Anglo-Chinese Junior College

JC2 Biology Preliminary Examination
Higher 2

A Methodist Institution
(Founded 1886)

CANDIDATE NAME		FORM CLASS	
TUTORIAL CLASS		INDEX NUMBER	

BIOLOGY **9744/02**
Paper 2 Structured Questions 22 August 2024
2 hours

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Name, Class and Index number 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.

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 Examiners' use only	
1	/ 8
2	/ 10
3	/ 11
4	/ 10
5	/ 11
6	/ 9
7	/ 10
8	/ 10
9	/ 10
10	/ 5
11	/ 6
Total	/ 100

This document consists of __ printed pages.

[Turn over

For Examiner Use

Answer **all** questions.

1 Fig. 1.1 is an electron micrograph of a cell found in the human adrenal cortex which secretes the hormone adrenaline into the bloodstream.

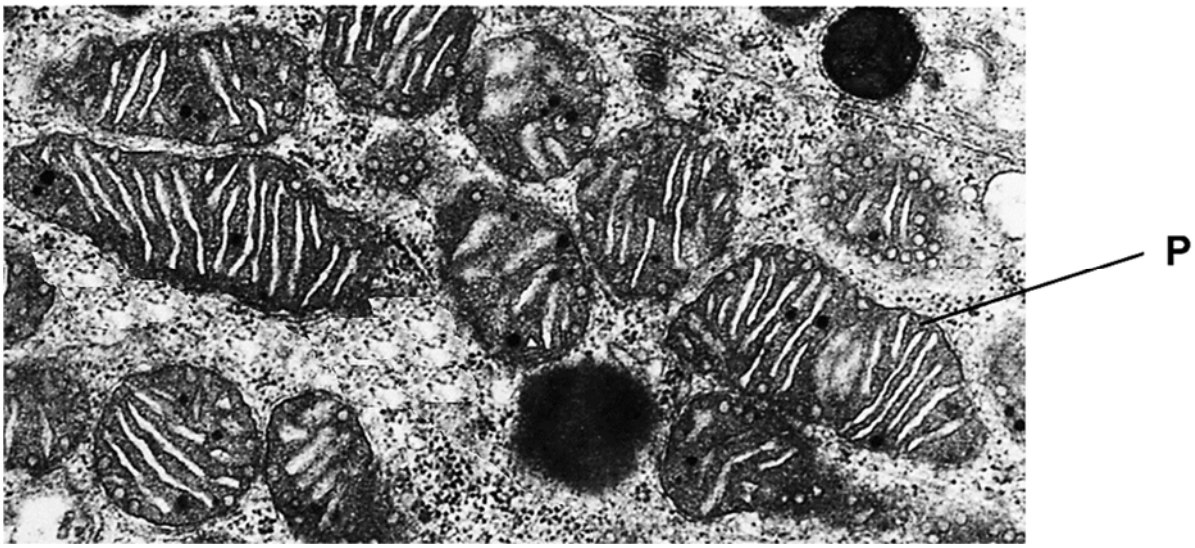

Fig. 1.1

(a) (i) Identify organelle **P**.

Mitochondrion; R! mitochondria

..... [1]

(ii) Describe how organelle **P** is involved in the secretory process of the cell in Fig. 1.1.

1. **ATP is synthesised during aerobic respiration/ Krebs cycle/ oxidative phosphorylation/ chemiosmosis; R! cellular respiration, glycolysis**

.....

2. **To provide energy R! produce energy for the synthesis and secretion of the secretory products via exocytosis;**

..... [2]

For Examiner Use

(b) Cells expressing proteins of interest are allowed to take up radioactively labeled amino acids for a brief interval, during which all newly synthesised proteins will exhibit a certain level of radioactivity.

Fig. 1.2. shows the percentage of radioactivity found in three organelles of the endomembrane system, **X**, **Y** and **Z** within the span of two hours.

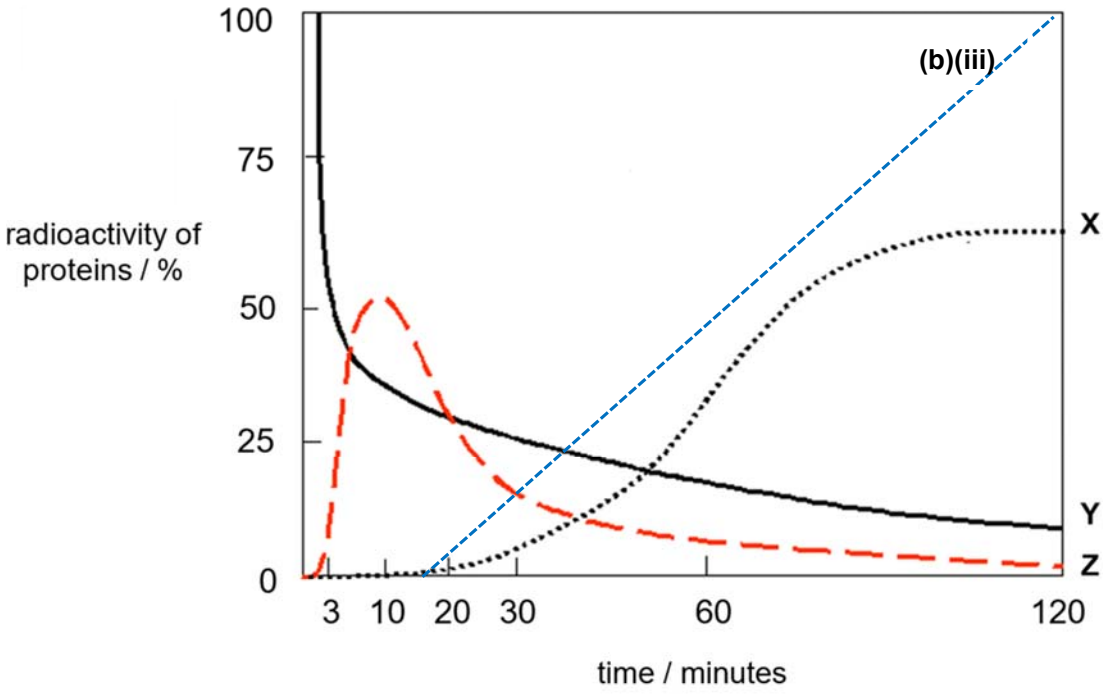

Fig. 1.2

(i) Identify organelle **Y**.

Rough endoplasmic reticulum; R! rough ER / RER , ribosomes

…… [1]

(ii) Using Fig. 1.2, account for the level of radioactivity in organelle **Y**.

1. ***Radioactivity from 100% at 1.5 minutes (A! 2 minutes) decreased sharply to 55% (A! 50-60%) at 3 minutes OR 10% (A! 8-11%) at 120 minutes;**

……

2. **Initially high due to synthesis of polypeptides by ribosomes attached to outer membrane of rough ER and entering the rough ER lumen.**

……

3. **decreases as proteins / polypetides synthesised are being packaged into transport vesicles which bud off from the rough ER;**

……

@ 1 mark, max 2
***MP1 compulsory**

…… [2]

[Turn over

(iii) Bafilomycin A1 is a chemical inhibitor that blocks the process of exocytosis at the cell surface membrane. This causes a change in one of the graphs in Fig 1.2.

On Fig. 1.2, sketch a graph that represents this expected change. [1]

Higher radioactivity in organelle X
R! increase in graph before 15 minutes

(iv) Explain your answer in **(b)(iii)**.

Secretory vesicles are <u>unable to fuse with the cell surface membrane</u>, hence the secretory product / protein will remain in them / remain in the cell;
…….....[1]

[Total: 8]

2 Collagen plays a structural role and contributes to mechanical properties and shape of tissues in the body.

Fig. 2.1 shows the approximate composition of collagen and the molecular structure of four of the amino acids found in it.

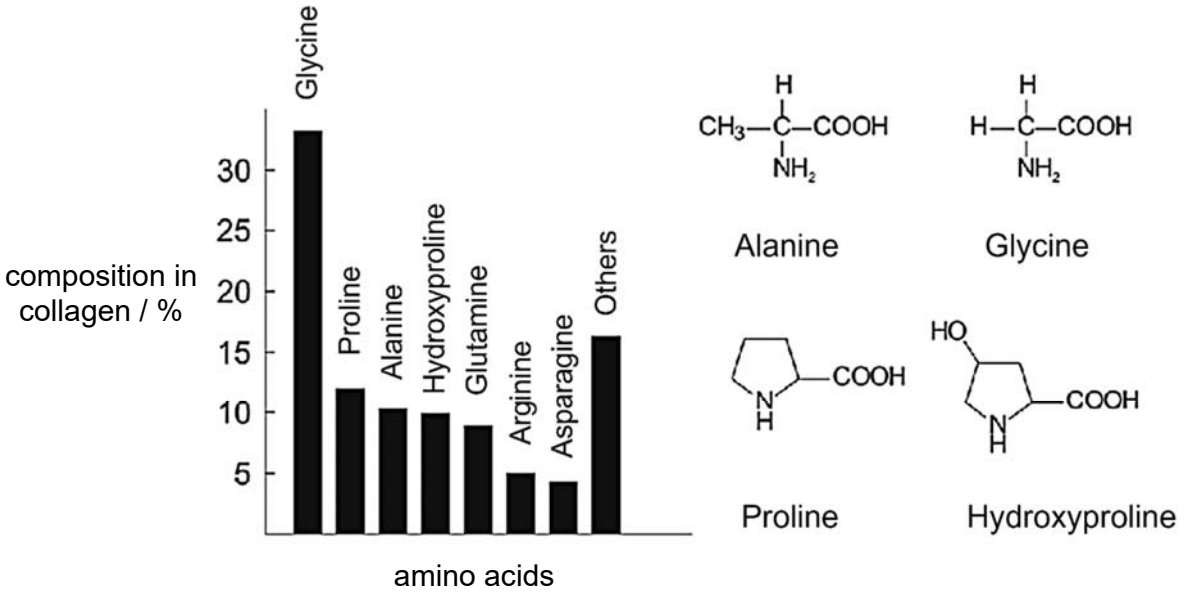

Fig. 2.1

(a) (i) With reference to Fig. 2.1, explain why collagen is an insoluble protein.

1. **Alanine, proline and glycine make up 10, 12 (A! 11.5) and 33% (A! 32%) of amino acids in collagen respectively / 55% (A! 54%) of the amino acids in collagen;**

……

2. **which makes up the majority / more than half of amino acids in collagen;**

……

3. **All three amino acids (alanine, proline and glycine) have non-polar/ hydrophobic R groups, will not be able to form hydrogen bonds with water molecules; R! hydroxyproline**

……

4. **Hydroxyproline is a polar amino acid but the OH group is used to form H bond with other polar residues in adjacent α-chains of tropocollagen, hence not be able to form hydrogen bonds with water molecules;;**

……

@ 1 mark, max 3

…… [3]

[Turn over

(ii) Explain why the abundance of glycine in collagen is essential for its function.

1. **Glycine has a <u>small R-group</u> of all amino acids (-H only) forming collagen;**

……

2. **This allows the α-chains of tropocollagen to be able to wind tightly together/ fit into the restricted space between α-chains to allow <u>formation of hydrogen bonds/ cross-links</u>; R! α-helix**

……

3. **Which leads to an increase in <u>tensile strength</u> of collagen, making it a suitable structural protein;**

…… [3]

(b) Fig. 2.2 shows how changes in concentration of oxygen affects its binding to haemoglobin.

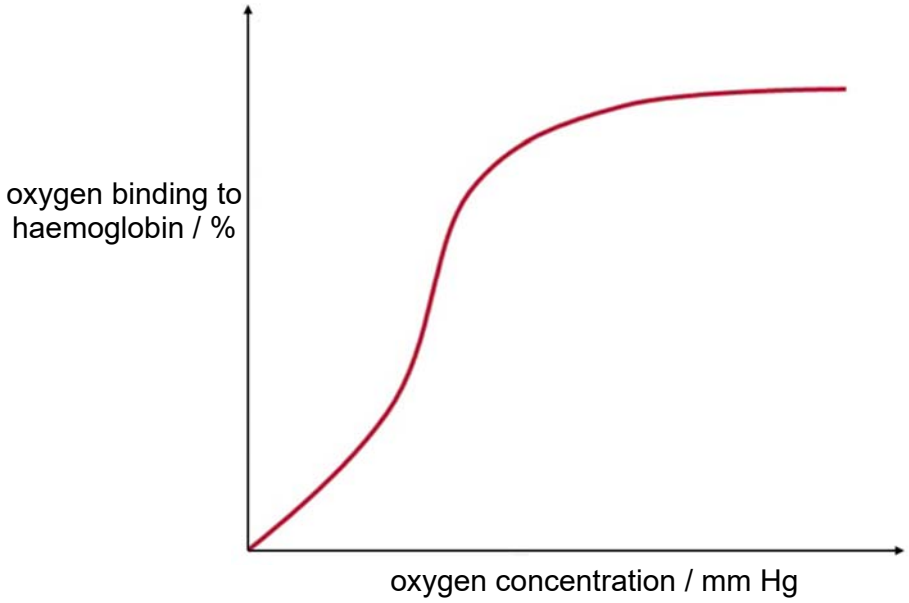

Fig. 2.2

(i) State the property of haemoglobin that is illustrated in Fig. 2.2.

Cooperativity;

…… [1]

(ii) Using your knowledge of the structure of haemoglobin, explain how the property stated in **(b)(i)** enhances its function.

1. **Haemoglobin is made up of 4 polypeptides/ two dimers each carrying a haem group;**

……

2. **the two dimers are held together by weak hydrogen bonds, resulting in the ability of the two dimers to move with respect to each other;**

……

3. **the binding of an oxygen molecule to one subunit induces a conformational change in the remaining subunits, which increases the affinity for oxygen in these subunits;**

……

4. ***This facilitates the effective loading and unloading of oxygen at the lungs and body tissues respectively;**

***MP4 compulsory, @ 1 mark, max 3**

…… [3]

[Total: 10]

[Turn over

3 Fig. 3.1 shows the fluid mosaic model of cell surface membrane.

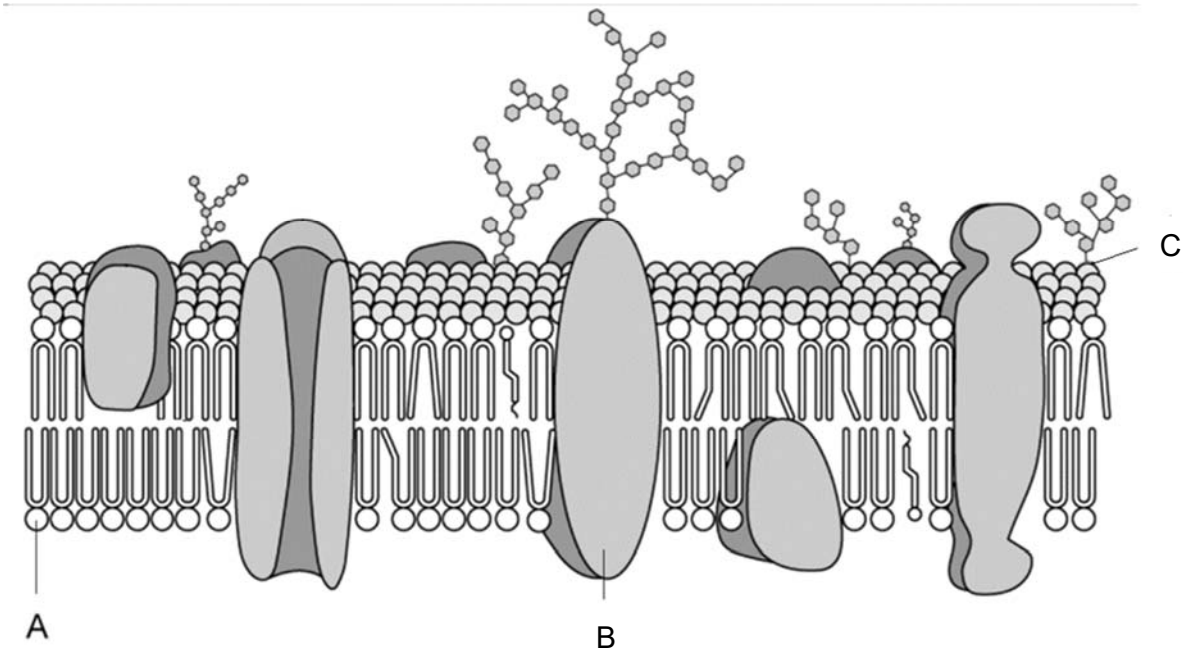

Fig. 3.1

(a) Identify structures labelled **A** and **B** in Fig. 3.1.

A: phospholipid; R! phosphate head/ groups
B: (transmembrane) glycoprotein; R! transmembrane protein
…….. [2]

(b) Explain why the structure of **C** varies across different membranes in a cell.

1. **C is a glycolipid which may contain fatty acid chains of different lengths/degrees of saturation OR different arrangements of the carbohydrate chain attached to it/ different glycosylation patterns during chemical modifications at the Golgi apparatus;**

2. **This enables membranes to maintain fluidity, allowing the embedded membrane proteins to function normally/transport across membranes to occur normally;**

3. **This enables glycolipids to bind to a variety of molecules and structures OR serve diverse roles such as cell-cell recognition/adhesion/cell signalling;**

…….. [2]

(c) Table 3.1 shows the results from a study on the mean percentage of cholesterol found in the cell surface membrane of epithelial skin cells of different animals.

Table 3.1

animal	mean percentage of cholesterol in cell surface membrane of epithelial skin cell
giraffe	10
rhinoceros	12
eurasian mouse	15
scottish blackface sheep	18
antarctic penguin	28
african elephant	8
arctic fox	30

(i) Suggest why arctic foxes have a greater mean percentage of cholesterol in their cell surface membranes than giraffes.

1. Arctic foxes live in cooler environments;
2. A higher percentage of cholesterol in their membranes will prevent the close packing of phospholipids at lower temperatures, increasing membrane fluidity/ prevent the membrane from solidifying;

..... [2]

(ii) Estimate, with a reason, the percentage of cholesterol that would be found in the cell surface membranes of polar bears.

1. 30%;
2. because the polar bear lives in a similar, cold environment to the Arctic fox/ Antarctic penguin;
A! any values from 25% to 35%

..... [2]

(iii) Explain why the mass of cholesterol in the cell surface membranes is calculated as a percentage rather than an absolute number.

1. The cell membrane may be of different length/ width/ size/ mass in different animals;
2. Allows valid comparison of the values in different animals;

..... [2]

[Turn over

(iv) Suggest why the percentage of cholesterol in Table 3.1 is an underestimate of the actual percentage found in the entire cell.

1. **Membrane-bound organelles which also contain cholesterol are present in the cell;**

……[1]

[Total: 11]

4 Fig. 4.1 shows the process of DNA replication.

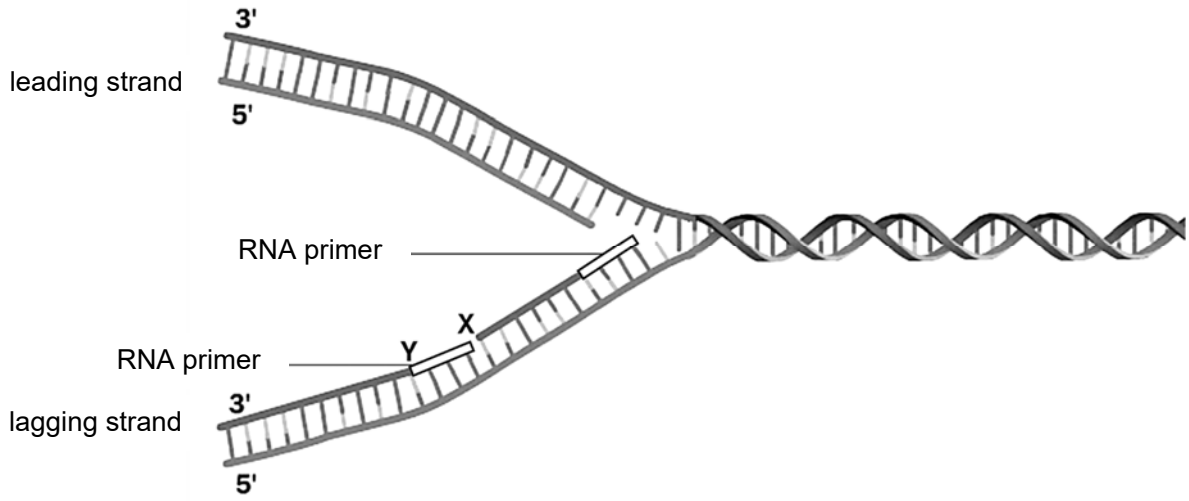

Fig. 4.1

(a) With reference to Fig 4.1,

(i) identify the enzyme that will remove the RNA primers shown,

1. **DNA polymerase I; A! DNA polymerase; R! DNA polymerase III**

..... [1]

(ii) state whether the first deoxyribonucleotide to be added between both Okazaki fragments, after the removal of the RNA primer, will be at X or Y, and

1. **X;**

..... [1]

(iii) justify your answer in **(a)(ii)**.

1. **DNA polymerase I will only be able to add the first deoxyribonucleotide at the 3' OH end/ synthesises the DNA strand from 5' to 3' direction;**
2. **The 3D conformation of the active site of DNA polymerase is complementary to that of the 3'OH group on the deoxyribonucleotide;**

..... [2]

[Turn over

(b) Fig. 4.2 shows the action of telomerase enzyme at the end of a linear chromosome after DNA replication. The entire length of the chromosome is not shown in Fig. 4.2.

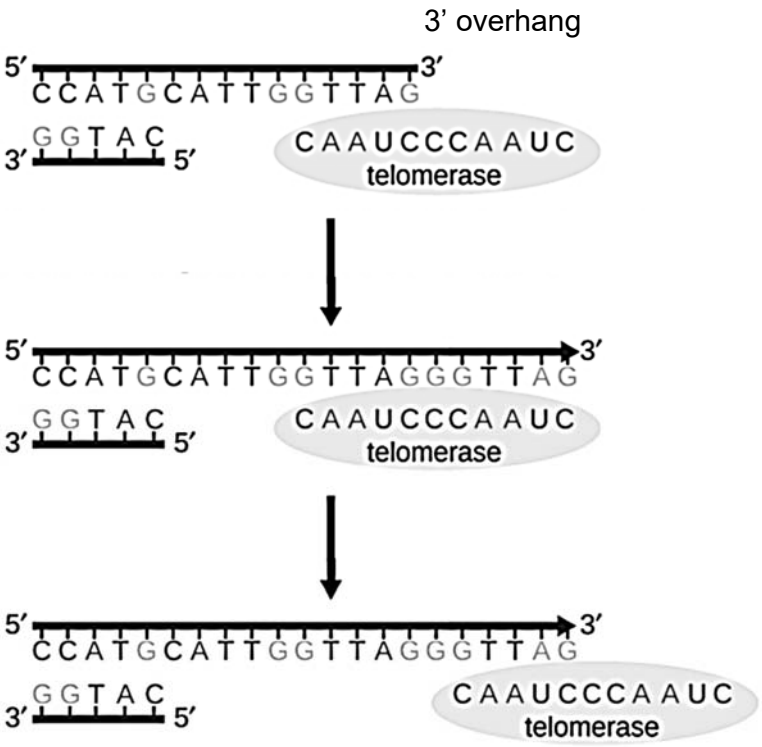

Fig. 4.2

(i) With reference to Fig. 4.2, explain the purpose of the sequence within the telomerase enzyme.

1. **It is <u>complementary</u> to <u>3' end</u> of the DNA/ <u>3' overhang</u>;**
2. **It provides a <u>template</u> for the complementary base pairing of new deoxyribonucleotides;**
3. **to form telomeric repeat of 5'-GTTAGGGTTAG-3'/ 5'-GTTAGGGTTAG-3';;**

..... [2]

(ii) In Fig. 4.2, after the action of telomerase enzyme, the newly-synthesised DNA strand with the 3' overhang is now extended.

With reference to named enzymes, describe the events that must occur at the shorter complementary DNA strand to extend it to the same length.

1. **Addition of <u>RNA primer</u>(s) by <u>primase</u>; R! RNA primase**
2. **which in turn will allow <u>DNA polymerase</u> to add <u>deoxyribonucleotides</u> to <u>3'</u>OH end of primers/ add <u>deoxyribonucleotides</u> via <u>complementary base pairing</u> to the template;**

..... [2]

(c) When a human is in the newborn phase, white blood cells have telomeres ranging from 8,000 to 13,000 base pairs in length. After this phase, the number of base pairs tends to decline by approximately 20 to 40 per year.

Calculate the range of base pairs a telomeric end could have lost by the time a person reaches the age of 40. Show your working.

1. **20 base pairs/year x 40 years to 40 base pairs/year x 40 years;**
   = 800 to 1600base pairs

800 to 1600;

range of base pairs lost = ……

[2]

[Total: 10]

5 Fig. 5.1 shows enterobacteria phage T2, a virulent phage in the family *Myoviridae,* which T4 phage also belongs to.

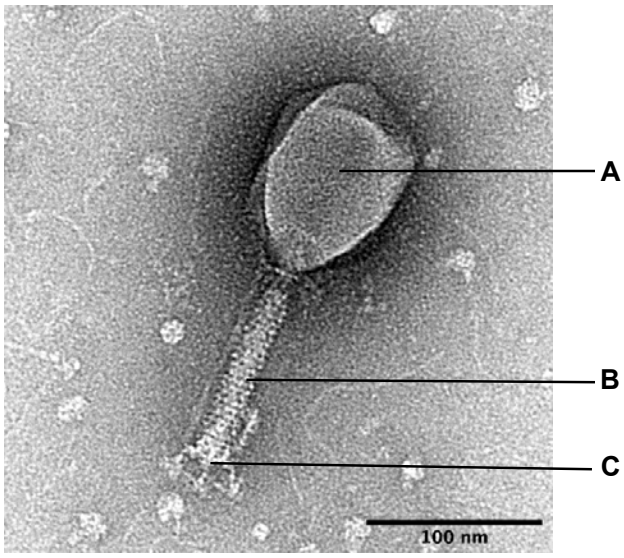

Fig. 5.1

(a) (i) Name the structures labelled **A**, **B** and **C** in Fig. 5.1.

Capsid/ Capsid head/ Nucleocapsid;

A .....

Tail sheath/ contractile sheath; R! tail

B .....

Base plate;

C ..... [3]

(ii) With reference to the information provided, suggest the molecular structure of the genetic material of phage T2.

1. DNA;

.....

2. Double stranded, linear;

..... [2]

(b) (i) As a virulent phage, phage T2 replicates through the lytic cycle.

Describe how newly-synthesised phage T2 are released from the host cell.

1. Phage-coded lysozyme breaks down the bacterial peptidoglycan cell wall;

.....

2. This causes osmotic lysis of host cell / fluid enters, bacterial cell swell and bursts, releasing intact phage T2.

..... [2]

(ii) Temperate phage replicates through both the lysogenic and lytic cycles.

Suggest why it may be advantageous for a phage to have a lysogenic cycle.

1. **Phage DNA / genome / prophage can also be replicated each time the host cell/ bacteria divides;**

……

2. **hence allowing a large number of viral particles to be assembled upon prophage induction;**

……

3. **Phage DNA/ genome integrates itself into the host cell/ bacteria's chromosome/ genome/ DNA and becomes dormant as a prophage;**

……

4. **This allows the phage to survive for long periods when conditions are unfavourable for viral reproduction, such as lack of nutrients or presence of harsh chemicals;**

……

5. **When conditions change, the prophage can switch back to the lytic cycle and start reproducing again;**

……

……..... [4]

[Total: 11]

[Turn over

6 The production of β-galactosidase is controlled by a length of DNA called the *lac* operon.

(a) Fig. 6.1 shows the *lac* operon when lactose is absent.

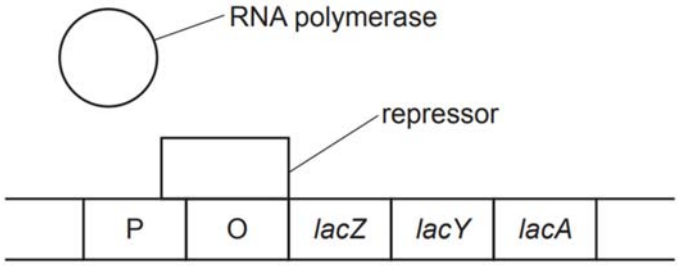

Fig. 6.1

Using the symbols from Fig. 6.1, on Fig. 6.2 draw the positions of RNA polymerase and the repressor molecule when lactose is **present**.

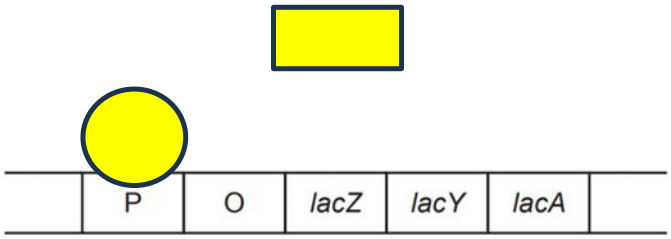

Fig. 6.2

1. RNA polymerase (<u>circle</u>) attached to P;
2. Repressor (<u>rectangle</u>) detached from O and not at any other segments of operon;
R! any other symbols used

[2]

(b) State the function of the *lacY* gene.

***LacY* gene codes for <u>lactose permease</u> which actively transports <u>lactose</u> into the cytoplasm of bacterium;**

…….. [1]

(c) In an investigation into the growth of *E. coli*, a sample of the bacterium was grown in a medium that contained limited concentrations of glucose and lactose. The population size of *E. coli* was measured at regular intervals.

Fig. 6.3 shows the population growth curve from this investigation.

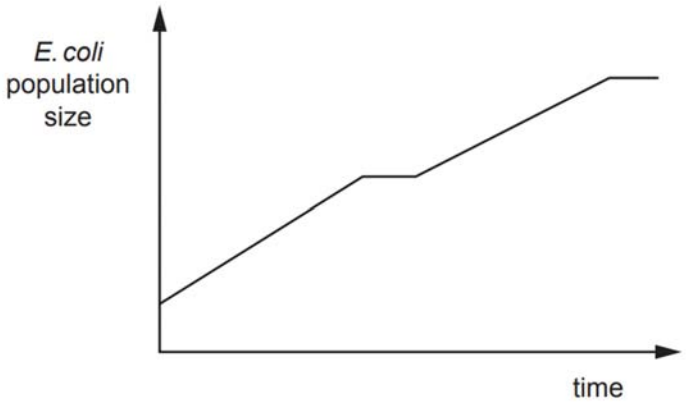

Fig. 6.3

Account for the population growth curve shown in Fig. 6.3.

1. ***E. coli* population size initially increases before levelling off for a while, increases once more and levels off again;**
2. **The initial increase in population size is due to *E.coli* cells utilising glucose for respiration;**
3. ***E.coli* cells divide via binary fission;**
4. **Population size levels off when glucose depletes, and the bacteria take time to activate the lac operon to produce β-galactosidase;**
5. **Population size increases again as bacteria now hydrolyse/ break down/ digest lactose into glucose and galactose and utilises the glucose;**
6. **Population size levels off again as lactose is depleted;**

…….. [4]

(d) The *lac* operon is an example of an inducible system whereas *trp* operon is an example of a repressible system.

Suggest why it is an advantage to prokaryotes to have repressible systems.

1. **When the end-product is abundant, the synthesis would stop;**
2. **operon can be repressed to minimise wastage/conserve resources (which is particularly important in resource-limited environments);**
3. **resources can be redirected to other cellular processes important to the bacterium;**

…….. [2]

[Total: 9]

[Turn over

For Examiner Use

7 Stem cells are unspecialised cells of the human body capable of self-renewal. In recent years, stem cell therapy has become a very promising research topic.

(a) (i) Using a named example, describe the feature of totipotent stem cells.

1. **Totipotent stem cells, such as the zygote / zygotic stem cells;**
2. **have the potential to become any cell type to form an entire organism, including the extra-embryonic membranes; R! extra-embryonic cells**

…… [2]

(ii) Describe two ethical challenges of stem cell therapy and research.

Defining the moral status of an embryo

1. **Procedure of harvesting of ES cells destroy the embryo R! zygote which has the potential to develop into a full-sized organism/ akin to taking a human life;**
2. **Intentional creation of embryos with the intention of using them for research and destroying them in that process is considered active killing and violates respect for nascent human life;**

max 1

Welfare of donors and patients

3. **Harvesting of oocytes R! embryos is invasive/painful / Medical risk of oocyte retrieval from the women / reducing the number and possibly the quality of remaining oocyte for future reproductive purposes**
4. **Increasing risk of exploitation of women for commercial benefits;**
5. **Informed consent of donors of surplus ES cell lines from frozen embryos from IVF may not be obtained / donors may not fully understand the implications of the donation**
   OR
   confidentiality of the donor may not be protected;
   OR
   Patient may not fully understand the moral issue arising from the use of stem cell for their consent;
6. **ES cells from donor may exhibit unknown long term effects that range from incompatibility to tumor formation in recipient and recipient may not fully understand the implications;**

Social responsibilities

7. **Technologies used to produce stable stem cell lines can be licensed and patented by the biotechnology companies, only the rich has access to and can afford the stem cell therapies that come with high costs;**

ES research involving human and animals

8. **Creation of ES cells using nonhuman oocytes may give rise to chimeras that appear part human and part animal / have characteristics of both humans and animals;**
9. **The implantation of human stem cell into animals during experimentation may cause development of human part on animals';**

max 1

R! ethics of animal testing
R! religious concerns
R! genetic modification
R! cloning of individuals

…… [2]

(b) During an ischaemic stroke, many brain cells will die due to the lack of oxygen. Scientists have investigated the use of different types of stem cell to treat damage to the brain after a patient suffers from an ischaemic stroke.

One of the types of stem cells that scientists are working on is the neural stem cell (NSC).

Fig. 7.1 shows the types of cells which NSCs can differentiate into.

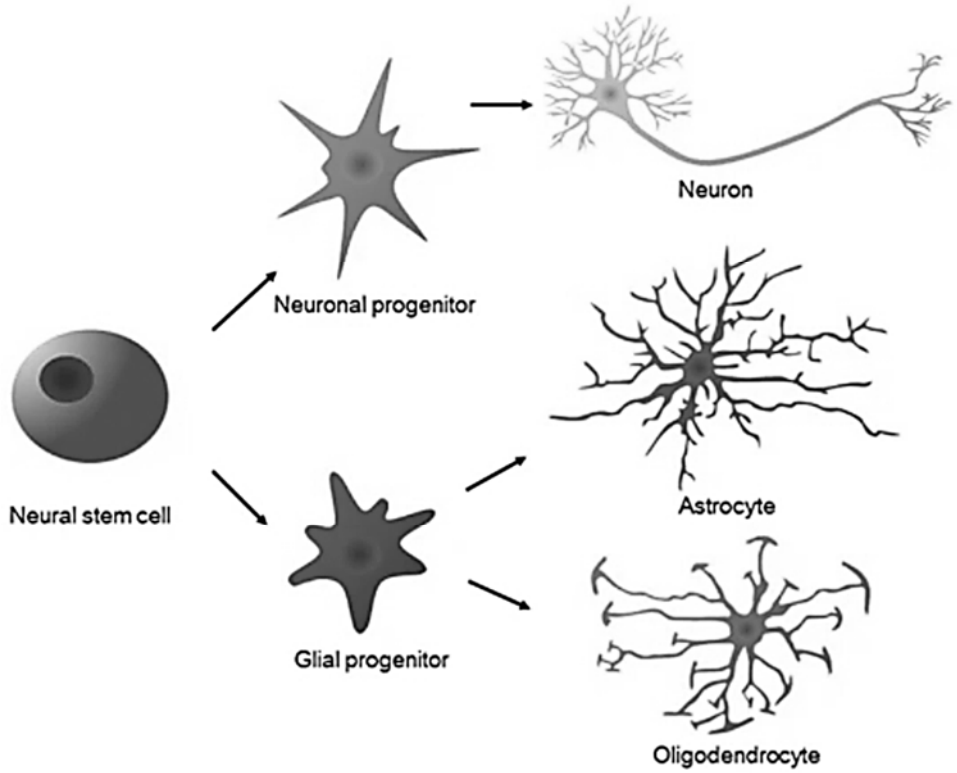

Fig. 7.1

(i) With reference to Fig. 7.1, state the potency of NSCs and explain how they are suitable to treat ischaemic stroke patients.

1. **Multipotent stem cells;**

……..

2. **They have the potential to differentiate into a limited range of cell types of the brain, such as a neuron, astrocyte and oligodendrocyte (any 2) to replace dead cells; R! repair dead cells**

…… [2]

[Turn over

(ii) NSCs are capable of undergoing asymmetrical division.

Describe the advantage of asymmetrical division.

1. **Asymmetrical division allows stem cells to produce one daughter stem cell that is identical to the parental stem cell, ensuring a constant pool of stem cells;**

……

2. **and one progenitor cell that is only capable of differentiating into related specialised cell type, increasing population of specialised cells in a specific tissue;**

…… [2]

(iii) Suggest how implanting NSCs into a patient's damaged brain could potentially cause additional harm.

1. **As NSCs have the ability to self-renew, they can continue dividing non-stop;**
2. **Which can lead to growth of tumours/ cancers;**
   OR

……

3. **Implanted NSCs may face immune/ tissue rejection OR are recognised by the brain immune cells ;**
4. **Causes inflammation which leads to brain damage OR immunosuppressant drugs will need to be taken lifelong;**

…… [2]

[Total: 10]

8 Fig. 8.1 shows an electron micrograph of structures within a chloroplast.

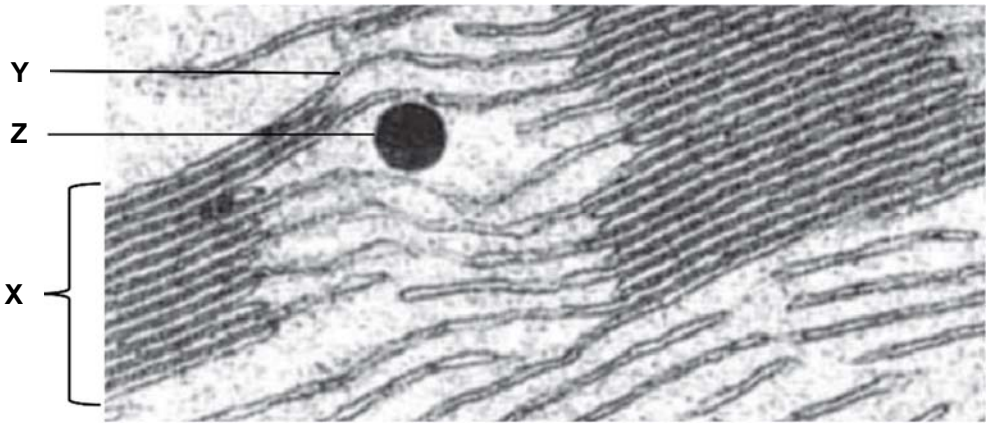

Fig. 8.1

(a) (i) Name the structures labelled **X** and **Y** in Fig. 8.1.

1. **Granum (R! Grana)**

X: ……

2. **Intergranal thylakoid / Intergranal lamella (R: Intergranal lamellae) / Intergranum**

Y: ……

[2]

(ii) Z is a lipid droplet that can be formed within chloroplasts.

Suggest how lipids can be synthesised within the chloroplasts even though it lacks smooth endoplasmic reticulum.

1. **Enzymes that can catalyse the formation of lipids;**
2. **are found in the stroma of chloroplast;**

OR

3. **Calvin cycle that occurs in the stroma will produce a 3-carbon compound known as glyceraldehyde-3-phosphate; (R! GALP)**
4. **Glyceraldehyde-3-phosphate will leave the Calvin cycle and be chemically converted to lipids in a series of reactions;**

……..

…….. [2]

[Turn over

(b) Fig. 8.2 shows two graphs relating to photosynthesis overlaid on the same grid.

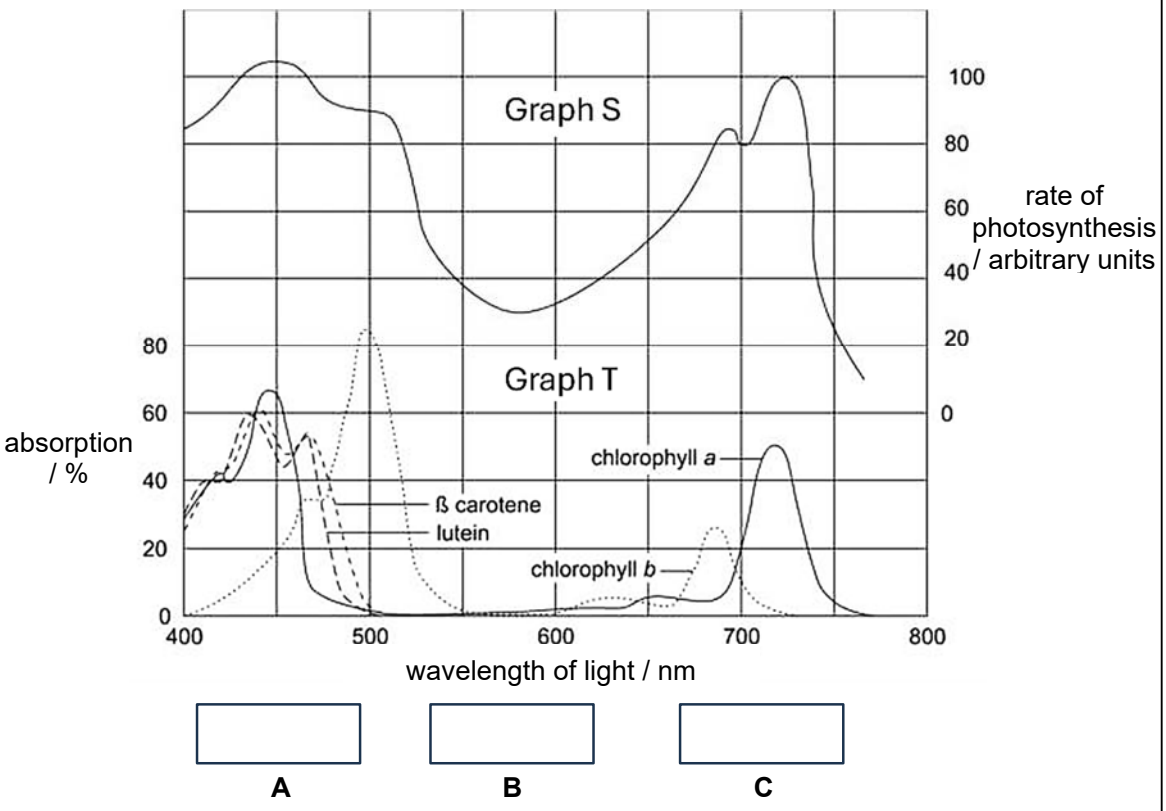

Fig. 8.2

(i) Describe how light is absorbed during photosynthesis.

1. **Light energy/ photon is absorbed by <u>pigment molecules/ chlorophyll/ light harvesting complex/ accessory pigments</u>;**
2. **which are in <u>photosystems</u>, embedded on the <u>thylakoid membranes</u>;**

……[2]

(ii) Compare graphs S and T.

Similarities:

1. **Both graphs have general <u>peaks</u> at <u>450 nm</u> (A! 440 to 460 nm) and <u>680 - 690/ 720 - 725 nm</u> wavelength;**
2. **Both graphs have their low range/ point (575 nm) at the 550 - 625 nm wavelength range;**
3. **The <u>peaks</u> for both graph at <u>450 nm</u> is higher than the peaks at <u>680-725 nm</u>;**

Differences:

4. **The y-axis of Graph S is <u>rate of photosynthesis</u> whereas that of Graph T is <u>absorption</u> (%);**
5. **Graph S is generated from data of all photosynthetic <u>pigments</u> whereas Graph T comprises of data from specific photosynthetic <u>pigments</u>;**
6. **Graph S shows one graph line whereas Graph T comprises 4 different graph lines;**

Note: at least one similarity and one difference to score max 2.

……..... [2]

(iii) Red, blue and green light coincide with specific wavelengths.
On Fig. 8.2, indicate in the boxes **A**, **B** and **C** at the bottom of the graph, where red, blue and green light is found.

Box A: Blue; Box B: green; Box C: red

1. All 3 correct, 2 marks awarded; 1 or 2 correct, only 1 mark awarded.

[2]

[Total: 10]

[Turn over

For Examiner Use

9 **(a)** Explain what is meant by the term phylogeny.

1. Phylogeny is the organisation of species according to particular characteristics;
2. which takes into consideration the evolutionary relationships between the species;
…….. [2]

In the Hawaiian archipelago, there is a group of birds known as the Hawaiian honeycreepers. They do not occur naturally in other parts of the world. Although at least 56 species of Hawaiian honeycreepers have been documented, only 18 of them survive today with the most recent extinction occurring in 2004.

Fig. 9.1 shows the phylogenetic tree of the Hawaiian honeycreeper species. The four grey vertical bars indicate the times when the four Hawaiian islands were formed.

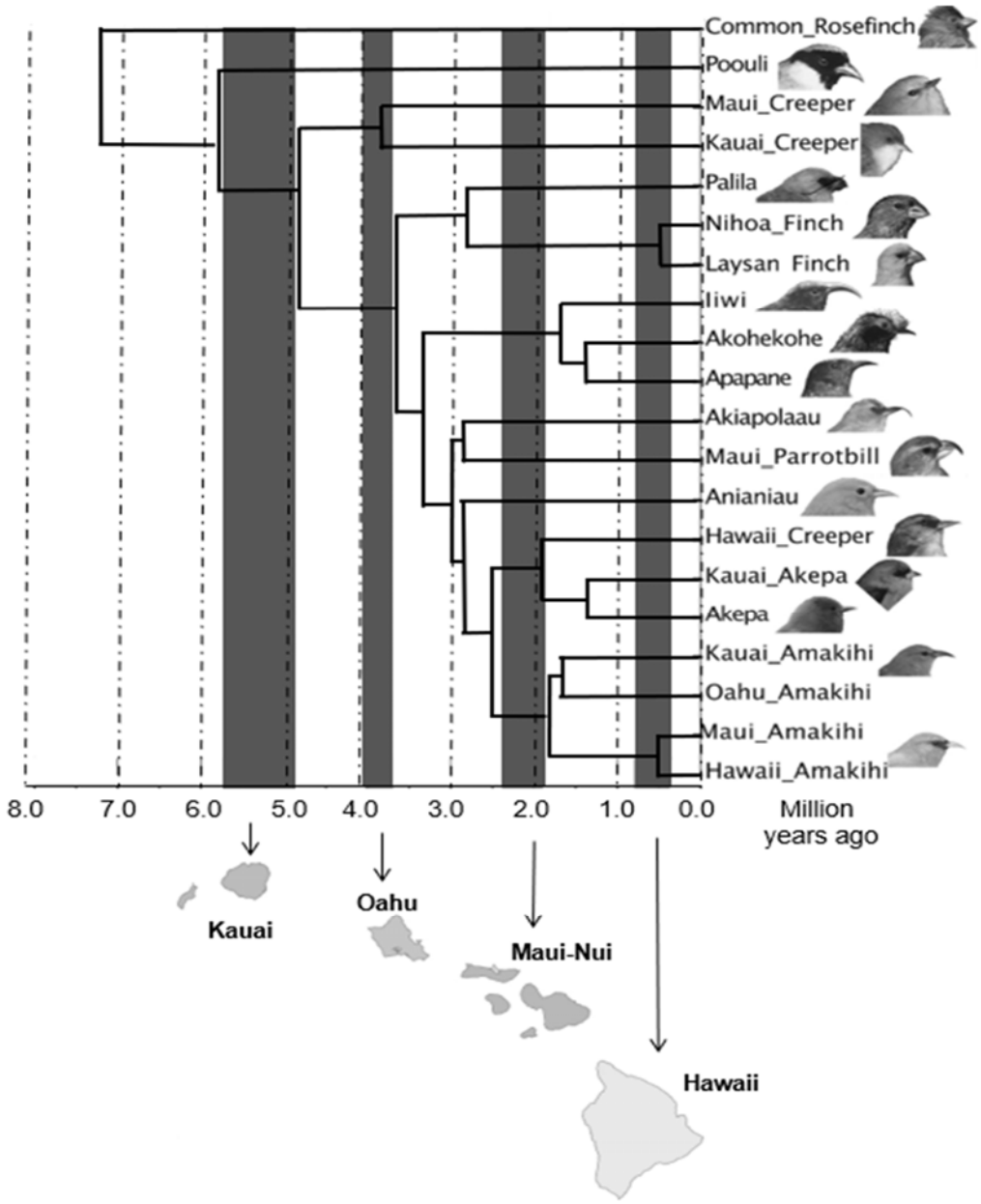

Fig. 9.1

(b) Explain how the common ancestor of Hawaiian honeycreepers evolved into so many different species in just under 6.0 million years.

1. **Inheritable variation is present in the ancestral population of honeycreepers;**
2. **Whenever a new island formed, a population of birds colonised it and became geographically isolated as the surrounding water bodies act as a barrier to separate the islands;**
3. **Numerous niches were available on the new island and adaptive radiation occurred;**
4. **Different environment present on different islands exerts different selection pressures;**
5. **Honeycreepers with favourable traits are selected for, have higher reproductive success and pass on the alleles to their offspring;**
6. **Divergence may occur by natural selection and genetic drift, changing allele frequency in gene pools such that the gene pools become distinct over time;**
7. **No gene flow occurs between population;**
8. **Honeycreepers from different islands become reproductively isolated and cannot interbreed to produce fertile, viable offspring;**

…….. [5]

(c) With reference to Fig. 9.1, name the island whose emergence corresponds to the greatest number of speciation events.

Oahu;

…….. [1]

(d) The Maui Creeper, while endemic to Maui-Nui, did not originate there. Suggest how the Maui Creeper appears in Maui-Nui.

1. **It emerged in Oahu and when Maui-Nui formed later, it colonised Maui-Nui;**
2. **This may be due to honeycreepers having reduced competition for resources in Maui-Nui / better resources/ environment available in Maui-Nui**
3. **leads to Founder effect, which has reduced genetic variation compared to the original population;**

…….. [2]

[Total: 10]

[Turn over

10 When a person received the smallpox vaccine, the number of plasma cells specific for the smallpox pathogen were measured from blood samples taken over a period of 35 days.

Fig. 10.1 shows the changes in the number of smallpox-specific plasma cells over 35 days following vaccination.

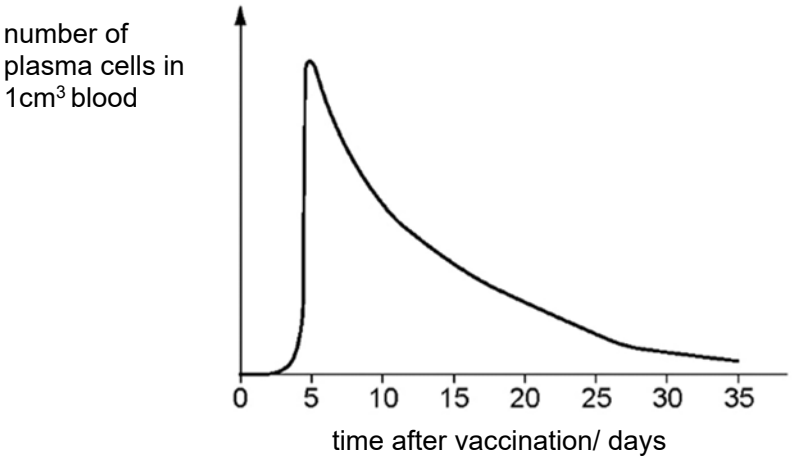

Fig. 10.1

(a) With reference to Fig. 10.1, describe the changes in the number of smallpox-specific plasma cells during the 35 days.

1. **From day 0 to day 2.5 (A! 2–3), the number of smallpox-specific plasma cells remained at 0, then it exponentially/ rapidly/ quickly increased to a peak at day 5 (A! 5.5);**
   OR
   From day 0 to day 5 (A! 5.5);, the number of smallpox-specific plasma cells exponentially/ rapidly/ quickly increased to a peak;

……

2. **From day 5 to day 35, it decreased (slowly) from the peak to close to 0/ low numbers;**
   R! plateau

…… [2]

(b) Explain how a single dose of this vaccine can provide immunity for up to 10 years even though plasma cells are short-lived.

1. **Upon vaccination, memory B cells are also produced along with plasma cells;**
2. **where they are long-lived;**

……

3. **Memory cells are able to proliferate and differentiate into effector cells/ plasma cells upon re-exposure to the same antigen;**

……

4. **resulting in a faster and stronger secondary response to provide immunity;**

…… [3]

[Total: 5]

11 Fig. 11.1 shows the annual change in atmospheric methane concentrations at Baring Head, New Zealand between 1990 and 2022. The dashed line shows the change in atmospheric methane concentration from year to year.

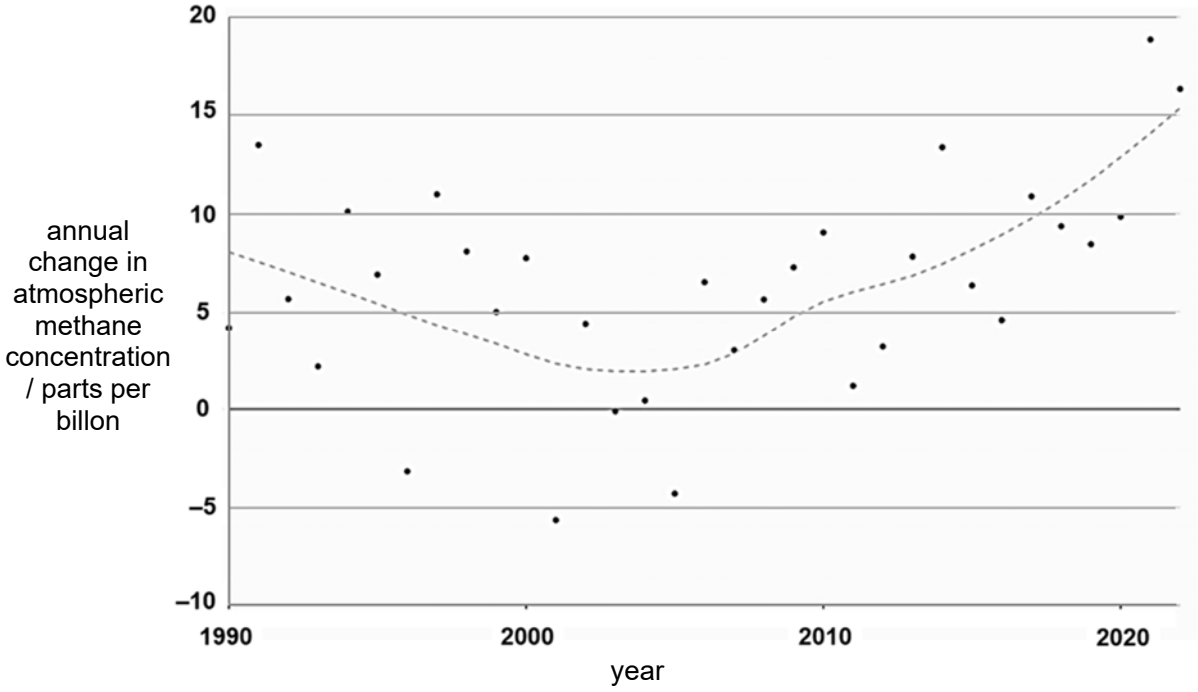

Fig. 11.1

(a) Describe the change in atmospheric methane concentration from 1990 to 2022.

1. **From year 1990 to 2004, the change in atmospheric methane concentration decreased from 8.2 parts per billion to 1.8 parts per billion; A! 8.0 – 8.4 to 1.8 – 2.2**
2. **From year 2004 to 2022, the change in atmospheric methane concentration increased from 1.8 parts per billion to 15.3 parts per billion; A! 1.8 – 2.2 to 15.1 – 15.5**

A! ECF from MP1
A! 2003/ 2005;

…… [2]

(b) Suggest what could have resulted in the change in atmospheric methane concentration from 1990 to 2004.

1. **Drilling for fossil fuels decreased during that time period;**
2. **Livestock farming declined during that time period;**
3. **Usage of landfills reduced / waste management improved during that period;**
4. **Implementation of methane mitigation strategies in agriculture;**
5. **Alternative sources of energy used e.g. solar, wind, hydro, nuclear;**

……[1]

[Turn over

(c) Deduce how the change in atmospheric methane concentration between 2004 to 2022 could affect the temperatures at Baring Head during this period.

1. **As rate of change of methane increased from 2002 to 2022, temperatures would have increased at a more drastic rate at Baring Head;**
2. **This is because methane is a greenhouse gas that traps heat in the atmosphere.**

……..……..[2]

Carbon dioxide is similar to methane with respect to its negative impact in the atmosphere and environment.

Name one other naturally-occurring gas in the atmosphere that could have the same negative impact resulting in climate change.

(d)

1. **Water vapour (R! water, H_2O)**
2. **Nitrous oxide (R! N_2O)**
3. **Ozone (R! O_3)**

(R! Chlorofluorocarbon)

A! Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), Sulphur hexafluoride (SF6) Nitrogen trifluoride (NF3)

……..……..[1]

[Total: 6]

END OF PAPER