow for comparison.  **Fig. 2.2**	
	(c)	Using information provided in this question, explain how the data in Fig. 2.2 shows the change in binding affinity of ATP synthase to ADP across the Kingdoms **and** why certain amino-acid residues in the β-subunit must be conserved.	[4]
		1. Binding affinity of ATP synthase to ADP decreases from prokaryote to animal;; 2. As higher ADP concentration required;	

		3. To overcome binding of ATP synthase active site (to competitive inhibitor); [Accept alternate argument on higher rate at each ADP conc.] These amino-acid residues are conserved because 4. They are catalytic residues; 5. Involved in formation of phosphoester bond; OR 6. They are contact residues; 7. involved in binding to ADP; OR 8. Residues involved in maintaining (shape of) active site; 9. Complementary to ADP; If residues are changed 10. unable to produce ATP for essential cellular activities; 11. Organisms die / do not survive;	
	(d)	ATP synthase facilitates both the transportation of H^+ ions and the production of ATP. Describe two features that are similar between the processes.	[2]
		1. Specificity of channel of ATP synthase to H+ ions and active site of ATP synthase to ADP;; 2. The higher the concentration of substance, i.e. proton or ADP, the higher the rate of transport across membrane and rate of ATP synthesis respectively;; 3. AVP;; Max. 2	
			[Total 10]

3 In a developing oocyte, mRNAs are synthesized and then exported to the cytoplasm. However, these mRNAs are not immediately translated but are stored in the cytoplasm for future use in a zygote.

Fig. 3.1 shows the changes to the 3' end of a mature mRNA in a zygote starting from 20 minutes after fertilisation **and** the corresponding amount of protein synthesized.



time / min	20	40	60	80	100	120	140
concentration of protein	×	✓	✓	✓✓	✓✓✓	✓✓✓	✓✓✓

key

× no production

✓

✓✓

✓✓✓ high concentration

Fig. 3.1

(a) With reference to Fig. 3.1, explain the relationship between the length of poly(A) tail of the mRNA and the concentration of protein produced. [3]

1. When length of poly(A) tail is <50 nucleotides long, no protein was produced;;
2. (with short poly(A) tail) ribosome is unable to bind to RNA;
3. RNA is degraded by exonucleases;
4. When length of poly(A) tail increases from 50 to 250 nucleotides, concentration of protein increases;;
5. longer poly(A) increases mRNA stability / half-life;
6. facilitates ribosome binding for translation; (award once)
7. (Increased stability) for repeated translation;

During formation of functional protein, the polypeptide chain must be folded properly in the endoplasmic reticulum (ER). Disruption of protein folding causes misfolded proteins to accumulate, triggering the unfolded protein response (UPR). UPR activates a kinase known as PERK and leads to halting of translation.

Fig. 3.2 shows the UPR pathway.

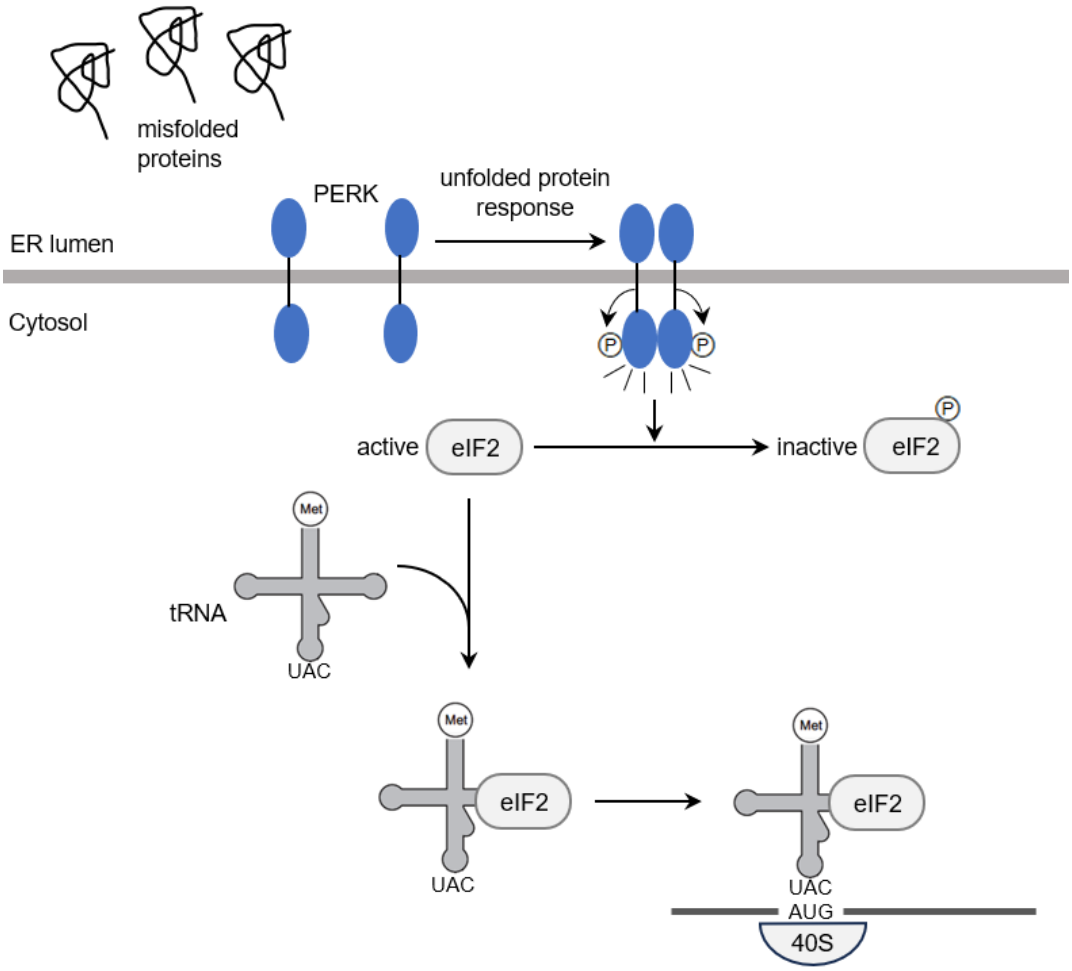


Fig. 3.2

(b) Using Fig. 3.2, explain how activation of the UPR stops translation. [3]

1. UPR causes dimerisation of PERK;
2. PERK activated by auto-phosphorylation;
3. inactivate eIF2 by phosphorylation;
4. Phosphorylated/inactive eIF2 is unable to bind to initiator tRNA;
5. initiator tRNA cannot bind to start codon;
6. translation initiation complex is not formed;

	(c)	Describe how misfolded proteins can be degraded in the cytoplasm of the cell.	[1]
		1. Misfolded proteins are tagged with ubiquitin; 2. Degraded by proteasome;	
	(d)	Outline the significance of amino-acyl tRNA synthetase in translation.	[3]
		1. to catalyse the formation of (covalent) bond between amino acid and 3' CCA end of tRNA;; 2. to join the correct amino acid specified by anticodon on tRNA;; 3. to allow the correct amino acid to be added to the polypeptide chain according to the mRNA codon sequence;;	
			[Total: 10]

4 Fig. 4.1 shows actively dividing cells at various stages of the mitotic cell cycle.

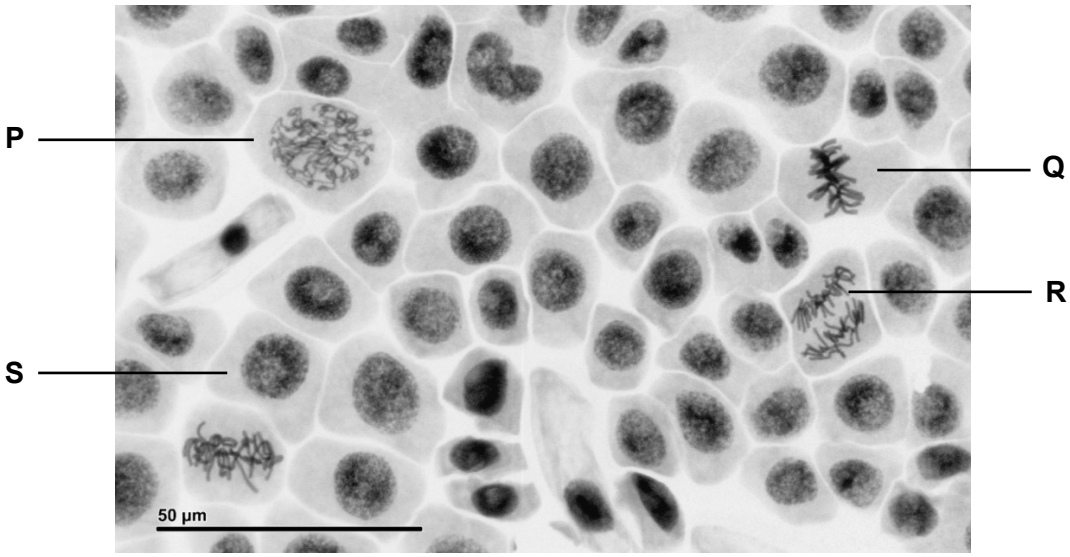


Fig. 4.1

(a) (i) Complete Table 4.1 below by:

- identifying the stages shown in Fig 4.1, and
- describe the behaviour of chromosomes at the identified stages. [3]

Table 4.1

stage	name of stage	behaviour of chromosomes
P	prophase;	condensation of chromatin into chromosomes;;

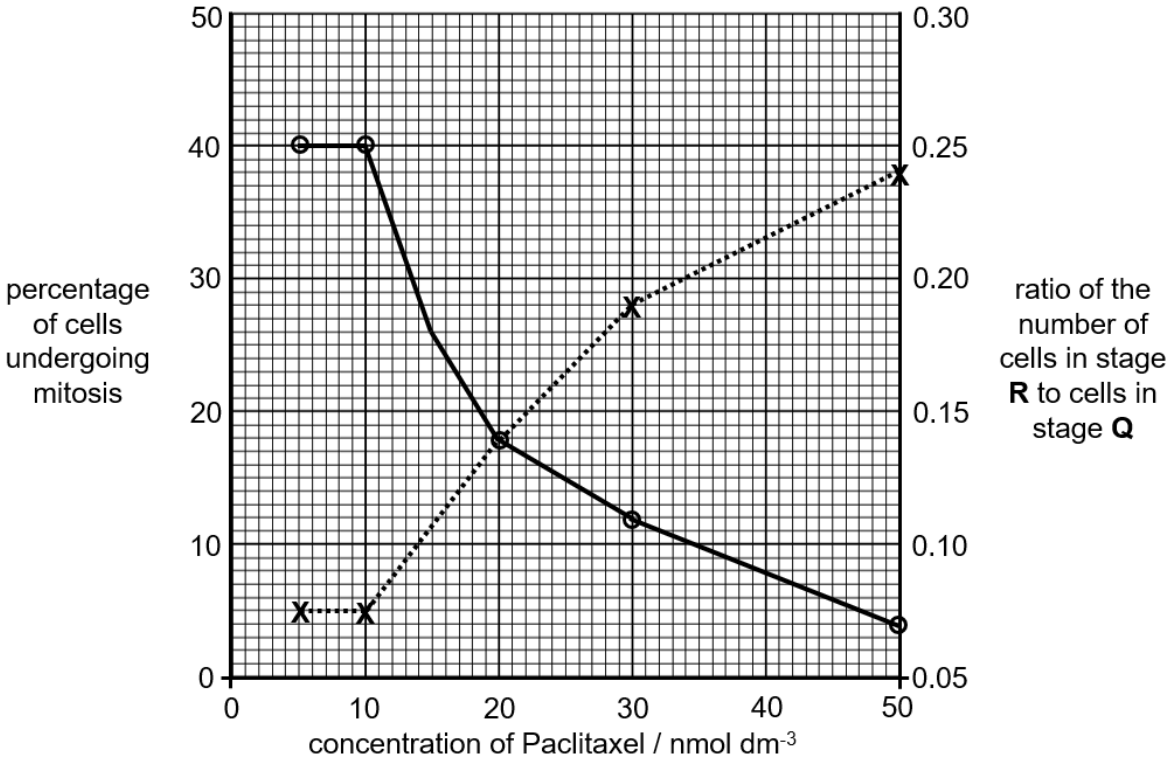
			Q	metaphase;	chromosomes are aligned (in a single row) along metaphase plate;;	
		(ii)	Describe how the lagging strand is synthesised during DNA replication in stage **S**.			[3]
			1. DNA polymerase catalyses the formation of phosphoester bond between nucleotides; 2. Synthesis of daughter strand is discontinuous; 3. Away from replication fork; 4. Multiple RNA primers required for elongation; 5. Therefore forming Okazaki fragments; 6. Another DNA polymerase replaces RNA primer with DNA; 7. DNA ligase joins Okazaki fragments; Max. 3			

Paclitaxel is a drug used in the treatment of uncontrolled mitosis in some forms of cancer.

Researchers investigated the effect of Paclitaxel on the mitotic cell cycle.

- Cells were grown for two days and divided into groups.
- Each group was treated with a different concentration of Paclitaxel.

The results of the investigation **after** one cell cycle (28 hours) are shown in Fig 4.2.



	key ··x··· percentage of cells undergoing mitosis —o— ratio of the number of cells in stage **R** to cells in stage **Q** **Fig. 4.2**			
	(b)	**(i)**	With reference to Fig. 4.2, account for the change in percentage of cells undergoing mitosis **and** the change in ratio of the number of cells beyond 10 nmol dm^{-3} of Paclitaxel.	[3]
			1. As concentration of paclitaxel increases from 10 nmol dm^{-3} to 50 nmol dm^{-3}, the percentage of cells in stages of mitosis increases from 5% to 38%;; 2. Inhibitor resulted in cell cycle arrest; 3. As concentration of paclitaxel increases from 10 nmol dm^{-3} to 50 nmol dm^{-3}, the ratio of the number of cells in stage **R** to cells in stage **Q** decreases from 0.25 to 0.07;; 4. Cell cycle halts at metaphase / unable to proceed to anaphase;	
		(ii)	Paclitaxel is found to act on proteins involved in mitosis. Suggest a mechanism in which paclitaxel can treat uncontrolled mitosis.	[1]
			Paclitaxel may: 1. Binds to kinetochore microtubule, therefore prevents disassembly / depolymerisation of microtubules;; 2. Inhibits separase, therefore prevents centromere from separating;; 3. Binds to cyclin / cdk, therefore prevent formation of cyclin-cdk complex promoting anaphase;; 4. AVP;; [R: kinetochore protein as cell enters metaphase] any one	
				[Total: 10]

5 In treatment of genetic diseases, scientists have developed vectors to introduce 'normal' genes into target cells that are malfunctioning. Of the different vectors, viral vectors offer the best possibility of success.

Fig. 5.1 shows a modified lentiviral vector which contains a single-stranded RNA genome. The vector can bind to cells lining the airways of the lungs.

The lentivirus is a form of retrovirus modified to contain glycoproteins which are also found on the influenza envelope.

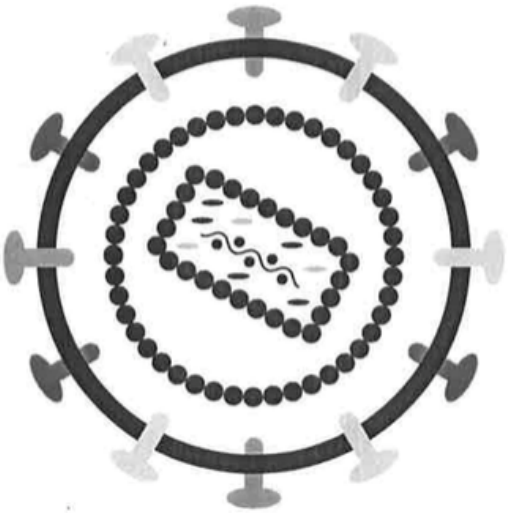


Fig. 5.1

(a) With reference to Fig. 5.1, compare **two** features of lentivirus and influenza and explain how these features promote rapid mutation in influenza. [4]

1. Both lentivirus and influenza contains single-stranded RNA as genome;;

2. Single-stranded RNA does not have corresponding strand to act as template during repair;;

3. Lentivirus contains one RNA segment while influenza contains 8 RNA segments;;

4. Antigenic shift can occur in influenza producing novel strains;;

(b) Explain how 'normal' genes are delivered by lentivirus to target cells to result in stable gene expression. [4]

1. Haemagglutinin binds to specific glycoprotein receptors / sialic-acid receptors on host cells;
2. Lentivirus enters by receptor-mediated endocytosis;
3. Drop in pH results in fusing of viral envelope with endosome membrane;
4. To release ssRNA into cytoplasm;
5. ssRNA coding for gene is reverse transcribed;
6. by reverse transcriptase;

		7. forming complementary DNA; 8. acts as template to form double-stranded DNA; 9. Integrase incorporates dsDNA into cell (as provirus); Which can be expressed by host cell mechanism Max. 4m	
	(c)	Explain how influenza causes disease.	[2]
		1. Hijacking of cellular machinery and resources to produce new viral particles; 2. Disrupts normal activities for cell survival; 3. Budding of large amount of viral particles can disrupt cell surface membrane; 4. Causing cell death; 5. AVP;	
			[Total: 10]

6 A genetic marker is a DNA sequence with a known locus on a chromosome. It can be used in diagnosis of genetic diseases as the marker is inherited together with alleles located in close proximity.

An example of a genetic marker is the microsatellite and it is shown in Fig. 6.1. The two alleles of this marker can be used to identify a recessive disease due to gene **G/g**.

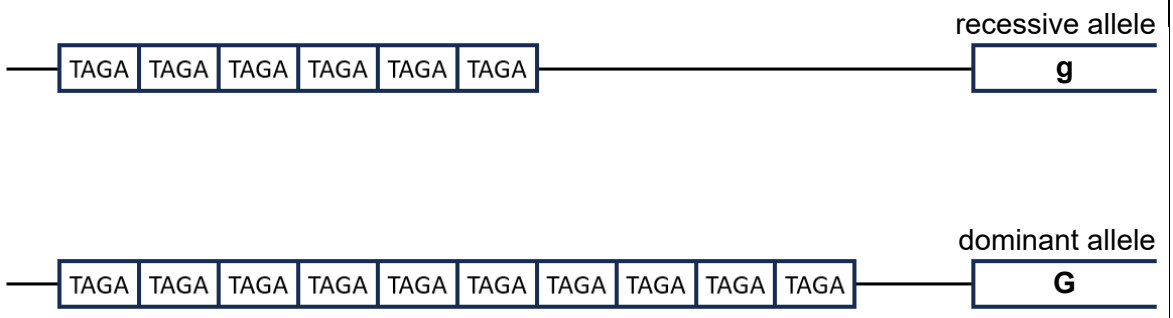


Fig. 6.1

(a) State the features of a microsatellite in this context. [2]

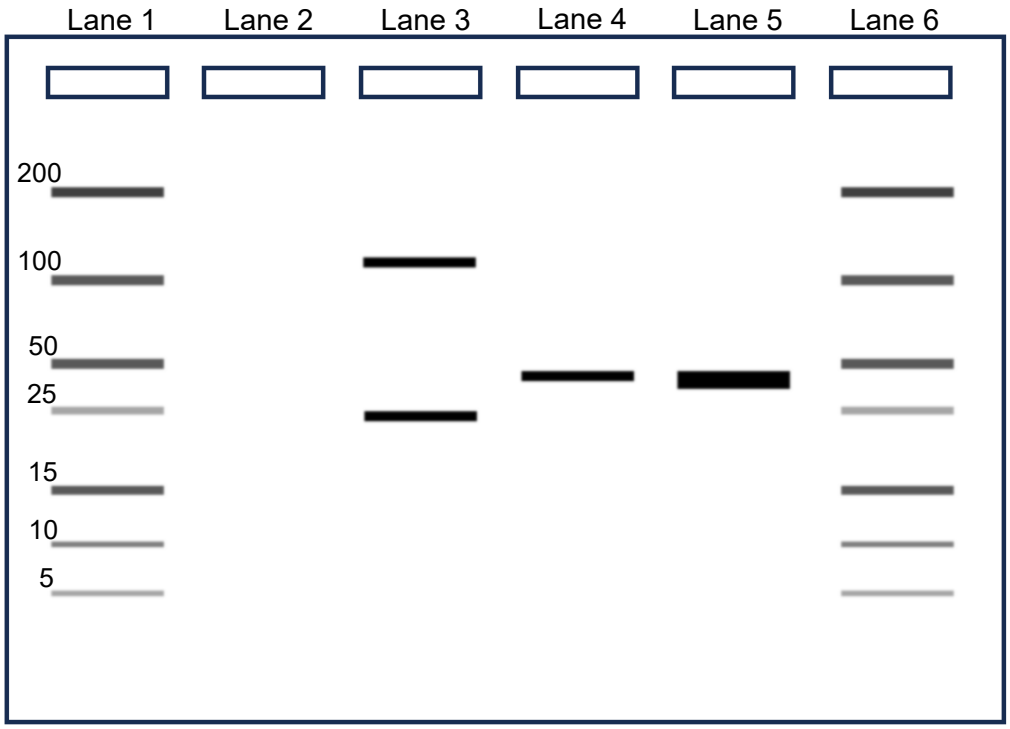
1. Non-coding DNA sequence;
2. Short; tandem repeats (of TAGA);
3. Linked / on same chromosome as gene for genetic disease;

To diagnose the disease, DNA is first extracted from the individual.

(b) Outline how a carrier of the disease can be identified from extracted DNA **and** draw the expected results in Lane 2 on Fig. 6.2. [4]

1. Add forward & reverse primers;
2. Flanking 3' ends of genetic marker;
3. Amplify using polymerase chain reaction;
4. Separate products using gel electrophoresis;
5. Shorter fragment migrates furthest;
6. Due to smallest molecular mass / size; [A: reverse argument]
7. Carrier should have 2 bands;
8. At 24bp and 40bp;

Fig. 6.2 shows the diagnostic results of the disease on several individuals, using the microsatellite in Fig. 6.1. All individuals are carriers of the disease.



key

Lanes 1, 6: DNA ladder
Lane 2, 3, 4, 5: individuals who are carriers of the disease

Fig. 6.2

(c) Suggest what may have happened to result in each band pattern observed in lanes 3, 4 and 5. [3]

Lane 3

1. Duplication of genetic marker allele linked to dominant allele **G**;;

Lane 4

2. Deletion of genetic marker linked to recessive allele **g**;;

   [R: Translocation]

Lane 5

3. Crossing over of genetic marker segments in one of the carrier parents;;
4. AVP;;

Microsatellites can also be used in DNA fingerprinting of individuals in a population.

Table 6.1 shows different types of microsatellites, their repeat motifs and the number of different alleles each has.

Table 6.1

microsatellite	repeat motif	number of alleles
D19S433	AAGG	9
CSF1PO	TAGA	10
TH01	TCAT	12
D18S51	AGAA	21
TPOX	GAAT	8

Adapted from Butler, Biotechniques, 43(4), 2018

(c) In 2023, Singapore has an estimated population of 6,014,723.

Using the data in Table 6.1, explain which microsatellites should be used so that the **fewest** microsatellites are needed to DNA fingerprint the whole of Singapore's population. [1]

1. D18S51, TH01 and CSF1PO;
2. Produces 6350400 different combinations of genotypes;

***if order matters**

OR

3. D18S51, TH01 and CSF1PO, D19S433;
4. Produces 44594550 different combinations of genotypes;

***if order does not matter**

[Total 10]

7 Wing pattern in the butterfly species *Heliconius melpomene* is controlled by genes on autosomal chromosomes.

The gene for banding pattern on the upper wing has two alleles:

- a dominant allele, **B**, coding for a full band
- a recessive allele, **b**, coding for a broken band.

The gene for ray pattern on the lower wing has two alleles:

- a dominant allele, **R**, coding for rays
- a recessive allele, **r**, coding for no rays.

Scientists conducted a few crosses on butterflies of different phenotypes as shown in Fig 7.1.

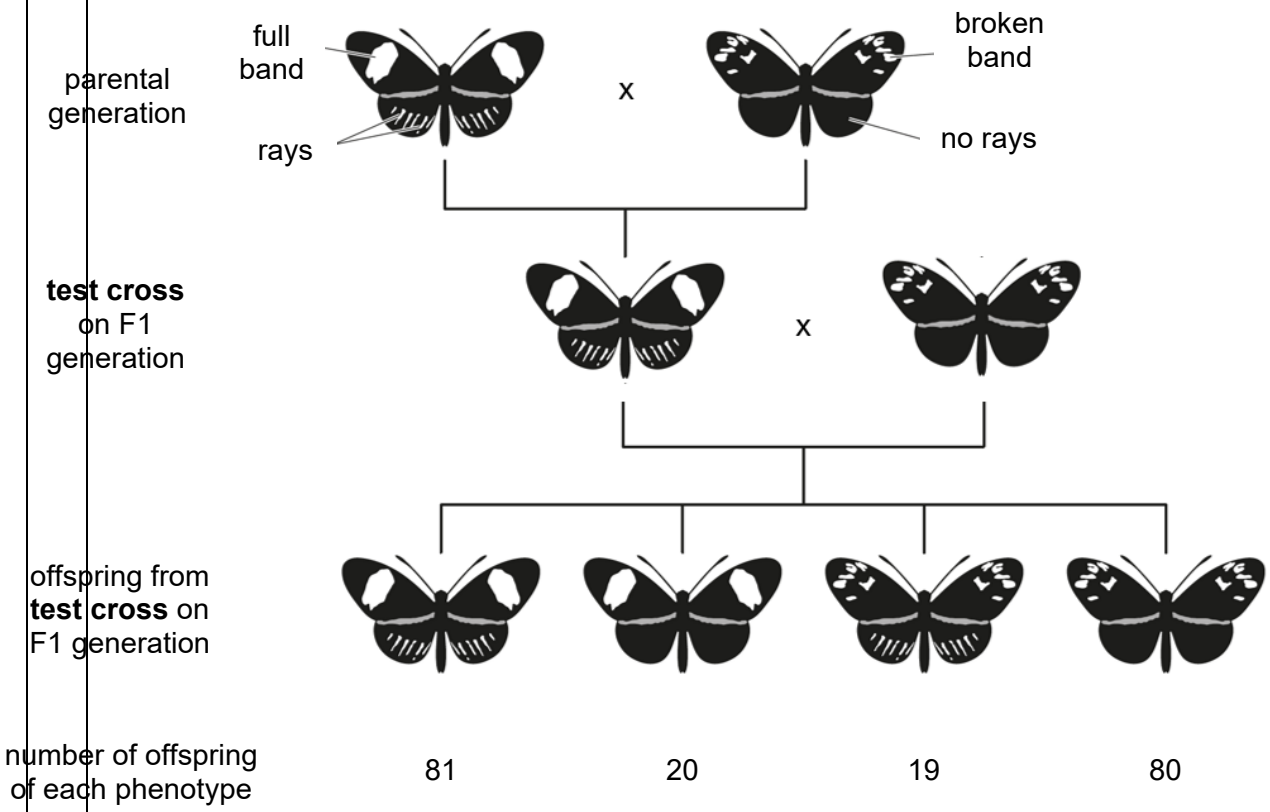
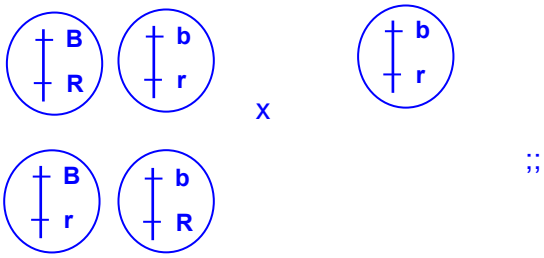
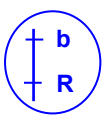
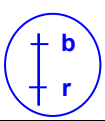
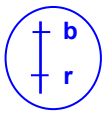
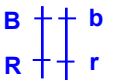
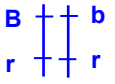
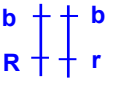
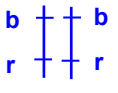


Fig. 7.1

	(a)	Explain what is meant by the terms		
		(i)	homozygous,	[1]
			when both alleles at a given locus are identical in diploid condition;;	
		(ii)	allele.	[1]
			alternative form of the same gene and responsible for determining the contrasting characteristics of a gene;; A: Alleles occupy the same locus of a pair of homologous chromosomes	

	(b)	State the expected phenotypic ratio from the test cross on F1 generation.	[1]
		1 full band rays: 1 full band no rays: 1 broken band rays: 1 broken band no rays;;	
	(c)	Draw a genetic diagram to explain the results of the test cross.	[4]
		Parental phenotypes: full band, rays x broken band, no rays *Parental genotypes:*  ;; *Gametes:*  ;; *Punnett square showing fusion of gametes:*	
	(d)	Explain why there are more parental phenotypes than recombinant phenotypes among the offspring of the test cross.	[3]
		1. The two genes B/b and R/r are linked; 2. are always inherited together (as one unit);	

				
	 full band, rays	 full band, no rays	 broken band, rays	 ;; broken band, no rays ;;
Observed no. of offspring	81	20	19	80

		3. and do not assort independently (during meiosis); 4. accounts for the larger number of full band ray & broken band no rays (parental phenotypes); 5. crossing-over (between the two genes) only occurs by chance; 6. hence fewer recombinant phenotypes (full band and no rays & broken band and rays) among the offspring;	
	[Total: 10]		

8	(a)	Explain the role of NAD in aerobic respiration.	[3]
		1. coenzyme of dehydrogenase; 2. reduced to form NADH; 3. carries (high energy) electrons; 4. and protons; 5. from Krebs cycle & link reaction; 6. and from glycolysis; 7. to electron transport chain; 8. reoxidised/ regenerated NAD^+; 9. 3 ATP molecules per molecule of reduced NAD; Max. 3	

To investigate respiration in mammalian cells, the following steps were carried out:

- mitochondria were extracted and incubated in a buffer solution
- pyruvate and inorganic phosphate (Pi) were added at 0 minute
- ADP was added one minute later
- the oxygen concentration of the buffer solution containing mitochondria was monitored throughout the investigation
- all other variables were in excess throughout the investigation

The results of the investigation are shown in Fig. 8.2.

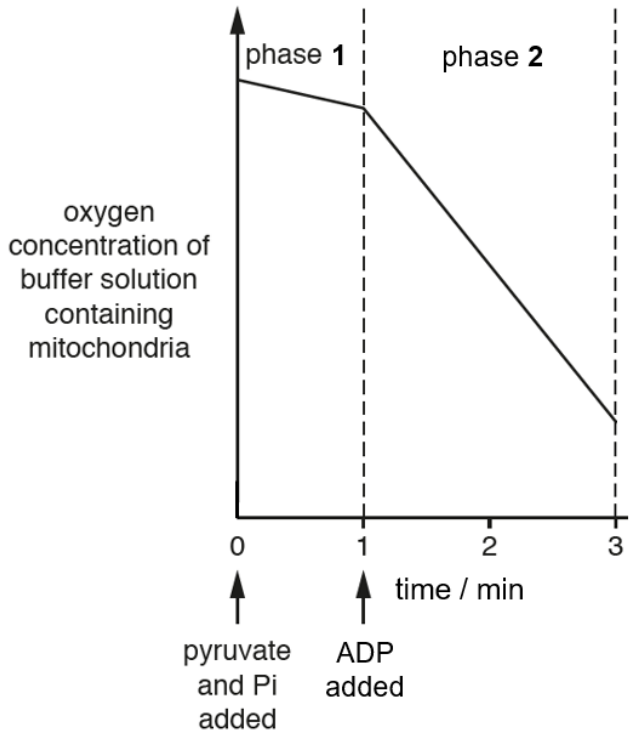


Fig. 8.2

	(b)	**(i)**	Describe the immediate fate of pyruvate after it is added at 0 minute.	[2]
			1. Pyruvate enters mitochondrial matrix; 2. During link reaction; 3. undergoes oxidative decarboxylation; 4. forms acetyl which joins to coenzyme A; 5. to form acetyl coenzyme A; Max. 2m	
		(ii)	Explain why the graph shows a steeper decrease during phase **2** than during phase **1**.	[3]
			1. more ADP (as substrate) for ATP synthase; 2. ATP synthase couples movement of H^+ to ADP phosphorylation; 3. therefore more H^+ needs to be pumped by ETC; 4. to maintain proton gradient; 5. more electron flow down ETC; 6. more oxygen is used up faster to act as final electron acceptor;	
	(c)	Other than carbohydrates, fats can also be used during cellular respiration. In an investigation, the oxygen consumption by cellular respiration of the same mass of fats and carbohydrates were measured. Put a tick (✓) in one box to indicate the total oxygen consumption for fats as compared to carbohydrates. Explain your answer.		[2]
		lower ☐	same ☐	higher ✓ ;
		1. fats contain more hydrogen atoms / C—H bonds but less oxygen per unit mass than carbohydrates (hence require more oxygen);; 2. hydrogen atom is oxidized by oxygen during cellular respiration;		
				[Total: 10]

9 (a) Explain why genetic variation is important to the survival of a species. [2]

1. Genetic variation is an important source of raw material for evolution;
2. Increases ability of a species to survive in a changing environment;
3. Resultant phenotypic variation selected for by different selection pressures;
4. Also may allow species to inhabit a wide range of habitats;

(b) Suggest why a small, isolated population is less able to preserve its genetic variation. [1]

1. Inbreeding increases homozygosity / reduces heterozygote protection;;
2. Increased possibility of losing alleles due to genetic drift / bottleneck effect;;
3. AVP;;

Mimulus is a plant genus containing a diverse range of species that have colourful flowers to attract pollinators. The role of pollinators is to transfer pollen between flowers for plant sexual reproduction.

Table 9.1 compares features of two closely-related species of *Mimulus* that both grow in the same region of North America. These features include:

- the year the species was first discovered
- the altitude at which the two species grow
- the distance from the opening of the flower to the nectar on which the pollinators feed
- the percentages of pollinator visits that they receive and successful pollination

Table 9.1

species of *Mimulus*	year first discovered	altitude / m	distance to nectar / mm	percentage of visits (and successful pollination) from pollinator type	
				hummingbird	bee
M. lewisii	1876	1500 – 3200	15	0	100 (79)
M. cardinalis	1838	0 – 2100	29	95 (58)	5 (0)

Adapted from Nelson et al, PLOS Genetics, 17(2), 2021

(c) Using the data in Table 9.1, explain how the two species were formed. [4]

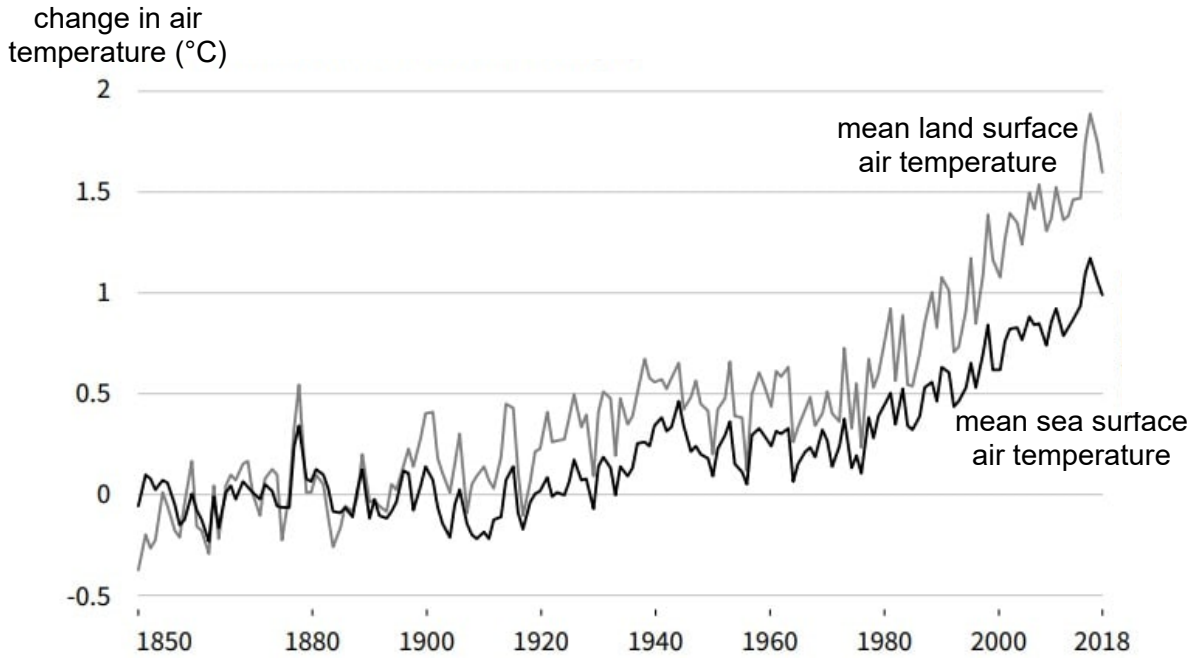
From data, *M. cardinalis* & *M. lewisii* may share same common ancestor before speciation OR *M. lewisii* may be a sub-population that underwent speciation.

1. Mutations results in phenotypic variation in *M. cardinalis*;

		2. Forms a sub-population able to live in higher altitude from 1500-3200m; 3. Further mutation results in shorter distance to nectar; from 29mm to 15mm; 4. Selected for by bee; 5. more survive and pass down alleles to offspring; 6. Sympatric speciation occurs (to form *M. lewisii*); 7. As bee can only act as pollinator for *M. lewisii*; 8. Unable to interbreed with *M. cardinalis*; 9. To give rise to viable, fertile offspring; Max 4			
	(d)	Describe one limitation for each of the following species concepts:			[3]
		(i)	biological species concept	Unable to use on 1. organisms reproducing asexually;; 2. fossil records;;	
		(ii)	ecological species concept	1. presence of organisms with overlapping interactions with environment;; 2. organisms ability to adapt / change how it interacts with environment;;	
		(iii)	morphological species concept	1. subjectivity in structures used to define species;; 2. presence of dimorphism in same species;; 3. different species may be morphologically indistinguishable;; 4. AVP;;	
		Max 1m each			
					[Total 10]

10	Antibiotics, such as penicillin, affects bacterial cells in the gut of mosquitoes.		
	(a)	Outline the effect of penicillin on bacterial cells.	[3]
		1. Binds to active site; of penicillin binding protein; 2. interferes with / prevents interpeptide linking of peptidoglycan; 3. cell wall becomes structurally weak / unable to withstand pressure / prone to collapse / disintegrate when bacteria attempts to divide; 4. leads to osmotic instability / autolysis; 5. results in bacterial cell death / has bactericidal effect;	
	The female *Anopheles* mosquito is the vector of the *Plasmodium* pathogen that causes malaria. Research has shown that *Plasmodium* is not always transmitted to uninfected people, due to two main reasons: • Individuals in the human population may be vaccinated against *Plasmodium*. • Bacteria living in the gut of mosquitoes compete with *Plasmodium* so it does not survive to continue its life cycle.		
	(b)	Using the information provided, explain why vaccination and antibiotics have different effects on the transmission of malaria.	[2]
		Vaccination prevents transmission 1. Because vaccination produces anti-*Plasmodium* antibodies; 2. removes pathogen from the bloodstream; Antibiotics does not prevent transmission 3. antibiotics decreases gut bacteria; 4. decreases competition between *Plasmodium*; and increases *Plasmodium* population; Max. 2m	
			[Total: 5]

11 Climate change results in global warming which affects both land and water masses. Scientists measured the change in mean land surface air temperature and mean sea surface air temperature, shown in Fig. 11.1.



Adapted from IPCC Special Report on Climate Change and Land, 2019

Fig. 11.1

(a) Other than heat capacity, explain the difference between the change in the two mean surface air temperatures from 1980. [2]

1. Mean land surface air temperature increases more rapidly than mean sea surface air temperature; from 1980 to 2018 by 0.6°C;
2. More heat retained / less heat radiated to atmosphere by land;
3. Due to greater deforestation resulting in lack of cover / reduced transpiration;

OR

4. Due to urbanisation resulting in more urban heat islands;

(b) Climate change also results in more extreme weather conditions. [3]

Describe the effects of such environmental stress on food chains and niche occupation.

On food chains

1. Floods / droughts can harm producers and reduce yield;
2. Reduced prey availability for predators;
3. Removal of predators can result in prey population explosion;
4. Heat waves can decrease population through increased disease vulnerability / reduced fertility / milk production;

		On niche occupation 5. Increased competition intensity due to reduced resource availability; 6. May result in niche alteration due to changes in behaviour; 7. Niche expansion or contraction; 8. AVP;		
				[Total: 5]