

Mark schemes

Q1.

(a) chromosome(s)

allow chromatid(s) / gene(s) / allele(s)

1

(b) sugar

allow deoxyribose

allow pentose

*do **not** accept ribose*

1

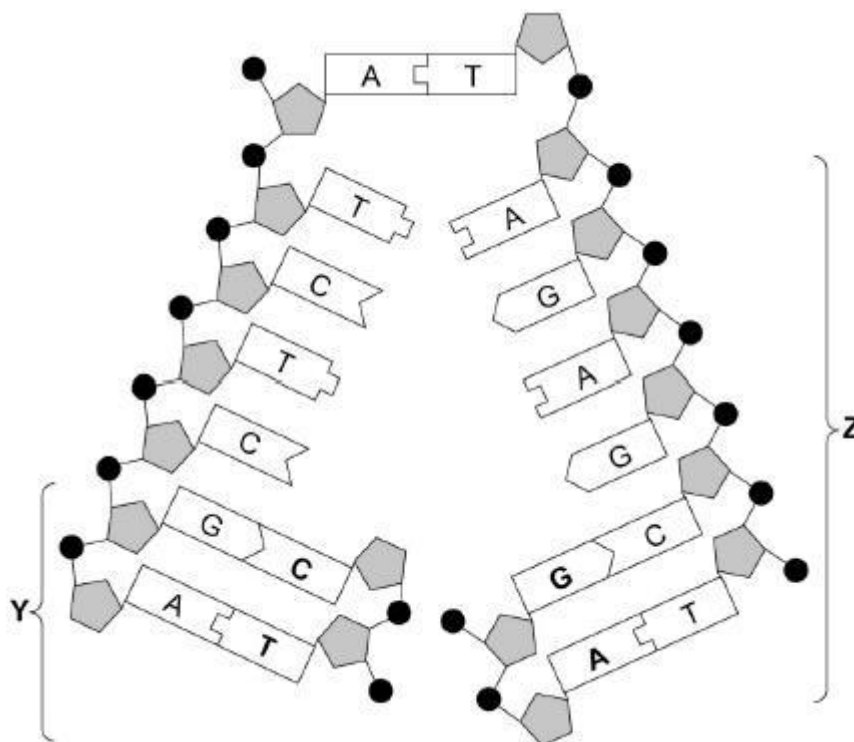
(c) base(s)

allow nitrogenous base(s)

*allow adenine **and** cytosine **and** guanine **and** thymine*

1

(d)



all four required for the mark

1

(e) replication

1

(f) protein

allow polypeptide

1

(g) 3×10^{-12} grams 1

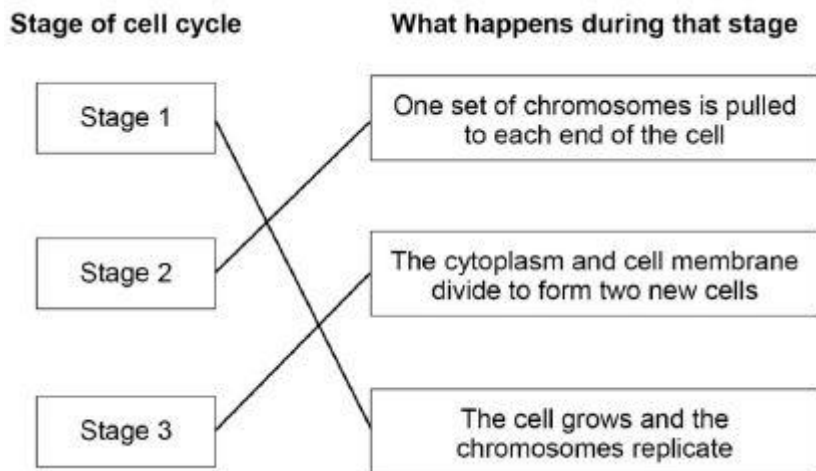
(h) meiosis 1

[8]

Q2.

(a) mitosis 1

(b) all lines correct = 2 marks
1 or 2 lines correct = 1 mark



additional line from a box on the left negates the credit for that box 2

(c) $\frac{7}{10} \times 100$

allow $\frac{252}{300} \times 100$ 1

70%

*allow answer calculated from angle in range 250° to 254°
if no other mark awarded, allow 0.7 for 1* 1

(d) 3 1

(e) DNA

allow deoxyribonucleic acid for 1 1

(f) a gene 1

- (g) (bone marrow) cells differentiate into many / other types of (named) cell
allow (bone marrow) cells can become many / other types of (named) cell

1

- (so) will cure diseases where new cells are needed
 or will cure diseases where cells are damaged

*allow (so) will cure anaemia / leukaemia
 or blood cancer or blood disorders
 allow (so) will cure paralysis / diabetes*

1

[10]

Q3.

- (a) any **two** from: (both have)

- cytoplasm
- (cell) membrane
- DNA / genetic material

ignore reference to shape

allow RNA

ignore genetic information

- ribosomes

*if no other mark awarded allow
 sub-cellular structures for 1 mark*

*if no other mark awarded allow correct
 cellular process, e.g. respiration for 1
 mark*

2

- (b) any **three** from:

*allow converse for eukaryotic cells
 allow reference to bacterium instead of
 prokaryotic cell
 ignore reference to features not shown
 in the diagram*

- prokaryotic cell is smaller
- prokaryotic cell has no mitochondria
- prokaryotic cell has no nucleus
 or DNA is free in the cytoplasm
 or genetic material is free in the cytoplasm
*if neither mark awarded, allow
 prokaryotic cell has no
 membrane-bound organelles
 ignore genetic information*
- prokaryotic cell has a single loop of DNA
 or prokaryotic cell has a single loop of genetic material
ignore genetic information
- prokaryotic cell has plasmids
ignore circular / rings of DNA

- allow prokaryotic cells have smaller ribosomes*
- 3
- (c) 1 μm = 0.001 mm
 or 1 mm = 1000 μm
 or 0.05 mm = 50 μm
 or 0.05 \times 1000
- 1
- (1:) 50
- do **not** accept if a unit is given*
- 1
- (d) mitosis
- correct spelling only*
- 1
- (e) 35%
- 1
- (f) (stage 1)
 DNA / chromosomes replicate / duplicate
- ignore names of the stages of the cell cycle*
ignore genetic material ignore DNA / chromosomes double / reproduce
- 1
- mitochondria / ribosomes / sub-cellular structures increase in number
 or mitochondria / ribosomes / sub-cellular structures replicate
- allow cytoplasm increases*
ignore cell grows unqualified
- 1
- (stage 2)
 one set of chromosomes is pulled / moved to each end of the cell
- allow one of each chromosome is pulled / moved to each end of the cell*
ignore nucleus divides
- 1
- (stage 3)
 the cytoplasm **and** cell membrane divides (to form two cells)
- allow cytoplasm divides **and** (new) cell membranes form ignore nucleus divides*
- 1
- [13]**
- Q4.**
- (a) any **three** from:
- mitosis produces two (daughter) cells but meiosis produces four (daughter) cells

answers must be comparative

- one cell division in mitosis but two cell divisions in meiosis
- mitosis produces cells with two of each chromosome, but meiosis produces cells with one of each chromosome

*allow mitosis produces diploid cells but meiosis produces haploid cells
allow mitosis maintains the number of chromosomes or mass of DNA or mass of genetic material but meiosis halves the number / mass*

allow mitosis produces cells with 23 pairs or 46 chromosomes but meiosis produces cells with 23 chromosomes

- mitosis produces genetically identical cells, but meiosis produced genetically different cells

allow other correct differences between the processes of mitosis and meiosis

3

(b) any **one** from:

- DNA doubles / copies / replicates (once)
- increase in the number of mitochondria / ribosomes / sub-cellular structures

allow chromosomes or genetic material or genetic information double / replicate / are copied

ignore mitochondria / ribosomes are copied / duplicated

allow chromosomes / chromatids pulled to side (of cell)

allow other correct similarities between the processes of mitosis and meiosis

1

(c) Dd / dD

allow heterozygous

1

has **D** because has Dupuytren's **and** has **d** because child / person 6 is homozygous recessive **or** does not have Dupuytren's **or** is **dd**

*allow has **D** because has Dupuytren's **and** person 1 and person 2 both passed **d** to child / person 6*

*allow has **D** because has Dupuytren's **and** cannot be homozygous / **DD** or all the children would have Dupuytren's*

1

(d) male / person 7 gametes correct: **D** and **d**

1

female / person 8 gametes correct: **d** and **d**

*allow 1 mark for both sets of gametes
correct if parents not identified*

1

correct derivation of offspring genotypes:

Dd Dd dd dd

*allow correct derivation of offspring
genotypes from incorrect gametes*

1

offspring with Dupuytren's identified

*allow correct for genotypes stated in
mp3*

1

probability correct from the correct identification given

*allow probability correct from offspring
genotypes if identification not given*

1

(e) female(s) / person(s) 3 / 11 / 12 have Dupuytren's

allow some females have Dupuytren's

1

females don't have Y chromosome

or

Dupuytren's is passed from fathers / 1 / 7 to daughters / 3 / 12, (so is not on the Y chromosome)

allow only males have Y chromosomes

allow females are XX

*allow Dupuytren's is passed from
mothers / 11 to children / 15, (so is not
on the Y chromosome)*

1

[13]

Q5.

(a) blood is pumped to the lungs by one / right side of the heart

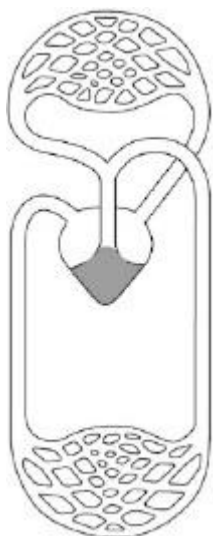
and

blood is pumped to the body by the other / left side of the heart

*allow blood enters the heart twice for
every (one) circuit around the body*

1

(b) ventricle correctly identified as any part of grey area below:



- 1
- (c) oxygenated and deoxygenated blood mixes
allow some deoxygenated blood is sent to the body / tissues / cells
- 1
- (so) less oxygen reaches the body / tissues / cells
allow named tissues / organs
- 1
- (d) concentration gradient (of oxygen) is shallow(er) / less steep
- 1
- (therefore) less oxygen diffuses into blood / cells / gills
- 1
- allow idea that concentration gradient is negative (i.e. out of axolotl) (1)*
so oxygen diffuses out of axolotl's blood / cells / gills (1)
- (so) less (aerobic) respiration occurs so less energy is released / available
or
 (so more) anaerobic respiration occurs so less energy is released / available
- 1
- do **not** accept no respiration occurs*
*do **not** accept energy production*
- (so) less metabolism
- ignore reduced living processes unqualified*
*allow reduction of building larger molecules **or** movement / muscle contraction **or** keeping warm **or** urea formation **or** chemical reactions*
- or**
 (so when) anaerobic respiration occurs, lactic acid is produced (and

- is toxic) 1
- (e) stem (cells)
do not accept embryonic stem cell 1
- (f) any **one** from:
 - paralysis
 - diabetes*allow other examples such as Parkinson's / heart disease / stroke / cystic fibrosis / cancer / burns*
do not accept infectious diseases 1
- (g) any **one** from:
 - easy to breed
allow reproduce quickly
 - easy / cheap to keep / rear (as are small)
 - don't take up much space
allow reference to not being dangerous (to the scientist)
allow they are not endangered
allow removal of gill will not kill the axolotl 1
- (h) any **one** from:
 - it's not a mammal **or** it is an amphibian
 - regeneration in gills may be different to that in other organs
 - metabolism / body processes are too different to humans
allow humans do not have gills
*allow it's an endangered species **or** species need to be protected from extinction*
*ignore reference to genetic differences **or** ethics* 1
- [12]**

Q6.

- (a) 46 1
- (b) half the mass of the DNA in cell A 1
- (c) meiosis 1
- (d) mutation 1

- (e) any **two** from:
- different egg / sperm each time
 - genes from two parents
 - each gamete / egg / sperm has different alleles / genes / DNA / genetic information
- ignore different chromosomes*
ignore the children have different genes / alleles
- 2

(f) 8 1

(g) 40 1
allow in range 39 to 41

(h) 1
an answer of 80 scores 3 marks
allow ecf from part (g) for 3 marks
an answer of 0.08 scores 2 marks

$$\frac{40}{500}$$

allow $\frac{\text{answer to part (g)}}{500}$

× 1000 1

80 1
an answer from mp1 but not × 1000
scores 2 marks

(i) embryo is (very) small 1

(so) embryo not seen / felt
or
lost in normal menstrual flow
ignore not noticed

1

[13]

Q7.

(a) nucleus 1

(b) gene(s) 1
allow allele(s)

- (c) copying of chromosomes 1
- (d) mitochondria 1
- (e) 60 – 45
or
120 – 105 1
- 15 (minutes) 1
- an answer of 15 (minutes) scores 2 marks*
- (f) C 1
- (g) 8 1
- (h) to repair tissues 1
- [9]**

Q8.

(a)

	statement is true for		
	mitosis only	meiosis only	both mitosis and meiosis
all cells produced are genetically identical	✓		
in humans, at the end of cell division each cell contains 23 chromosomes		✓	
involves DNA replication			✓

3 correct = 2 marks
2 correct = 1 mark
0 or 1 correct = 0 marks

2

(b) any **two** from:

ignore references to one parent only

- many offspring produced
- takes less time

- allow asexual is faster*
- (more) energy efficient
 - genetically identical offspring
allow offspring are clones
 - successful traits propagated / maintained / passed on (due to offspring being genetically identical)
 - no transfer of gametes or seed dispersal
allow no vulnerable embryo stage
allow no need for animals
 - not wasteful of flowers / pollen / seeds
 - colonisation of local area
must imply local area
- 2
- (c) genetic variation (in offspring) 1
- (so) better adapted survive
allow reference to natural selection or survival of the fittest 1
- (and) colonise new areas by seed dispersal
or
can escape adverse event in original area (by living in new area)
must imply new area 1
- many offspring **so** higher probability some will survive 1
- allow bluebell example described (max 3 if not bluebell)*
- [8]**

Q9.

- (a) an undifferentiated / unspecialised cell 1
- that can differentiate / become / change into (many) other cell types 1
- (b) (malignant tumours) invade / spread to other tissues via the blood (benign don't)
or
(malignant tumours) form secondary tumours in other organs
ignore cancer unqualified
allow converse
allow metastasises 1

- (c) mitosis
correct spelling only 1
- (d) glucose
answers in any order
ignore sugar 1
- protein / amino acids 1
- (e) no need to wait for a donor
or
can be done immediately 1
- (so) no risk of rejection
or
no need for immunosuppressant drugs
if no other marks awarded, allow for 1 mark idea of ethics surrounding the use of tissue from another / dead person 1
- (f) stent opens up the trachea 1
- allowing air to flow through
or
allowing patient to breathe 1
- (g) **Level 3 (5-6 marks):**
A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.
- Level 2 (3-4 marks):**
Some logically linked reasons are given. There may also be a simple judgement.
- Level 1 (1-2 marks):**
Relevant points are made. They are not logically linked.
- Level 0**
No relevant content
- Indicative content**
- embryos advantages**
- can create many embryos in a lab
 - painless technique
 - can treat many diseases / stem cells are pluripotent / can become any type of cell (whereas bone marrow can treat a limited number)
- embryos disadvantages**

- *harm / death to embryo*
- *embryo rights / embryo cannot consent*
- *unreliable technique / may not work*

bone marrow advantages

- no ethical issues / patient can give permission
- can treat **some** diseases
- procedure is (relatively) safe / doesn't kill donor
- tried and tested / reliable technique
- patients recover quickly from procedure

bone marrow disadvantages

- *risk of infection from procedure*
- *can only treat a few diseases*
- *procedure can be painful*

both procedures advantage

can treat the disease / problem

both procedures disadvantages

- *risk of transfer of viral infection*
- *some stem cells can grow out of control / become cancerous*

[16]

Q10.

- | | | |
|-----|---|---|
| (a) | C | 1 |
| (b) | cytoplasm and cell membrane dividing
<i>accept cytokinesis for 1 mark</i> | 1 |
| | to form two identical daughter cells | 1 |
| (c) | stage 4 | 1 |
| | only one cell seen in this stage | 1 |
| (d) | (4 / 36) × 16 × 60 | 1 |
| | 107 / 106.7 | 1 |
| | 110 (minutes)
<i>allow 110 (minutes) with no working shown for 3 marks</i> | 1 |
| (e) | binary fission
<i>do not accept mitosis</i> | |

- (f) shortage of nutrients / oxygen 1
- 1
- so cells die
- or**
- death rate = rate of cell division 1

[11]

Q11.

- (a) testis / testes 1
- 1
- allow testicle(s)*
- (b) (i) **B** = 13.2
- C** = 6.6
- E** = 3.3
- all 3 correct = 2 marks*
- 2 or 1 correct = 1 mark*
- If no marks awarded allow ecf for C **and** E based on answer to B*
- ie C = ½ B and E = ½ C for one mark* 2
- (ii) 6.6 1
- 1
- allow twice answer for cell E in part bi*
- (iii) mitosis 1
- 1
- correct spelling only*
- (c) (i) any **two** from:
- cells that are able to divide
 - undifferentiated cells / not specialised
 - can become other types of cells / tissues **or** become specialised / differentiated
- allow pluripotent* 2
- (ii) 4-day embryo is a (potential) human life 1
- 1
- or**
- destroying/damaging (potential) human life
- allow cord would have been discarded anyway*
- ignore reference to miscarriage*
- allow cannot give consent* 1
- (iii) perfect tissue match **or** hard to find suitable donors

allow same/matching antigens
allow no danger of rejection
allow no need to take immunosuppressant drugs
(for life)
*ignore genetically identical **or** same DNA*

1

- (iv) stem cells have same faulty gene / allele / DNA / chromosomes
allow genetically identical
ignore cells have the same genetic disorder

1

[10]

Q12.

- (a) (i) fewer cows

1

any **one** from:

- less methane
*do **not** allow CH⁴*
- less CO₂ in the atmosphere because of less deforestation **or**
 less plants consumed.

allow less CO₂ released into the atmosphere
*because less fuel used e.g. to heat cowsheds **or** to*
transport meat
*do **not** allow CO²*

1

- (ii) any **two** from:

- could be mass produced to feed an increasing population
- disease free meat
- no / low fat
- no harm to animals or less intensive farming
allow (may be) suitable for vegetarians
- antibiotic free meat
- more land available for farming crops
allow no energy loss along a food chain

2

- (b) fungus / Fusarium

1

with glucose (syrup)

1

in aerobic conditions **or** in presence of oxygen

ignore air

1

mycoprotein is harvested / purified

allow ammonia added (as source of nitrogen)
ignore stirring / mixing and temperature

1

[8]

Q13.

- (a) the movement of particles from a high concentration to a low concentration 1
- (b) (gills) have (many) projections
allow description of projections
allow have lots of / five gills 1
- (for) large(r) surface / area
- or**
- (gills) are on the outside of the body (1)
- for good access to water (1) 1
- (c) differentiation 1
- (d) mitosis
*do **not** accept meiosis* 1
- (e) hair 1
- (f) axolotls are cheap to feed 1
- axolotls are easy to breed 1
- (g) D 1
- (h) trachea
allow windpipe
allow cartilage (ring) 1
- (i) pulmonary artery 1

[11]