Name:		Index Number:		Class:	

DUNMAN HIGH SCHOOL
Preliminary Examination
Year 6

H1 BIOLOGY 8876/02

Paper 2 Structured Questions

14 September 2018
2 hours

INSTRUCTIONS TO CANDIDATES:

DO NOT TURN THIS PAGE OVER UNTIL YOU ARE TOLD TO DO SO.

READ THESE NOTES CAREFULLY.

Answer **all** questions.

Write your answers on space provided in the Question Paper.

INFORMATION FOR CANDIDATES

Essential working must be shown.

The intended marks for questions or parts of questions are given in brackets [ ].

For Examiner's Use	
Section A	
1	**/ 10**
2	**/ 5**
3	**/ 7**
4	**/ 8**
5	**/ 6**
6	**/ 9**
Section B	
1 / 2	**/ 15**
Total [60]	

This document consists of **15** printed pages and **1** blank page.

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Section A: Structured Questions (45 marks)

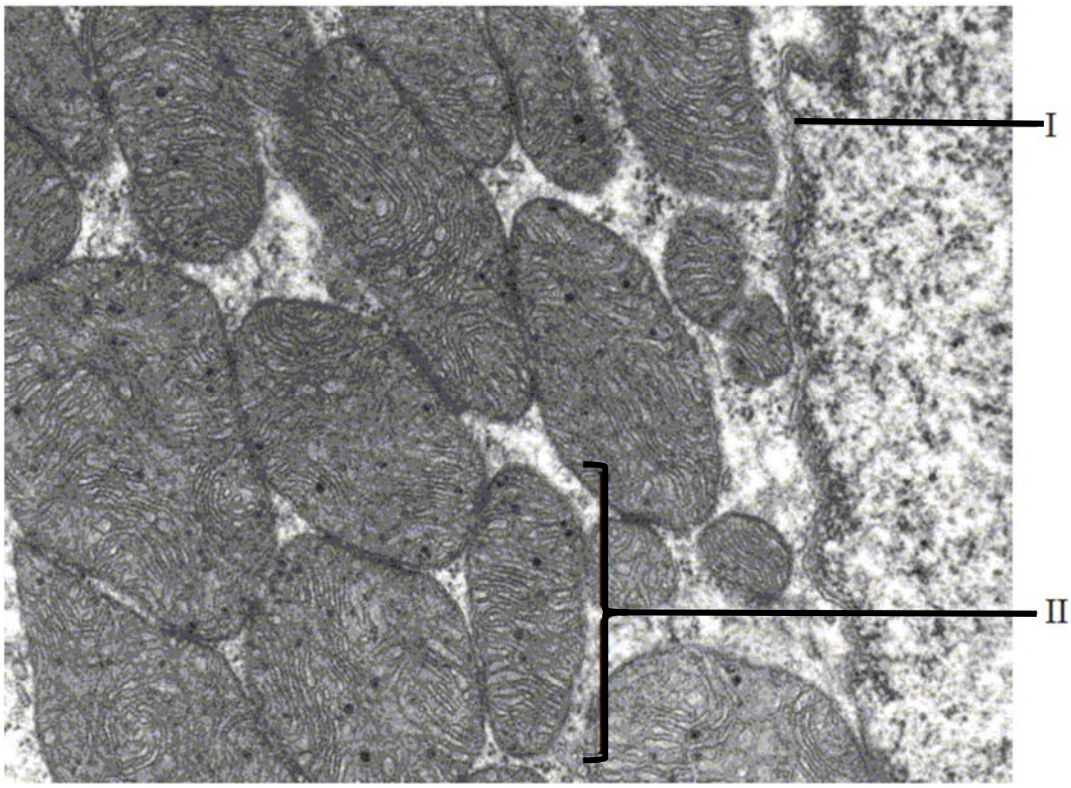
Answer **all** questions in this section.

For Examiner's use

Question 1

(a) Distinguish between the terms "***resolution***" and "***magnification***". [1]

The electron micrograph below shows part of a cell.



(b) **(i)** Identify the structures labelled **I** and **II**. [2]

I :

II :

(ii) State one function of structure **I**. [1]

For Examiner's use

(iii) State one function of structure **II**. [1]

(iv) Deduce, with a reason, whether this cell is eukaryotic or prokaryotic. [1]

(c) RNAs are synthesised in nucleus and transported out into the cytoplasm for use in protein synthesis. Describe the roles of mRNA and rRNA in protein synthesis. [4]

mRNA:

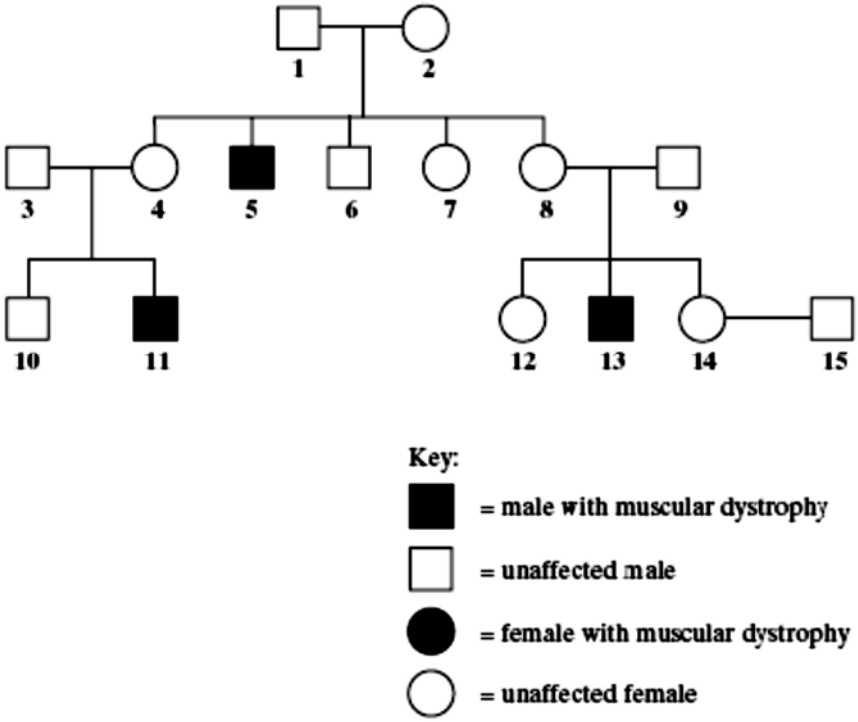
rRNA:

Total: [10]

Question 2

For Examiner's use

Duchenne muscular dystrophy is a sex-linked inherited condition which causes degeneration of muscle tissue. It is caused by a recessive allele. The diagram shows the inheritance of muscular dystrophy in one family.



(a) Give evidence from the diagram which suggests that muscular dystrophy is:

(i) sex-linked. [1]

.....

.....

(ii) caused by a recessive allele. [1]

.....

.....

For Examiner's use

(b) Using the following symbols:

$\mathbf{X^D}$**=** an X chromosome carrying the normal allele
$\mathbf{X^d}$**=** an X chromosome carrying the allele for muscular dystrophy
Y = a Y chromosome

Give **ALL** the possible genotypes of each of the following persons. [2]

5:

6:

7:

8:

(c) A blood test shows that person **14** is a carrier of muscular dystrophy. Person **15** has recently married person **14** but as yet they have had no children.

What is the probability that their first child will be a male who develops muscular dystrophy? [1]

Total: [5]

Question 3

For Examiner's use

(a) The *APP* gene provides instructions for making a protein called amyloid precursor protein. This protein is found in many tissues and organs, including the brain and spinal cord. The most common mutation on the *APP* gene involves one codon being changed from GCC to GUC. Fig. 3.1 shows the genetic code.

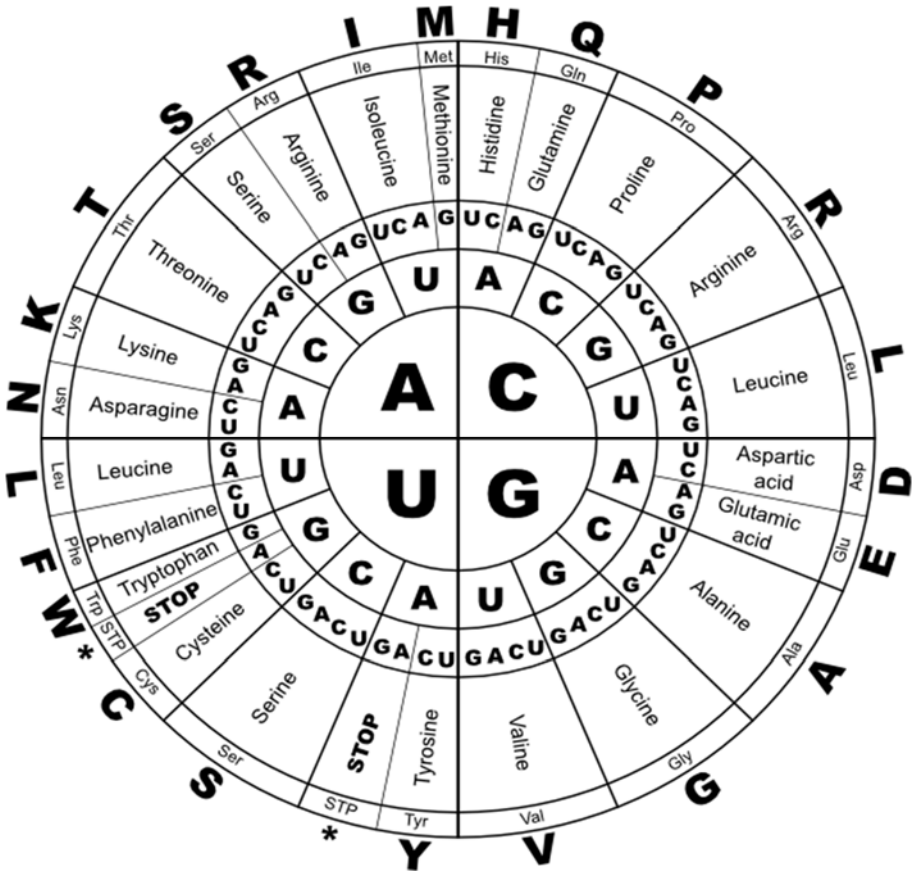


Fig. 3.1

Explain the significance of codon in translation. [3]

For Examiner's use

(b) With reference to Fig. 3.1, describe the mutation that has occurred. [2]

(c) Amyloid precursor protein is cut by enzymes to create smaller fragments, some of which are released outside the cell. Two of these fragments are called soluble amyloid precursor protein (sAPP) and amyloid beta (β) peptide. This mutation in the *APP* gene can lead to the production of a "stickier" form of the β peptide. When these protein fragments are released from the cell, they can accumulate in the brain and form clumps called amyloid plaques. These plaques are characteristic of Alzheimer disease.

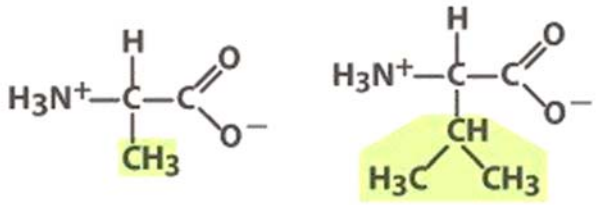


Fig. 3.2

Fig. 3.2 shows the structures of alanine and valine. Both amino acids contains non-polar R group. Suggest how a change from alanine to valine can result in a mutated amyloid precursor protein which then give rise to amyloid plaques. [2]

Total:[7]

Question 4

For Examiner's use

Dengue is the most rapidly spreading mosquito-borne viral disease in the world. In the last 50 years, incidence has increased 30-fold with increasing geographic expansion to new countries and, in the present decade, from urban to rural settings. An estimated 50 million dengue infections occur annually and approximately 2.5 billion people live in dengue endemic countries.

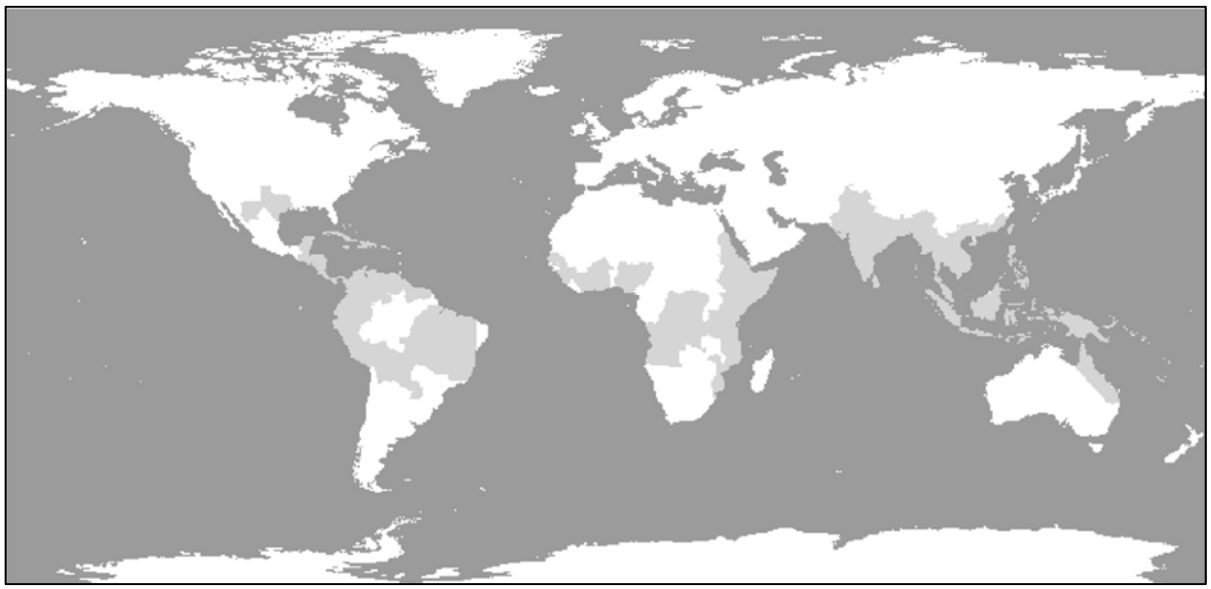


Fig. 4

Shaded areas in Fig. 4 represents countries at risk of dengue fever due to presence of Aedes mosquito, as of 2008.

(a) Outline the developmental stages in the life cycle of the Aedes mosquito. [4]

(b) Explain why the growing area of influence of dengue fever overlaps with that of the Aedes mosquito. [3]

For Examiner's use

(c) To some extent the range of the Aedes mosquito has also followed human expansion. Explain how this may be true. [1]

Total:[8]

Question 5

For Examiner's use

Cranes are large birds. One of the earliest methods of classifying cranes was based on the calls they make during the breeding season.

(a) Suggest why biologists could use calls to investigate relationships between different species of crane. [2]

The bone protein, osteocalcin, has been extracted from fossil Neanderthal skulls found in Shanidar Cave, Iraq. The skulls were estimated to be approximately 75 000 years old.

Using mass spectrometry, the amino acids of this Neanderthal osteocalcin have been sequenced. This sequence has been compared with that in osteocalcin from *Homo sapiens* and other modern primates.

The sequences of the first 20 amino acids in the primary structure of osteocalcin from this study are shown below in Fig. 5. Amino acids are represented by capital letters.

	1								10									20
Modern human	Y	L	Y	Q	W	L	G	A	P	V	P	Y	P	D	P	L	E	P	R	R
Neanderthal	Y	L	Y	Q	W	L	G	A	P	V	P	Y	P	D	P	L	E	P	R	R
Chimpanzee	Y	L	Y	Q	W	L	G	A	P	V	P	Y	P	D	P	L	E	P	R	R
Orang-utan	Y	L	Y	Q	W	L	G	A	P	V	P	Y	P	D	P	L	E	P	K	R
Gorilla	Y	L	Y	Q	W	L	G	A	O	V	P	Y	P	D	P	L	E	P	K	R
Monkey	Y	L	Y	Q	W	L	G	A	O	A	P	Y	P	D	P	L	E	P	K	R

Fig. 5

(b) Suggest what the data indicate about the relationships between Neanderthals and modern primates. Give reasons for your answer. [4]

Total: [6]

For Examiner's use

Question 6

The following experiment was carried out to investigate the effect of light intensity on the rate of photosynthesis of a water plant, *Elodea*.

- *Elodea* was cut into three pieces, each 10 cm long.
- Each piece of *Elodea* was placed in a glass tube, containing 0.5% sodium hydrogen carbonate solution, which was then sealed with a bung.
- Tube **A** was placed 10 cm away from a lamp.
- Tube **B** was placed 5 cm away from a lamp.
- Tube **C** was placed in a dark room.
- An oxygen sensor was used to measure the percentage of oxygen in the solutions at the start of the experiment and again at 5, 10 and 20 minutes.

The results are shown in Fig. 6.1.

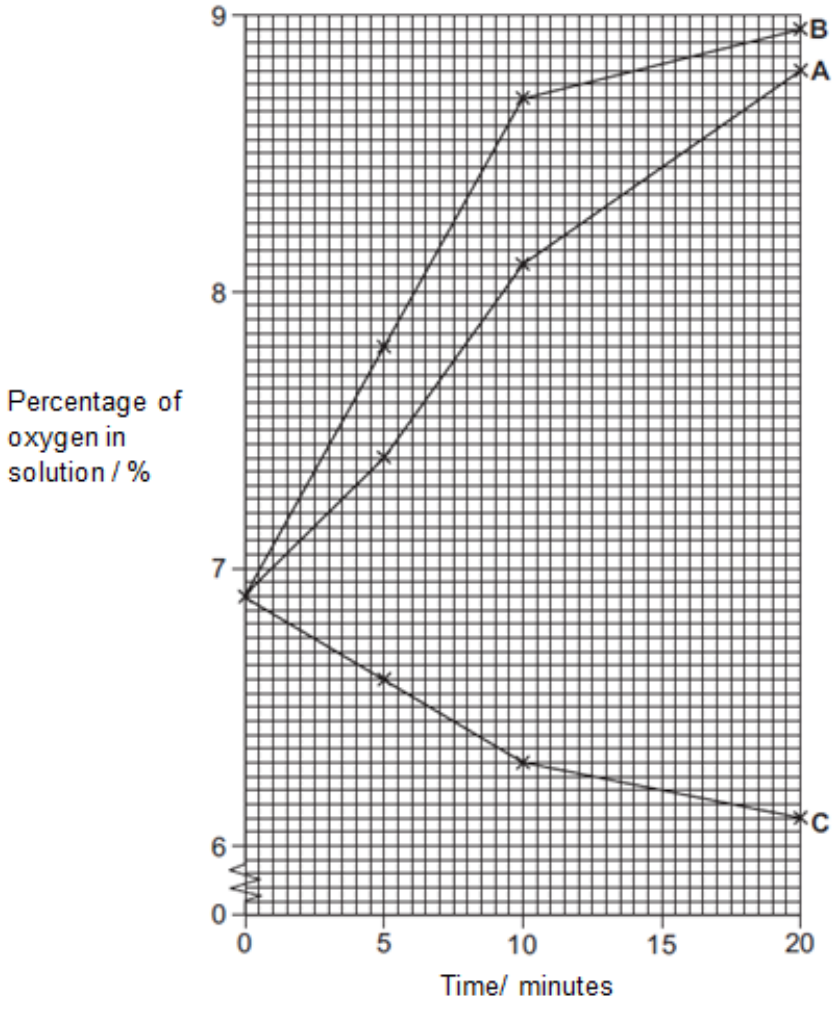


Fig. 6.1

For Examiner's use

(a) With reference to Fig. 6.1,

(i) Calculate the rate of oxygen production for tube **A** for the 20 minutes of the experiment. Give your answer to two decimal places. Show your working. [1]

(ii) Compare the results for tubes **A** and **B**. [2]

(iii) Explain the results for tube **C**. [2]

Fig. 6.2 outlines the early stages of respiration in yeast cells in the presence of oxygen.

For Examiner's use

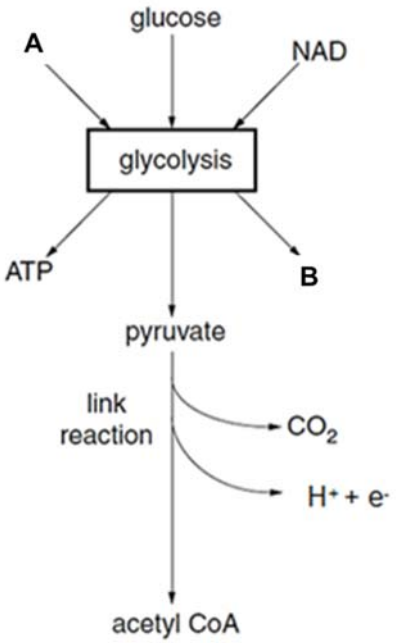


Fig. 6.2

(b) With reference to Fig. 6.2,

(i) Identify molecules **A** and **B**. [2]

A: .....

B: .....

(ii) Explain what would happen to pyruvate in the absence of oxygen. [2]

.....

.....

.....

.....

Total: [9]

Section B: Free-Response Question (15 marks)

Answer only **one** question.
Write your answers on the writing paper provided.
Answer each part (a) and (b) on a fresh piece of writing paper.

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.
A **NIL RETURN** is required.

Question 1

(a) Describe the role of proteins in the structure of the cell surface membrane. [5]

(b) Describe ATP synthesis in various cellular processes. [10]

Total: [15]

OR

Question 2

(a) Describe the structure of DNA and explain how its stability is maintained. [5]

(b) Describe how cancer occurs and outline the factors that increase the chances of cancerous growth. [10]

Total: [15]

END OF PAPER

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DUNMAN HIGH SCHOOL
PRELIMINARY EXAMINATION 2018
YEAR SIX
H1 BIOLOGY (8876)

Suggested Answers

Question 1

(a)
Resolution refers to the degree of details that can be seen whilst magnification refers to the number of times a specimen can be enlarged

(b)(i)
I : nuclear envelope
II : mitochondrion

(ii)
I :
Contain nuclear pores to allow for RNA to leaves nucleus and nucleotides and enzymes to enter nucleus

(iii)
II : Involved in cellular (aerobic) respiration that result in the formation of ATP

(iv)
Eukaryotic cell due to presence of membrane bound organelles namely mitochondria and nucleus

(c)
mRNA
sequence of codons determine the sequence of amino acids in polypeptide
direct the initiation and termination of translation by the start and stop codon

rRNA
rRNA is a component of ribosome
rRNA component interacts with mRNA and tRNA by bringing them to correct orientation during proteins synthesis

Question 2

(a)(i)
Only seen in males / not in females

(a)(ii)
Unaffected parents/mother → child with M.D. / (1 x)2 → 5 / (3 x) 4 → 11 / 8 (x 9) → 13

(b)
5 X^dY
6 X^DY
7 X^DX^d AND X^DX^D
8 X^DX^d

All 4 correct = 2 marks
2 or 3 correct = 1 mark

(c)
¼ / 0.25 / 25% / 1:3 / 1 in 4; (NOT '1:4')

Question 3
(a)
- A codon is three nucleotides/bases on mRNA that specify an amino acid
- It is where the corresponding tRNA anticodon will complementary base-pairs
- signals the start of translation
- signals the termination of translation

(b)
- Single base pair substitution mutation from guanine to adenine on DNA template strand
- Results in the substitution/replacement of an amino acid from alanine to valine

(c)
- Ref. alanine and valine gives rise to different extent of hydrophobic interaction
- more extensive hydrophobic interaction between β peptides and thus forming amyloid plaques

Question 4
(a)
- Eggs are laid on damp surfaces/ surface of stagnant water
- Larvae hatch from eggs upon being submerged in water
- larvae feed on microorganisms and particulate organic matter, shedding their skins three times to be able to grow from first to fourth **instars**
- When the larva has acquired enough energy and size and is in the fourth instar, metamorphosis is triggered, changing the larva into a pupa
- Pupae do not feed, they just change in form until the body of the adult, flying mosquito is formed and emerged

(b)
- *Aedes aegypti* is a mosquito vector
- In the last 50 year, as climate change to warmer and wetter in more countries, mosquito also thrives in these new places
- therefore where the vector thrives so does the dengue virus

(c)
- ref. human activity provide viable habitats e.g. stagnant water for Aedes to thrive
- In colder latitudes or altitudes, urbanisation / large cities provide a warmer habitat

1 Max

Question 5
(a)
the calls made by cranes are species specific

the greater the similarity in calls, the closer the relationship between different species is likely to be

(b)
- Neanderthals, modern human and chimpanzee are the most closely related
- because the first 20 amino acid sequences for all three organisms are identical
- subsequent relatedness to Neanderthal is in the order of orang-utan, gorilla and monkey
- because orang-utan has 1 amino acid difference from Neanderthals, gorilla 2 differences and monkey 3 differences
- at least one difference described in detail e.g. orang-utan has 1 amino acid difference from Neanderthals at amino acid 19, a change from R to K in orang-utan

4 max

Question 6
(a)(i)
(8.8% - 6.9%) / 20 = 0.10 % per minute

(a)(ii)
1 mark for quoting appropriate pair of values with units
1 mark for describing appropriate difference (using comparative terms) between solutions A and B

E.g.
- From 0-20mins, percentage O_2 in solution **B** increased from **6.9% to 8.95%** but percentage O_2 in solution A increased from **6.9% to 8.8%**.

- From 0-10min, percentage O_2 in solution **B increased more steeply** from **6.9% to 8.7%** but percentage O_2 in solution **A** increased from **6.9% to 8.1%.**

OR
- From 0-10min, percentage of O_2 in solution **B has a higher increase of 1.8%** but O_2 increase in solution **A increased by only 1.2%**.

- From 10-20min, percentage O_2 in solution **B increased less steeply** from **8.7% to 8.95%** but percentage O_2 in solution A **increased more steeply from 8.1% to 8.8%**.

OR
- From 10-20min, percentage of O_2 in solution **B has a lower increase of 0.25%** but O_2 increase in solution **A** has a **higher increase of 0.7%**.

(a)(iii)
(quote values and describe trend) From 0 – 20 mins, percentage of O_2 in solution C decreased from 6.9% to 6.1%

In the absence of light, no photolysis of water, hence, no oxygen released

As oxygen is used up in respiration
2 max

(b)(i)
A: ATP / ADP
B: reduced NAD / NADH

(b)(ii)
Anaerobic respiration / lactic acid fermentation;
Pyruvate will be used in anaerobic respiration / alcohol fermentation;

to form ethanol and CO_2 instead of undergoing link reaction to form acetyl CoA;

Essay Answers

1(a)

1. channel proteins with hydrophilic pores found within intrinsic protein molecules
2. Conformation change in carrier protein allows selective passage of molecules across the plasma membrane
3. for facilitated diffusion of ions, large and polar molecules/ for osmosis / water molecules diffuse across the membrane
4. for active transport to pumps to move solutes against concentration gradients
5. receptor proteins for binding of antigens / hormones / external signal molecules
6. to allow an external signal to trigger or initiate reactions within a cell
7. Glycoprotein function in cell-cell adhesion / function in cell junctions / cell-cell recognition

1(b)

1. ATP is synthesized by substrate level photophosphorylation, oxidative phosphorylation and photophosphorylation.
2. ATP is synthesized during glycolysis, in the cytoplasm, and during Kreb cycle in the mitochondrial matrix. ;
3. 4 ATP / 2 nett ATP is synthesized per glucose molecule during glycolysis. ;
4. In anaerobic respiration, ATP is synthesized only by substrate level phosphorylation in glycolysis. ;
5. In the Kreb cycle, 2 ATP is synthesized per glucose when succinyl-CoA is converted to succinate. ;
6. NAD and FAD are reduced during glycolysis, link reaction and Kreb cycle. ;
7. Reduced NAD and FAD donates electrons to the electron transport chain on the inner mitochondrial membrane. ;
8. As electrons are transported along a series of electron carriers of progressively lower energy levels, some energy is used to pump H^+ from the matrix to the intermembrane space, against its concentration gradient ;
9. This creates a proton gradient across the inner mitochondrial membrane, driving protons to diffuse down its concentration gradient via ATP synthase on the inner mitochondrial membrane. ;
10. ATP synthase harness the proton motive force for phosphorylation of ADP to ATP, in the mitochondria matrix. ;
11. O_2 is the final electron carrier of the electron transport chain. ;
12. 3 ATP is synthesized per reduced NAD and 2 ATP per reduced FAD. ;
13. ATP is produced during non-cyclic photophosphorylation and cyclic photophosphorylation;
14. During non-cyclic photophosphorylation, photolysis of water donates electrons to the electron transport chain on the thylakoid membrane;
15. Light energy is harvested by photosynthetic pigments and the energy is passed on to the reaction centre chlorophyll;
16. Electron at reaction centre chlorophyll a is excited to a higher energy level;
17. As electrons are transported along a series of electron carriers of progressively lower energy levels, some energy is used to pump H^+ from the stroma to the thylakoid lumen, against its concentration gradient ;
18. This creates a proton gradient across the thylakoid membrane, driving protons to diffuse down its concentration gradient via ATP synthase on the thylakoid membrane. ;

QWC: at least 2 points each from substrate level photophosphorylation, oxidative phosphorylation and photophosphorylation

2(a)

2(b)

1. Cancer arises from uncontrolled cell division / loss of normal control of cell division
2. Due to mutations which alter the genes that control cell division
3. This causes the rate of cell division to exceed the rate of cell differentiation and cell loss
4. And leads to tumour formation / tumourigenesis
5. Which invades / infiltrates into surrounding tissues and disrupts its normal organisation
6. Cancer cells can metastasise / spread *via* blood or lymph vessels to other organs
7. Exposure to chemical carcinogens that are alkylating agents and electrophiles
8. Such as mustard gas, asbestos, polycyclic hydrocarbons, various pesticides and herbicides, carbon monoxide in cigarette smoke / OVA
9. High energy beams / wavelengths such as ultraviolet radiation / X-rays / gamma rays
10. Some viruses can also cause cancer by causing genetic changes in the cells that will make them cancerous
11. Some people also possess genetic predisposition to cancers, where genes involved in regulating cell division such as proto-oncogenes or tumour suppressor genes become defective
12. A compromised immune system could also lead to abnormal proteins on cancer cells to not be targeted and removed
13. As a person ages, cells are more likely to have accumulated enough changes to the genes / mutations to turn into cancerous cells

9 Max + QWC

QWC: Includes 2 points each for characteristics of cancer and factors that increases chances of cancerous growth