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

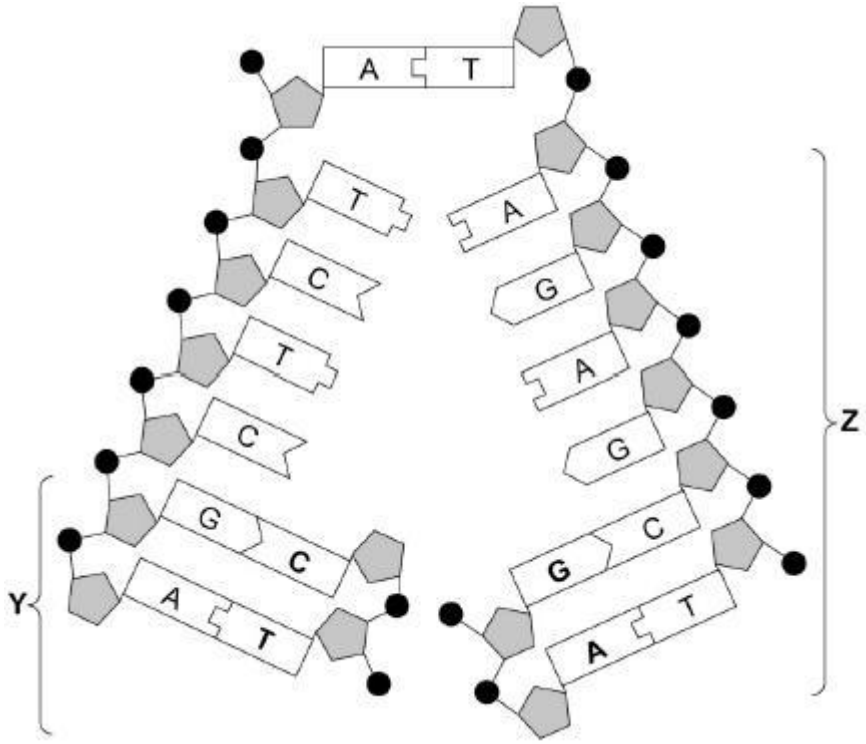
(c) base(s)

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

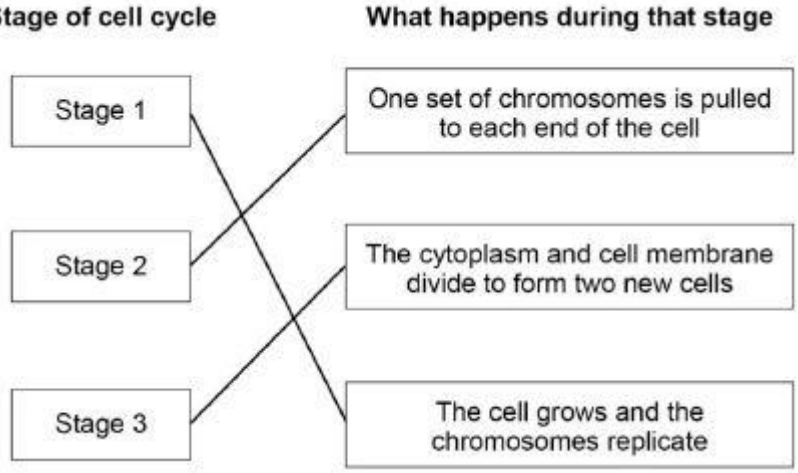
[8]

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 $\frac{252}{360} \times 100$

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 × 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]

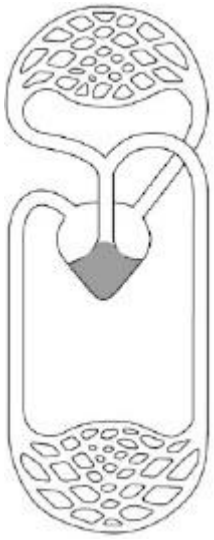
Q5.

(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

*do **not** accept no respiration occurs*

*do **not** accept energy production*

1

(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

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

1

× 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

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

*accept cytokinesis for **1** mark*

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)

*allow 110 (minutes) with no working shown for **3** marks*

1

(e) binary fission

*do **not** accept mitosis*

1

(f) shortage of nutrients / oxygen

1

so cells die
or
death rate = rate of cell division

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^4*
- less CO_2 in the atmosphere because of less deforestation **or** less plants consumed.

  *allow less CO_2 released into the atmosphere because less fuel used e.g. to heat cowsheds **or** to transport meat*

  *do **not** allow CO^2*

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 <u>glucose</u> (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]