Mark schemes

Q1.

(a) 1. Use cold, buffered solution with same water potential;
Accept isotonic for same water potential.

2. Homogenise tissue and (then) filter;
Accept blend OR grind for homogenise.

3. Centrifuge at low speed and remove supernatant

OR

Centrifuge at low speed to remove/separate nuclei;
Accept heavier/denser organelles

4. Centrifuge supernatant at higher speed (and pellet containing mitochondria is mixed with new supernatant);
Accept solution for supernatant.

4

(b) **MP1 must be included for max marks.**

(For)

1. SDs do not overlap so significant difference/increase (in respiratory capacity);
Accept 'difference/increase is not due to chance' for significant difference/increase.
Accept 'error bars' for SDs

2. Increase in ATP linked to increase in muscle contraction;

OR

Increase in ATP linked to increase in exercise capacity;

(Against)

3. Only males (in investigation)

OR

No females (in investigation);

4. Only 11 (individuals in investigation)

OR

Small sample size;

5. RET may not strengthen required muscles

OR

Don't know which (skeletal) muscles affected **OR**

Athletic performance not investigated;

Accept examples of athletic performance eg running.

Ignore reference to 'no statistical test'

6. Results may differ depending on age

OR

Only young (individuals) tested;

7. No idea of exercise done by individuals before investigation;

5 max

[9]

Q2.

(a) 1. Compare the DNA base/nucleotide sequence;

2. More closely related (species) the more similar the genes/DNA;

Accept RNA (to prevent ecf)

Accept 'more recent common ancestor' for more closely related

Accept 'clear phylogenetic relationship' for more closely related

2

(b) All (cellular organisms) have ribosomes

OR

All (cellular organisms) have ribosomal RNA/rRNA;

1

(c) 1. Obtain (more sun)light for photosynthesis;

2. Reduces transpiration/evaporation

OR

Reduces water loss;

Accept 'prevents/stops' water loss

2

(d) 1. Single/few layer(s) of (cells/tissue);

Accept: to avoid

2. So light can pass through;

2

(e) 1. Use single/continuous/joined lines

OR

Do not use sketching

OR

No crossing or hanging lines;

2. Do not use shading/hatching;

3. Draw (only) the outline of tissues

OR

Do not draw cells (detail);

4. Draw parts to the same scale/relative size;

5. Show labels/annotations/title;

6. Show magnification/scale (bar);

3 max

[10]

Q3.

(a) 1. Diaphragm (muscle) contracts pulling diaphragm down;

*Accept flattening **OR** moves down for 'pulling diaphragm down'*

2. External intercostal muscles contract pulling/moving ribs upwards/outwards;

Accept ribs lifted for 'pulling ribs upwards'

3. (Causes) volume increase **and** pressure decrease in thoracic cavity;

*Accept thorax **OR** lung(s) for thoracic cavity*

3

(b) 1. (Create a) single/few layer(s) of cells/tissue;

Accept to avoid overlapping cells

2. (So) light can pass through;

2

(c) Bronchiole(s);

Accept broncheole(s)
OR** bronchiol(les) **OR
*broncheol(les) **OR***
*bronkiol(les) **OR***
*bronkeol(les) **OR***
*brochiol(les) **OR***
brocheol(les)
Reject bronchiolus
OR** broncheolus **OR
OR** branchiol(les) **OR
*brancheol(les) **OR***
*bronchus **OR** bronchi*

1

(d) Correct answer for 2 marks, 75 (µm);;

Accept for 1 mark, evidence of

$$\textit{Real/actual} = \frac{\textit{Image}}{\textit{Mag(nification)}}$$

(correct rearranged magnitude word equation)

OR

÷ 40 (correct denominator from equation)

OR

3000 (µm) (correct mean diameter)

OR

× 1000 (correct conversion of mm to μm)

OR

0.075 (correct calculation with incorrect units (mm))

OR

Answer shows correct number but incorrect number of decimal places eg 0.75 / 7.5 / 750

2

(e) 1. (Uncertainty ±) 1 (mm);

2. (Percentage error) 25 (%);

Accept, if incorrect uncertainty
÷ 4 and multiplied by 100
***OR** – for example*
50% (if uncertainty is 2)
OR
12.5% (if uncertainty is 0.5)
OR
2.5% (if uncertainty is 0.1)

2

[10]

Q4.

(a) 1. Homogenise (tissue) **to** break open cells

OR

Homogenise (tissue) **to** release organelles/nuclei;
*Accept blend **OR** grind **OR** chop for homogenise*

2. Filter **to** remove (intact) tissue/cells/debris;

3. Cold (solution) **to** prevent enzyme activity;
Accept 'slow down' for prevent

4. (Solution with) equivalent water potential **to** prevent osmosis

OR

(Solution with) equivalent water potential **to** prevent organelles bursting/shrinking;
Accept isotonic for 'equivalent water potential'
Reject if reference is made to cells

5. Buffered (solution) **to** stop enzymes/protein denaturing;

6. Centrifuge/spin at low(er) speed **so** nuclei in pellet/move to bottom

OR

Centrifuge at low(er) speed and supernatant/solution discarded;
*Accept up to 1000 revolutions min^{-1} **OR** 1000 × gravity for identified slow spin speed*

6

(b) 1. DNA in nucleus codes for enzyme/protein (production);
*Accept genetic material/code **OR** gene for DNA*
Accept polypeptide for protein/enzyme

2. Ribosomes/rough endoplasmic reticulum produce enzyme/protein

OR

Translation on ribosomes/rough endoplasmic reticulum;

3. Rough endoplasmic reticulum transports/modifies/processes enzymes/protein;
Ignore rER/RER only once

4. Mitochondria produce ATP;
Reject produce energy

5. Golgi apparatus modify/process/ package/transport enzymes/protein

OR

Golgi apparatus make/transport glycoprotein

OR

Golgi apparatus forms/releases vesicles;

Accept body for apparatus

Accept 'adds lipid/carbohydrate to' for modify

Accept lipoprotein for glycoprotein

6. Vesicles move (protein) to cell(-surface) membrane

OR

Vesicles fuse with cell(-surface) membrane;

Accept lysosome for vesicle

Accept exocytosis for 'fuse with cell membrane'

5 max

(c) 1. Ribose, Adenine **and** 3 phosphates;

Accept a labelled diagram showing ribose, adenine and 3 phosphates

*Accept adenosine **and** 3 phosphates*

Reject Adenosine and 3 phosphates if ribose/pentose is also mentioned

Ignore pentose sugar

2. ATP to ADP + Pi by ATP hydrol**ase** in hydrolysis (reaction);

Accept ATPase for ATP hydrolase

Accept hydrolayse

3. ADP + Pi to ATP by ATP synth**ase**;

Accept synthayse

4. (In) condensation (reaction);

4

[15]

Q5.

(a) 1. Nucleus;

2. Nucleolus/nucleoli

OR

Nuclear membrane/envelope;

3. Mitochondria/chloroplast contain DNA;

Accept 'membrane bound nucleus' = 2 marks

2 max

(b) (In prokaryotes) Circular not linear

OR

Not associated with proteins/histones

OR

No introns;

Ignore 'loop'

Ignore 'plasmid'

1

(c) 1. Diaphragm (muscles) contract **and** diaphragm flattens/pulled down;

2. External intercostal muscles contract **and** ribcage pulled up/out;

3. (Causes) volume increase **and** pressure decrease in thoracic cavity (to below atmospheric pressure);

Accept lungs or thorax for 'thoracic cavity'

3

(d) 1. (Thicker capsule so phagocytes) less likely to bind to **murein** (in cell wall)

OR

(Thicker capsule so phagocytes) less likely to be stimulated by **murein** (in cell wall);

2. Reduced phagocytosis **so** more bacterial growth/division/reproduction/binary fission;

Accept replicate/ multiplication but reject mitosis

2

[8]

Q6.

(a) (Volume)

Correct answer of 57.9 (μm^3) = **2 marks**;;

OR

If volume incorrect, evidence of 2.35-2.45 (as radius) = **1 mark**

(Times larger)

8 (times larger) (or ECF) = **1 mark**;

*58 = **2 marks***

*57.91 = **2 marks***

*Accept 54.3/54 = **2 marks***

*Accept 61.6/62 = **2 marks***

Allow 7.5 – 8.52

ECF Allow any alternative for 8 which shows 463 ÷ their volume

3

(b) 1. Nuclear membrane /nucleolus /vesicles/ lysosomes/ribosomes distinct/visible;

Accept invaginations of membrane distinct/visible

Reject nucleus

Reject mitochondrion

2. EM has greater resolution;

assume 'it' refers to electron microscope

2

(c) Stimulating cytotoxic T cells

OR

Stimulating B cells

OR

Stimulating phagocytes;

Accept 'activate' for stimulating

1

(d) 1. Anticodon (on tRNA) binds to (complementary) codon (on mRNA);

2. (tRNA) brings/carries specific amino acid (to ribosome);

2

[8]

Q7.

(a) Site of translation, catalyse the joining of amino acids by condensation reactions;

1

(b) Any **two** from:

rRNA;

(Pre) mRNA;

tRNA;

Ignore capitalization of r, m and t

1 max

(c) 1. Less <u>phospholipids</u> in rough

OR

More protein/glycoprotein in rough

OR

Presence of ribosomes in rough;

Accept references to percentages from Table 1.

2. (More protein/glycoprotein/ribosomes) Rough – production/transport of proteins;

Accept modifies/packages proteins

3. (More phospholipid) Smooth – production/modification/packaging/transport of lipids;

Accept storage/synthesis of carbohydrates

Accept storage of lipds

3

[5]

Q8.

(a) 1. Genetic material, capsid **and** attachment protein;

*Accept 'DNA **or** RNA' (the 'or' OR '/' is needed) OR nucleic acid OR genome for 'genetic material'*

Ignore genetic information

Accept nucleocapsid for 'capsid and nucleic acid'

Accept capsomeres for capsid

2. Genetic material codes for (viral) protein

OR

Capsid protects the genetic material/RNA/DNA

OR

Attachment protein bind to receptors (on cell);

Accept glycoprotein for attachment protein

Accept capsomeres for capsid

Accept DNA OR RNA OR genome for genetic material

Accept contains OR stores OR encloses for protects

Accept glycoprotein for receptor

Accept ECF for correct function of incorrect viral structural feature; eg reverse transcriptase produces DNA from RNA

2

(b) 1. (Acellular) no cell(-surface) membrane

OR

Not made of cells;

Accept have no organelles/cytoplasm

Ignore 'do not contain membrane-bound organelles'

Accept 'do not have cell structure(s)'

2. (Non-living) have no metabolism/metabolic reactions;

OR

Cannot (independently) move/respire/replicate/ excrete

OR

(Have) no nutrition;

Accept correct named metabolic reaction

Accept reproduce for replicate

2

(c) Do not have bacterial structures/enzymes

OR

Do not have metabolic processes

OR

Do not have a cell wall/murein;

Accept 'do not have ribosomes'

Ignore 70S OR 80S

Accept named metabolic processes; for example, 'do not make protein' OR 'do not replicate'

Accept peptidoglycan OR glycoprotein for cell wall

1

[5]

Q9.

(a) Flagellum/flagella;

1

(b) 1. 3D with SEM, but 2D with TEM

OR

(Only) surface visible with SEM, but internal structures visible with TEM;

2. (Because) electrons deflected/bounce off (using SEM)

Accept Resolution is lower (with SEM)

OR

Electrons transmitted/pass through (using TEM);

2

(c) Shorter wavelength between electrons;

OR

Longer wavelength in light rays;

*Accept 'of electrons' **OR** 'of electron beam' for 'between electrons'*

Reject Electron microscope has a shorter wavelength

Reject Light microscope has a longer wavelength

1

(d) Mark in pairs: 1 **and** 2 **OR** 3 **and** 4

1. Measure (length of structure) **and** divide by magnification;

Accept correct equation making reference to a measurement

2. Correct conversion from measured length to μm, either

× 10 000 from cm

OR

× 1000 from mm;

3. Measure (length of structure) **and** divide by (image) length of scale bar;

4. Multiply by actual length of scale bar;

2

(e) 1. Circular DNA (molecule in cytoplasm);

2. Murein cell wall

OR

Peptidoglycan cell wall

OR

Glycoprotein cell wall;

3. Smaller/70S ribosomes in cytoplasm;

2 max

Accept mesosome

(f) 1. Capsid;

Accept capsomere

Ignore protein coat

2. Reverse transcriptase;

3. RNA genome;

*Accept 'genetic material' **OR** 'genes' for 'genome'*

4. Envelope;

2 max

[10]

Q10.

(a) **Structure**

1. Nuclear envelope **and** pores
OR
Double membrane **and** pores;
Ignore porous for pores

2. Chromosomes/chromatin
OR
DNA with <u>histones</u>;
Ignore genetic material/information
Accept nucleoplasm
Ignore promoter regions OR genes OR alleles
Accept regulation of gene expression

3. Nucleolus/nucleoli

Function

4. (Holds/stores) genetic information/material for polypeptides (production)
OR
(Is) code for polypeptides;
Accept protein OR amino acid sequences OR primary structure for polypeptides

5. DNA replication (occurs);

6. Production of mRNA/tRNA
OR
Transcription (occurs);
Ignore mRNA leaves nucleus

7. Production of rRNA/ribosomes;

4 max

Max 2 for structure or function

(b) Cellulose (plant) **and**

Chitin (fungi);
For fungi accept N-acetylglucosamine

1

(c) Individual organisms could not be identified/separated

OR

Too small/numerous to count individuals

OR

Too time consuming;

Ignore too difficult to identify/distinguish different species

Ignore too difficult to count unless qualified

Accept reference to fungi for plants

1

(d) Correct answer for 2 marks, 0.7– 0.71;;

Accept for 1 mark,

0.29 − 0.3 (correct calculation not subtracted from 1)

OR

120 (correct total shoot biomass)

A common correct answer is 0.707

Accept numbers rounding down to 0.71

2

[8]