DUNMAN HIGH SCHOOL
Preliminary Examination
Year 6

H2 Biology Prelim Exam 2022
Mark Scheme

Section A: Multiple Choice Question

1	A	**11**	D	**21**	C
2	A	**12**	C	**22**	A
3	C	**13**	B	**23**	D
4	C	**14**	B	**24**	D
5	A	**15**	A	**25**	A
6	B	**16**	C	**26**	A
7	B	**17**	C	**27**	C
8	B	**18**	B	**28**	A
9	D	**19**	B	**29**	D
10	D	**20**	C	**30**	D

Paper 2
Structured Question

Question 1

(a) Similarities:
Both structures A (mitochondrion) and B (nucleus) have a double membrane.;
Both structures A (mitochondrion) and B (nucleus) contains DNA.;

Differences:
Membrane of A (mitochondrion) is not perforated with pores, while membrane of B (nucleus) is perforated with large protein pores (nuclear pores).;
Inner membrane of A (mitochondrion) folds inward to form cristae, while the membrane of B (nucleus) does not fold.;
DNA exists as circular strands in A (mitochondrion). On the other hand, DNA is packaged into chromosomes in B (nucleus).;

At least 1 similarity and 1 differences.

(b) In structure C (nucleolus), ribosomal RNA (rRNA) is synthesized from DNA.;

In structure D (rough endoplasmic reticulum), ribosomal proteins are synthesized and folded into their conformation.;

rRNA combines with ribosomal proteins to form functional ribosomal subunits.;

(c) **(i)** There are a lot of E / mitochondria present in the cell, allowing for synthesis of many ATP molecules required for metabolism.;

(ii) Presence of free ribosomes in cytoplasm which allows for synthesis of proteins for use within the cell.

(d) In hepatocytes, proteins are secreted via exocytosis whereby secretory vesicles fuse with cell surface membrane to release proteins out of the cell. However, since bacteria do not have secretory vesicles, the proteins are directly transported out of the cell through protein channels present in cell surface membrane.;

A: carrier protein
R: budding as peptidoglycan cell wall is present.

Question 2

(a) ß-pleated sheet;

It is made up of different sections of one polypeptide chain that run alongside each other / can be parallel or antiparallel.;

Adjacent strands are held together by hydrogen bonds formed between -CO and -NH groups of polypeptide backbone to form the sheet.;

(b) Sialidase is made up of amino acids while its substrate is made up of α-glucose and sialic acid.;

Sialidase is made of peptide bonds while its substrate is made up of α(2→3) and α(2→6) glycosidic bonds.;

Sialidase has hydrophobic interactions, hydrogen bonds, ionic bonds and disulfide bonds that helps to maintain its structure, while its substrate does not have such bonds.;

Max 2

(c) H^+ ions will move against concentration gradient from cytosol, which has a lower concentration, into lysosome, which has a higher concentration, via a proton pump.;

ATP is hydrolysed to release energy for active transport.;

(d) Higher pH in cytoplasm results in lower concentration of H^+ ions, which alters the charges on R-groups of enzymes.;

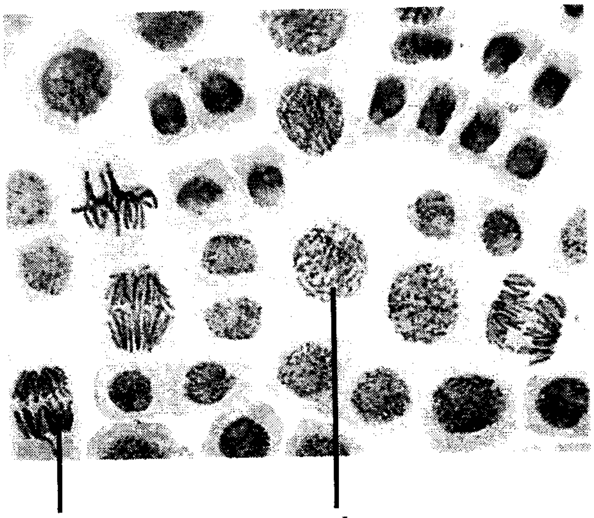
This disrupts hydrogen and ionic bonds within the enzymes, disrupting tertiary structure and thus changing conformation of active site of enzyme, resulting in denaturation.;

(e) Membrane proteins and phospholipids on lysosome membrane are chemically modified.;

Hence, the shape of the proteins and phospholipids are no longer complementary to the active site of lysosome enzymes.;

Question 3

(a)



anaphase prophase;

(b) G_2 checkpoint in interphase also ensures that semi-conservative DNA replication in S phase has been completed accurately, and that any errors in DNA are repaired.;

This ensures that each daughter cell receives a full set of chromosomes at the end of mitosis, maintaining genomic integrity / genetic information is correctly passed on to daughter cells.;

M checkpoint at the end of metaphase / before the start of anaphase ensures that all chromosomes are attached to the mitotic spindle by a kinetochore, ensuring that sister chromatids are correctly separated in anaphase.;

This ensures that daughter cell receives the correct number of chromosomes.;

Max 3

(c) **(i)** <u>S phase of interphase</u>

(ii) Cisplatin can form bonds with two <u>adenine</u> bases on the same strand or across helix.;

If cisplatin form bonds across the helix, helicase cannot break hydrogen bonds between the two DNA strands to unzip the double helix.;

If cisplatin form bonds on the same strand, helicase can unwind and unzip the double helix. However, cisplatin may block DNA polymerase from reading DNA template / forming complementary base pairing / adding deoxyribonucleotides, hence preventing DNA replication.;

(d) **(i)** Microtubule aids in the movement of vesicles / organelles with the help of motor proteins.;

Microtubule helps to support the cell as cytoskeleton.;

Microtubule is involved in cellular movement e.g. formation of cilia and flagella for motility.;

Max 2

(ii) During metaphase, chromosomes cannot be aligned in one row at the metaphase plate.;

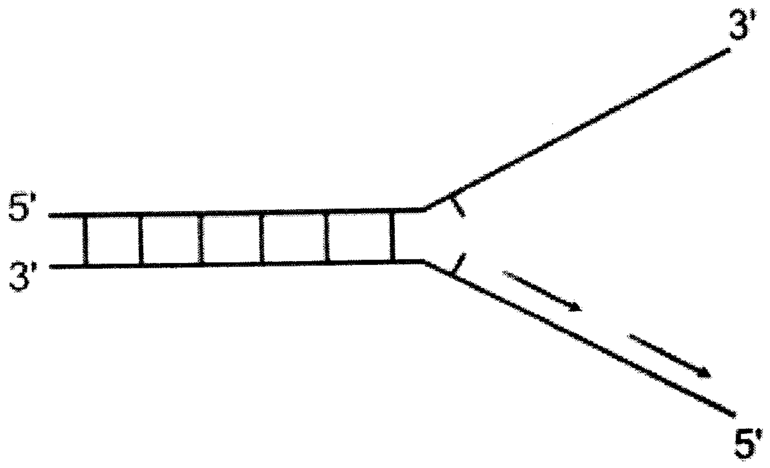
Hence, identical sister chromatids cannot be separated and pulled to opposite poles of the cells in anaphase.;

This prevents mitosis from completing, thereby preventing uncontrolled cell division and tumour formation.;

(iii) Blue light changes the wavelength of light / energy received by the cell.; This causes R group interactions in the tertiary structure of drug to change, causing conformational change.;

Question 4

(a) **(i)**



(ii) DNA is antiparallel.;

DNA polymerase III can only add deoxyribonucleotides to free 3' OH groups / DNA polymerase III can only synthesize new DNA strands in 5' to 3' direction.;

Replication fork moves in one direction. Hence, one strand will be synthesized continuously while the other is synthesized discontinuously.;

Max 2

(b) DNA polymerase I hydrolyse RNA primers and fill in these gaps by adding complementary deoxyribonucleotides.;

DNA ligase catalyses the formation of a phosphodiester bond to seal nicks.;

Both parental and daughter strands rewind into a double helix.;

R: Proofreading by DNA polymerase III as each nucleotide is checked against template as soon as it is added to growing strand.

(c) Ensures that DNA is replicated accurately according to parental template.;

OR

Ensures the formation of two identical DNA molecules at the end of DNA replication.;

Question 5

(a) The percentage of adenine to thymine and guanine to cytosine in unknown is not 1:1 as compared to *E. coli* and yeast.;

This is because the sample carries single-stranded DNA, and not double stranded DNA.;

(b) General transcription factors are unable to recognise the TATA box in promoter region, hence RNA polymerase cannot bind to promoter to form transcription initiation complex. Hence, transcription cannot take place.;

Without mRNA, translation cannot take place and no polypeptides formed.;

(c) **(i)** Due to degeneracy of the genetic code, the same amino acid can be coded by more than one codon.;

Change in the first and second base will likely change the amino acid coded, which may result in a non-functional protein, so the mutation will not be inherited and passed down.

(ii) Substitution of a base will only change one amino acid, and the sequence of amino acids downstream will not be affected.;

Overlapping of codons can cause difficulties in translation when tRNA comes into P site as it would be blocked by the previous tRNA.;

Max 1

(d)

Sequence of mRNA	**Sequence of antisense drug**
A	**U**
C	**G**
G	**C**
U	**A**
G	**C**

Question 6

(a) (i)

Protein structure	**DNA structure**
Amino acids	deoxyribonucleotides / sugar + phosphate + base;
Peptide bonds	Phosphodiester bonds;
Ref. to 2° / 3° / 4°, structure	Double stranded / double helix;
20 types subunits	4 types of subunits / A, T, C and G;

Max 2

(ii) cytoplasm;
cell / plasma membrane;
cell wall composed of peptidoglycan / murein;
70S ribosomes;
circular DNA / plasmid;
glycogen granule / oil droplet / food store;

AVP; A slime capsule / mesosome / pili / flagellum / named bacterial function

Max 3

(iii) Using host cell machinery, new viral DNA genome is replicated, DNA is transcribed and translated into viral proteins / viral heads and tails are synthesized;

synthesis of host proteins is inhibited / stopped;

Self- assembly of new viral particles near cell surface membrane;

Lysis of bacterial cell wall and viruses are released / burst out to infect other host cells;

Max 3

(b) (i) disulfide bond;

(ii) deoxyribose / pentose sugar;

Question 7

(a) **(i)**

Coding DNA	*lacZ / lac Y / lac A / lacI*
Non-coding DNA	operator / promoter;

(ii) Each eukaryotic gene under the control of single promoter vs. *lacZ, lacY* and *lacA* genes under the control of single promoter;

Large amounts of non-coding DNA between eukaryotic genes vs. *lac* genes are adjacent to one another;

Absence of operator region in eukaryotic genome vs. presence in bacterial genome;

(b) E2 – repressor protein not expressed, no binding at operator region;
E3 – repressor protein expressed, but unable to bind to mutant operator;

(c) Substitution mutation results in a change of codon on mRNA;

results in different amino acid with different R-group;

changes the types of bonds formed between amino acids in polypeptide chain, leading to change in protein structure;

Question 8

(a) (i) $X^rX^r Cc$ $X^RY Cc$

(ii)

					Mark
Parental phenotype:	White eyes, curly wings female	x	Red eyes, curly wings male		
Parental genotype:	$X^rX^r Cc$		$X^RY Cc$		
Gametes:	$X^r C$ $X^r c$		$X^R C$ $X^R c$ $Y C$ $Y c$		1

	$X^R C$	$X^R c$	$Y C$	Yc
$X^r C$	$X^R X^r$ CC	$X^R X^r C c$	$X^r Y C C$	$X^r Y Cc$
$X^r c$	$X^R X^r Cc$	$X^R X^r c c$	$X^r Y C c$	$X^r Y c c$

1

					Mark
offspring genotype:	$X^R X^r CC$ $2X^R X^r Cc$	$X^R X^r c c$	$X^r Y CC$ $2 X^r Y Cc$	$X^r Ycc$	1
offspring phenotype:	Red eyes, curly wings female	Red eyes, normal wings female	White eyes, curly wings male	White eyes, normal wings male	1

		Mark
offspring phenotypic ratio 1:	All females have red eyes and all males have white eyes.	1 or
offspring phenotypic ratio 2:	Ratio of curly wings to normal wings is 3:1. / wing and sex 3:1:3:1	1

Max 4

(b)

Classes	*Observed number (O)*	*Expected ratio*	*Expected number (E)*	$(O - E)^2$	$\frac{(O - E)^2}{E}$
Red eyes, curly wings female	83	3	90	49	0.544
Red-eyes, normal wings female	41	1	30	121	4.033
White-eyes, curly wings male	78	3	90	144	1.6
White-eyes, normal wings male	38	1	30	64	2.133
	240				$\sum\chi^2 =$ **8.31;**

; correct and 2 d.p

2. Degrees of freedom = c – 1 = 4 – 1 = 3

With reference to the χ^2 table, critical χ^2 value = 7.81 ;

3. The results of the χ^2 test suggest that there is significant difference between the observed and the expected values at p = 0.05. Any difference is not due to chance.
4. The probability that the difference is due to chance is $0.025 < p < 0.05$.
5. The observed numbers does not fit the expected phenotypic ratio of 3:1:3:1.
6. Law of independent assortment is not followed.

Max 4 from pt2-6

Question 9

(a) anaerobic respiration / glycolysis / fermentation / substrate level phosphorylation;

(b) the toxin may be effective as a pesticide / insecticide against crickets which destroy the crops;

(c) The increase in temperature / heat could have denatured the enzymes / killed the cells;

(d) Students are to indicate an initial rise in the temperature occurring faster than in trial 1;
and a decline that commenced no later than time interval 5;

(e) There would be no effect on the effect of the toxin;

2,4-dinitrophenol affects oxidative phosphorylation;

by making the mitochondrial membrane leaky to protons;

pyruvate is used in the link reaction before the electron transport process / oxidative phosphorylation;

Max 2

Question 10

(a) insulin binding to complementarily to the extracellular binding site of RTK/ signal reception;

dimerisation of two subunits of RTK;

activation of tyrosine kinase;

which autophosphorylation / cross phosphorylation of 2 tyrosine residues by tyrosine kinase;

(b) Nature: small non-protein molecule;

Significance: second messenger that activates downstream protein Akt;

Significance: signal amplification / large scale response / fast response;

(c) transport glucose from outside of cell to inside of cell;

decrease of concentration of blood glucose;

Question 11

(a) Data: Optimal temperatures of crops (corn is between 22 – 25°C; wheat is between 20 – 25°C, soybean is between 25 – 28°C) fall in the temperature range of Iowa between 16°C – 28°C;

High enzymatic reactions at optimal temperatures and hence maximum growth/ yield of crops;

(b) Increased temperatures beyond the optimal temperatures for enzyme activity leading to denaturation of enzymes and hence, corn production drops;

Extreme weather events such as heatwaves/ droughts could lead to corn crops wilting;

High precipitation in the form of rainfall can cause nutrient leaching/ waterlogged soil/ plant decay;

Paper 3
Section A

Question 1

(a) (i)
1. killing by humans / eaten by humans / hunting / poaching ;
2. loss of, habitat / waste land ;
3. loss of, (plant) food / grazing ;

Max 2

(ii)
1. DNA / nucleotide/protein/amino acid, sequencing OR *ref. to* mitochondrial DNA;
2. genetic fingerprinting / DNA profiling / Southern Blot ;
3. *idea of* comparing sequences or banding pattern from genetic fingerprint (from A and B) ;

(iii)
1. A is geographically isolated / B,C and D are on different part of Ireland;
2. over 12 000 years / long period of time / many generations ;
3. have mutations different from B,C and D; *R:accumulation of mutations only*
4. different, selection pressures / environmental conditions from B,C and D;
5. *ref. to* genetic drift / reduction in genetic diversity in A / population bottleneck ;
6. AVP ; e.g. no gene flow between populations

Max 3

(b)
1. Cyt-b gene is present in all 3 sub-species of deer and hence it is a good basis for comparison ;
2. There is a restriction on change and it is passed down the maternal line / Mitochondrial DNA does not undergo recombination like what the nuclear DNA goes through during meiosis to form gametes for sexual reproduction ;

(c) Based on the biological species concept;

Members of genus *Canis* are capable of interbreeding and producing fertile, viable offspring;

(d) (i) Molecular technique gives **quantitative and objective** data which allows for statistical analysis. By calculating the nucleotide differences between species, it is possible to infer and quantify the degree of relatedness;

Interbreeding only allow us to determine if they are the same species and does not allow us to determine how closely related two species are;

(ii) Side-striped jackal is more closely related to golden jackal because they have a most recent common ancestor;

(e)
1. Dingo and grey wolf shared a common ancestor R: ancestor (not specific enough). The common ancestor was brought to Australia thousands of years ago; (from Fig 1.2)
2. Australia is geographically isolated with the sea/ocean separating Australia and Europe; Accept other examples of geographical barriers e.g. mountain ranges etc; (from Fig 1.3)
3. This meant that the gene flow between populations from Australia and Europe were disrupted;
4. With the different environments with their different selection pressures, those best adapted to these environments will survive;
5. Allele frequencies change because of natural selection and genetic drift;
6. The population in Australia evolve independently and accumulate different mutations and allele frequency changes, which over a long period of time, led to formation of dingo as a distinct species (AWTTE).

(f) Genetic (based on DNA analysis of DNA/protein extracted from fossil samples);

Morphological (based structure of mandibles, long legs)

Ecological (based clues derived from structure of mandibles, long legs – clues about the niches they occupy and the competition for similar/ dissimilar resources for e.g. if the mandibles are very similar, they are likely to feed on and thus compete for similar types of food);

Max 2

(g) Can be used:
- Leg bones of giant Hawaii goose is much longer and stouter (idea of) than nene; (modified to suit a land-bound type of locomotion/ loss of flight)
- Skull and the mandibles show significant differences in size; (modified to adapt to differences in the types of food they eat/ to different types of food available)
- Wing bones of nene slightly longer and thinner; (modify to suit flying)

Cannot be used:
- Lack of an 'ancestral' fossil for comparison, so difficult to determine if the 2 sets of bones are "modified" from a common ancestor;

- Differences in structure of wing bones are not significant, so inconclusive about modification to adapt to different selective pressures for locomotion (i.e. flight vs flightless);

Max 4

Question 2

(a) **(i)** Test sticks are testing for the presence of different antigens / (*Plasmodium*) proteins / epitopes;

Different monoclonal antibodies have different variable regions / antigen binding sites;

(ii) (positive result of test strip 1) pLDH present, (so) the person, has malaria / is infected by *Plasmodium;*

(negative result of test strip 2) HRP-2 not present, (so) the cause of malaria is not / the person is not infected by *P. falciparum* / the person is infected by *Plasmodium* other than *P. falciparum*;

(b) Ref. to somatic recombination;

Ref. to V, D, J gene segments are selected randomly during V(D)J rearrangement, to give many combinations of heavy chains;

ref. to V, J gene segments are selected randomly during V(D)J rearrangement, to give many combinations of light chains;

Ref. to *random assortment* / combinations of, light and heavy chains;

(c) **(i)** Reverse transcriptase synthesises cDNA using the mRNA as template strand;

(ii) RNase degrade mRNA template strands;

RNase is then denatured by incubation 70°C to stop degradation reaction;

(iii) cDNA template is single-stranded;

There is no need to heat to 95°C to separate cDNA into single strands;

(d) Lack of RER and Golgi apparatus;

RER: to provide a conducive microenvironment for the folding of the polypeptide chain into the correct tertiary structure;

Golgi apparatus: for the linking of the light and heavy chains by the formation of disulfide linkages;

Question 3

(a) **(i)** Ref. to overall trend (i.e. positive correlation) / number of plant genera increases as mean annual rainfall increases;

Ref. to paired figures (i.e. genera number and mean annual rainfall in 2 named countries showing the trend) correctly quoted with units;

(ii) Ref. to increase / decrease in rainfall / increased incidence of flooding / drought, shorter / longer rainy season;

Ref. to relevant consequence on plants (e.g. plant wilting from loss of water / plant rotting from waterlogged roots / plants infected by pests and pathogens);

Ref. to idea of decrease / increase, in genetic diversity / species diversity;

(b) Any 3:

- (may produce) medicines;
- resources (for humans) e.g. wood for building / fibres for clothes / fuel / food / agriculture;
- maintain gene pool / genetic diversity;
- to maintain stability in ecosystems;
- aesthetic reasons;
- (eco)tourism;

Section B

Question 4

a) In eukaryotes, a gene mutation can give rise to a new allele. Outline how the frequency of a gene mutation can increase in a population. Consider both prokaryotes and eukaryotes. [10]

prokaryotes

1. from parent to offspring via binary fission;
2. Semi-conservative DNA replication ensures offspring are genetically identical to parents;
3. Competent cell transformed during uptake of naked piece of DNA containing the mutated gene;
4. With help of bacteriophages, that mistakenly packaged a piece of bacteria host DNA containing the mutated gene and insert into another bacteria during subsequent infection;
5. During conjugation when a F^+ bacteria transfers the mutated gene, found on the F plasmid, to an F^- bacteria;
6. Ref to genetic recombination;
7. Prokaryotes with the mutated gene that confers it selective advantage in an environment will be more likely to survive and divide;

Eukaryotes

8. Mutation of the gene should be in a gamete;
9. Random fusion of gametes allows the allele to be passed on to offspring;
10. In the event that a trait related to the allele is being selected for, the offspring is at a selective advantage to survive and reproduce, passing on the allele;

Max 9
Note: Pts 7 and 10 are of the same concepts. Right use of terms (bolded) allows 2m to be awarded, otherwise, only 1m should be awarded.
QWC: Scoring at least 3 points;

b) Describe how the structures of nuclei acids are adapted for protein synthesis. [15]

RNA		Structure	Function (Translation)	
mRNA	1.	Single-stranded and linear	For ribosomes to bind and read mRNA template easily	;
	2.	Presence of codons	To code for amino acids, allowing mRNA to act as a template for translation / to allow for correct sequencing of amino acids.	;
	3.	Mature mRNA consists of exons and no introns	To be translated into functional polypeptides	;
	4.	Has spliceosome recognition sites	To allow for excising of introns	;
	5.	Has start (AUG) and stop (UAA, UGA, UAG) codons	To signal the start and end of translation	;
	6.	Has 5' 7-methylguanosine cap and 3' poly-A tail	To increase stability and half-life of mRNA	;
	7.	Complementary base pairing between codons and anticodons (award only once for either mRNA or tRNA)	For tRNA to carry corresponding amino acids to mRNA template to add on to the polypeptide chain	;
tRNA	8.	Has 3' CCA end	Attach covalently to amino acids.	;
	9.	At least 20 different tRNAs	One tRNA for each corresponding amino acid since there are 20 naturally occurring amino acids	;
	10.	Presence of anticodons	To recognise and bind to codons on mRNA for transfer of amino acids	;
	11.	Intramolecular hydrogen bonds to form 2D clover-shape structure / 3D L-shape structure	To stabilise the molecule / to bind complementarily to binding site of ribosomes / active site of aminoacyl-tRNA synthetase	;
	12.	Ribosome recognition / binding site.	Make specific base pairing with rRNA of ribosomes to bind to A or P site of large ribosomal subunit.	;

rRNA	13.	Structural component of ribosome	Help to align mRNA in ribosome such that incoming aminoacyl-tRNA complexes can base pair conveniently.	;
			Provides the structural framework for holding mRNA and tRNA.	;
	14.	Several different types of rRNA	To give rise to a variety of ribosomal types e.g. 70S, 80S.	;

Max 11

	DNA Structure	**Transcription**	
15.	Double helix that is double-stranded.	Only antisense / non-coding strand serves as the template for transcription.	;
16.	Hydrogen bonding present between the strands. / complementary base pairing between A-T and C-G on the two strands.	For attachment of complementary ribonucleotides via transcription to make mRNA.	;
17.	Major and minor grooves on DNA.	Allowing RNA polymerase to bind.	;

Points are awarded only if structure and function are matched correctly.

QWC: at least 1 pair of structure-function for any RNA and 1 pair from DNA.

Question 5

a) Using named examples, outline the role of ATP in eukaryotes. [10]

1. ATP is the universal energy currency / carrier in cells of living organisms;
2. It is small and water soluble, hence can be transported within the cell easily OR a lot of chemical energy is stored in the bonds of ATP;

Respiration:

3. Activation of glucose to glucose-6-phosphate via phosphorylation using ATP during the energy investment phase of glycolysis, catalysed by hexokinase;
4. ATP is required for the phosphorylation of fructose-6-phosphate to fructose-1,6-bisphosphate, catalysed by phosphofructokinase;
5. ATP also serves as an allosteric inhibitor to phosphofructokinase;

Photosynthesis:

6. Energy from hydrolysis of ATP during Calvin cycle of the light-independent stage of photosynthesis in stroma of chloroplasts in plant cell is required to convert glycerate-3-phosphate (GP) to glyceraldehyde-3-phosphate (GALP);
7. Energy from hydrolysis of ATP is also needed to regenerate ribulose bisphosphate in Calvin cycle;

Cell signalling:

8. ATP is required as a substrate for the adenylyl cyclase enzyme, which upon activation by the activated GTP-bound G-protein, catalyses the conversion of ATP to cAMP, which serves as a second messenger in the signal transduction pathway;
9. ATP is also the substrate for the kinases in the phosphorylation cascade, which catalyses the addition of phosphate groups from the ATP molecules to the subsequent kinases in the cascade;

As a nucleotide:

10. ATP is a ribonucleotide and is incorporated into mRNA acid during transcription;

Other cellular activities:

11. Movement of secretory vesicles from the Golgi apparatus to the cell surface membrane along the cytoskeleton requires energy from the hydrolysis of ATP;
12. Active transport of molecules against concentration gradient across the cell surface membrane via the action of a specific carrier proteins called "pump" which use ATP to change its conformation. E.g. is sodium-potassium pump;
13. Bulk transport such as endocytosis and exocytosis involves the transport of large molecules like proteins and polysaccharides which require ATP. E.g. secretion of antibodies by plasma cells;
14. ATP required for amino acid activation prior to translation for the covalent attachment of the amino acid to the 3' acceptor stem of the corresponding tRNA, catalysed by amino acyl tRNA synthetase;
15. AVP;

Max 10

b) Eukaryotic cells contain various organelles that perform different specific functions. These organelles comprise membranes that have different compositions that are adapted to their specific roles.
Describe the different structures of various membranes using named examples and explain how they are adapted to the role they perform in a eukaryotic cell. [15]

Nuclear membrane [max 4]

1. Nuclear membrane is a double membrane with nuclear pores;
2. for compartmentalisation / separates the nuclear DNA from the rest of the cell;
3. membrane protect the DNA from cytoplasmic contents such as nucleases, and other potentially harmful chemical reactions from damaging the DNA integrity;
4. compartmentalisation also helps localize / increase the concentration of the materials required for DNA replication and transcription occurring in the nucleus;
5. Nuclear pore proteins transport mature mRNA and rRNA (to form ribosomes) out of nucleus for translation;
6. Nuclear pore proteins also transport raw materials such as free dNTP and RNA, and proteins such as enzymes necessary for DNA replication and transcription into the nucleus;

rER

7. Made up of numerous flattened membranous sacs, continuous with the outer membrane of the nuclear envelope with numerous ribosomes attached onto the membrane;
8. Studded with numerous ribosomes attached for efficient protein synthesis;
9. Fluidity of phospholipid allows for vesicle formation, fusion and budding; from rER to GA;

Golgi apparatus

10. Made up of numerous closed flattened sacs known as cisternae, with the membrane formed from vesicles from rER; has cis and trans faces;
11. to modify synthesised proteins and to package them for transport to respective designations; also involved in lipid transport and lysosome formation;
12. Compartmentalisation of specific enzymes within the cisternae, increases concentration / prevent denaturation of enzymes for efficient protein modification; [while not part of membrane, note that cis and trans cisternae contains different enzymes and hence this compartmentalisation furthers the specialisation of the different cisternae]
13. Fluidity of phospholipid allows for vesicle formation, fusion and budding; from rER to GA to targeted designations of proteins;

Chloroplast membrane [max 5]

14. Double membrane around the organelle;
15. compartmentalisation also helps localize / increase the concentration of the materials required for photosynthesis / Calvin Cycle;
16. Within the chloroplast is a third membrane called thylakoid which form stacks called grana;
17. Thylakoid is highly folded thus high increased surface area to volume ratio for increased attachment of proteins for photophosphorylation;
18. Proximity of the proteins within the membrane allows for higher efficiency of photophosphorylation;
19. Thylakoid contains light-harvesting proteins i.e. chlorophyll to capture light energy;
20. Thylakoid contains electron carrier proteins that form the electron transport chain for transferring electron;
21. Thylakoid contains H^+ pumps to pump H^+ from stroma into thylakoid space;
22. Thylakoid being impermeable to H^+ allows for compartmentalisation (space) for building up of high H^+ gradient for chemiosmosis
23. Thylakoid contains Also contains ATP Synthase for ATP synthesis from chemiosmosis of H^+

Mitochondria [max 4] (points need to be clearly differentiated from chloroplast to be awarded marks i.e. no double crediting)

24. Double membrane around organelle;
25. inner membrane is highly folded / forming finger-like projections / folded into cristae thus high increased surface area to volume ratio for increased attachment of proteins for oxidative phosphorylation;
26. inner membrane being impermeable to H^+ allows for compartmentalisation (space) for building up of high H^+ gradient for chemiosmosis
27. Proximity of the proteins within the membrane allows for higher efficiency of oxidative phosphorylation
28. inner membrane contains electron carrier proteins that form the electron transport chain for transferring electron
29. inner membrane contains H^+ pumps to pump H^+ from mitochondria matrix into intermembrane space
30. inner membrane contains ATP Synthase for ATP synthesis from chemiosmosis of H^+

QWC: at least 2 different named membranes from 2 organelles with clear use of scientific terms to describe structure and how they are adapted for their functions