

Mark schemes

Q1.

(a) chromosome(s)

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

1

(b) sugar

*allow deoxyribose  
allow pentose  
do not accept ribose*

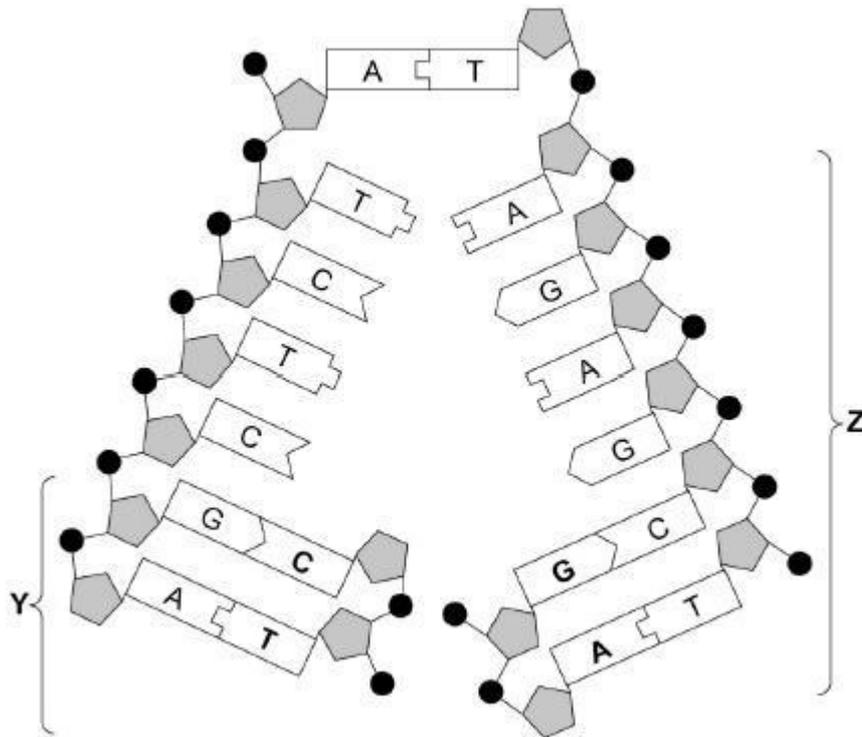
1

(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)  $3 \times 10^{-12}$  grams

1

(h) meiosis

1

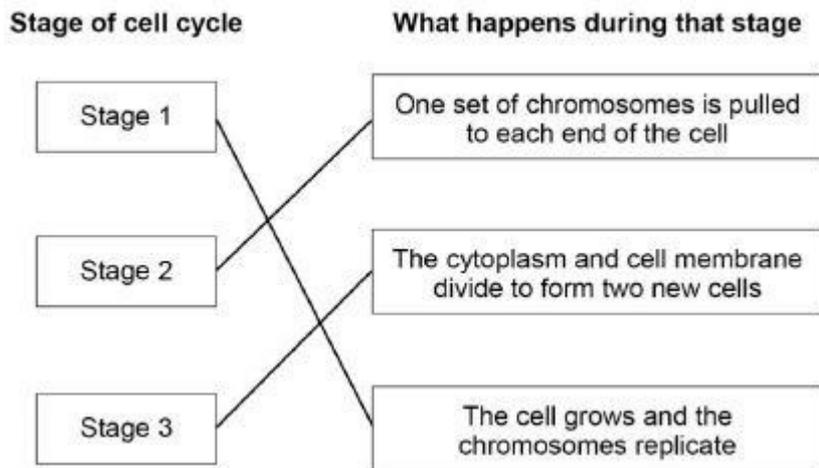
[8]

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  $\mu\text{m}$  = 0.001 mm  
 or 1 mm = 1000  $\mu\text{m}$   
 or 0.05 mm = 50  $\mu\text{m}$   
 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)  
*allow chromosomes or genetic material or genetic information double / replicate / are copied*
- increase in the number of mitochondria / ribosomes / sub-cellular structures  
*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]

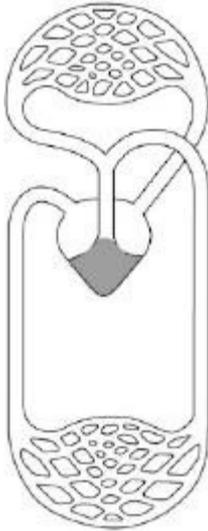
Q5.

(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) 1  
*do not accept embryonic stem cell*
- (f) any one from: 1  
 • paralysis  
 • diabetes  
*allow other examples such as Parkinson's / heart disease / stroke / cystic fibrosis / cancer / burns*  
*do not accept infectious diseases*
- (g) any one from: 1  
 • 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*
- (h) any one from: 1  
 • 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*
- [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
- allow in range 39 to 41*
- 1
- (h)
- 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
- an answer from mp1 but not × 1000 scores 2 marks*
- 1
- (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)
- allow allele(s)*
- 1

- (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

	<i>allow asexual is faster</i>	
	<ul style="list-style-type: none"> <li>• (more) energy efficient</li> <li>• genetically identical offspring</li> </ul>	
	<i>allow offspring are clones</i>	
	<ul style="list-style-type: none"> <li>• successful traits propagated / maintained / passed on (due to offspring being genetically identical)</li> <li>• no transfer of gametes or seed dispersal</li> </ul>	
	<i>allow no vulnerable embryo stage</i> <i>allow no need for animals</i>	
	<ul style="list-style-type: none"> <li>• not wasteful of flowers / pollen / seeds</li> <li>• colonisation of local area</li> </ul>	
	<i>must imply local area</i>	2
(c)	genetic variation (in offspring)	1
	(so) better adapted survive	
	<i>allow reference to natural selection or survival of the fittest</i>	1
	(and) colonise new areas by seed dispersal	
	or	
	can escape adverse event in original area (by living in new area)	
	<i>must imply new area</i>	1
	many offspring so higher probability some will survive	1
	<i>allow bluebell example described (max 3 if not bluebell)</i>	
		[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	
	<i>ignore cancer unqualified</i> <i>allow converse</i> <i>allow metastasises</i>	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<br><i>accept cytokinesis for <del>mark</del></i> | 1 |
|     | to form two identical daughter cells  | 1 |
| (c) | stage 4   | 1 |
|     | only one cell seen in this stage  | 1 |
| (d) | $(4 / 36) \times 16 \times 60$  | 1 |
|     | 107 / 106.7   | 1 |
|     | 110 (minutes)   |   |
|     | <i>allow 110 (minutes) with no working shown for 3 marks</i>                          | 1 |
| (e) | binary fission<br><i>do not accept mitosis</i>  |   |

(f) shortage of nutrients / oxygen

1

so cells die

or

death rate = rate of cell division

1

1

[11]

Q11.

(a) testis / testes

*allow testicle(s)*

1

(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

*allow twice answer for cell E in part bi*

1

(iii) mitosis

*correct spelling only*

1

(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

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 CH<sub>4</sub>*
- less CO<sub>2</sub> in the atmosphere because of less deforestation or less plants consumed.

*allow less CO<sub>2</sub> released into the atmosphere*  
*because less fuel used e.g. to heat cowsheds or to transport meat*  
*do not allow CO<sub>2</sub>*

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]