Mark schemes

1

(a) nucleus labelled correctly

1

cell membrane labelled correctly

1

(b) mitosis

1

(c) electron (microscope)

1

(d) higher magnification

1

(e) 45 (mm)

1

45 / 250 **or** 0.18 (mm)

allow ecf

1

180 (µm)

1

*allow 180 (µm) with no working shown for **3** marks*

(f) 0.2 µm

1

[9]

2

(a) to kill virus
or
to prevent virus spreading

1

(b) take (stem) cells from meristem
or
tissue culture

allow take cuttings

1

(c) use Benedict's solution

1

glucoses turns solution blue to orange

1

(d) **Level 2 (3–4 marks):**
A detailed and coherent explanation is provided. The student makes logical links between clearly identified, relevant points that explain why plants with TMV have stunted growth.

Level 1 (1–2 marks):
Simple statements are made, but not precisely. The logic is unclear.

0 marks:
No relevant content.

Indicative content

- less photosynthesis because of lack of chlorophyll
- therefore less glucose made
  so
- less energy released for growth
- because glucose is needed for respiration
  and / or
- therefore less amino acids / proteins / cellulose for growth
- because glucose is needed for making amino acids / proteins / cellulose

4

[8]

3

(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]

4 (a)

	Mitosis only	Meiosis only	Both mitosis and meiosis
How cells are replaced	✓		
How gametes are made		✓	
How a fertilised egg undergoes cell division	✓		
How copies of the genetic information are made			✓
How genetically identical cells are produced	✓		

if more than one tick per row then no mark

ignore first row

1
1
1
1

(b) (i) (adult) bone marrow

accept (umbilical) cord blood, skin, amniotic fluid / membrane

1

(ii) cells will not be rejected by the patient's body (if they have been produced by therapeutic cloning)

allow easier to obtain linked to embryo stem cells

or

(embryo stem cells) can develop into many different types of cells

allow doesn't need an operation linked to bone marrow

or

(embryo stem cells) not yet differentiated / specialised or undifferentiated

accept embryo cells are pluripotent

1

[6]

5 (a) **A** = nucleus

allow phonetic spelling

1

B = (cell) membrane

1

(b) for repair / growth **or** to replace cells

ignore new cells / skin

1

(c) (i) embryos

1

(ii) paralysis

1

[5]

6 (a) (i) fertilisation

1

(ii) in sequence:

accept 1 next to gene, 2 next to chromosome and 3 next to nucleus in box

1 gene
2 chromosome
3 nucleus

*allow 1 mark for smallest **or** largest in correct position*

2

(iii) DNA

1

(b) (i) On diagram:

tick drawn next to **X** and / or **Y** from Parent 1

tick(s) must be totally outside grid squares

allow ticks around "parent "

extra ticks elsewhere cancel

1

(ii) 0.5 / ½ / 50% / 1:1 / 50:50 / 1 in 2

allow 2/4 / 2 in 4 / 2 out of 4 / 'even(s)' / 'fifty – fifty'

*do **not** allow 1:2 or '50 / 50' or '50 – 50'*

1

2 (out of 4) boxes are **XX**

or

half of the sperm contain an **X**-chromosome

*allow **XY** is male and 2 (out of 4) boxes are **XY***

1

[7]

7 (a) (i) allele expressed even when other allele present **or** expressed if just one copy of allele is present **or** expressed if heterozygous

if present other allele not expressed

1

(ii) 2 affected parents have unaffected child **or 1** and **2** → **5** / **6**

or if recessive all of **1** and **2**'s children would have CADASIL

1

(iii) heterozygous – has unaffected children **or** because if homozygous all children would have CADASIL

1

(b) genetic diagram including:

accept alternative symbols, if defined

1

correct gametes:

D and **d**
and d (and **d**)

ignore 7 / 8 or male / female

1

derivation of offspring genotypes:

Dd Dd dd dd

*allow just **Dd dd** if ½-diagram*
allow ecf if correct for student's gametes

1

identification **of Dd** as CADASIL
or dd as unaffected
allow ecf if correct for student's gametes

1

correct probability: 0.5 / ½ / 1 in 2 / 50% / 1 : 1

1

(c) (i) stem cells can differentiate **or** are undifferentiated / unspecialised

1

can form blood vessel cells / brain cells

or

stem cells can divide

1

(ii) ethical argument - eg no risk of damage to embryo or adult can give consent for removal of cells **or** adult can re-grow skin
more ethical qualified
ignore religion unqualified

or
if from a relative then less chance of rejection **or** if from self then no chance of rejection
or
skin cells more accessible

1

[10]

8 (a) (i)

Feature	Mitosis only	Meiosis only
Produces new cells during growth and repair	✓	
Produces gametes (sex cells)		✓
Produces genetically identical cells	✓	

All 3 correct = **2** marks

2 correct = **1** mark

0 or 1 correct = **0** marks

2

(ii) (a man) testis / testes

accept testicle(s)

1

(a woman) ovary / ovaries

*do **not** accept 'ova' / ovule*

1

(b) (i) XY / YX

or

X and Y

1

(ii) XX

or

X and X or 2 X's

accept X

1

(c) ½ / 0.5 / 50% / 1:1 / 1 in 2

*do **not** accept 1:2 / 50/50*

allow 50:50

allow 2 in 4

1

[7]

9 (a) (i) DNA replication / copies of genetic material were made

'it' = a chromosome

allow chromosomes replicate / duplicate / are copied

ignore chromosomes divide / split / double

1

(ii) one copy of each (chromosome / chromatid / strand) to each offspring cell

ignore ref. to gametes and fertilisation

1

each offspring cell receives a complete set of / the same genetic material

allow 'so offspring (cells) are identical'

1

(b) (i) meiosis

allow mieosis as the only alternative spelling

1

(ii) Species A = 4 **and** Species B = 8

1

(iii) sum of A + B from (b)(ii) e.g. 12

1

(c) (i) similarities between chromosomes
or
similarities between flowers described

e.g. shape of petals / pattern on petals / colour / stamens

1

can breed / can sexually reproduce

allow can reproduce with each other / they can produce offspring

1

(ii) any **two** from:

- offspring contain 3 copies of each gene / of each chromosome / odd number of each of the chromosomes
- some chromosomes unable to pair (in meiosis)
- (viable) gametes not formed / some gametes with extra / too many genes / chromosomes

or
some gametes with missing genes / chromosomes

2

[10]

10 (a) comparisons are **not** required but should be credited
accept a clear indication of the statement even if incomplete

can develop into most other types of cell

1

each cell divides every 30 minutes

1

low chance of rejection by the patient's immune system

1

(b) any **three** from:

- cheaper / <u>only</u> costs £1000
  *this **must** be comparative*
  ignore costs £1000
- can collect many (stem) cells
- adults give permission for their own bone marrow to be collected
  comparisons are not required but should be credited
- safe

3

[6]

11 Marks should **not** be awarded for simply copying the information provided
A mark may be awarded for a <u>comparison</u> between treatments if the answer only involves copied information

any **four** from:

*For all **4** marks to be awarded, there must be at least 1 pro and 1 con*

<u>embryo stem cells – examples of</u>

pros

- can treat a wide variety / lots of diseases / problems
- many available / plentiful
- using them better than wasting them
- painless

cons

- (possible) harm / death to embryo
- (relatively) untested / unreliable / may not work
  allow long term effects not known
  ***or** may be more risky*
- embryo can't be 'asked' / 'embryo rights' idea

<u>adult bone marrow stem cells – examples of</u>

pros

- no ethical issues (in collection) **or** permission given
- quick recovery
- (relatively) safe
  allow does not kill (donor) / low risk
- well tried / tested / know they work

cons

- operation hazards eg infection
- few types of cell / tissue produced **or** few diseases / problems treated
- painful so may deter donors

4

Conclusion to evaluation:

A reasoned conclusion from the evidence

1

[5]

12 (a) (i) mitosis

correct spelling only

1

(ii) replicates / doubles / is copied / duplicates

accept cloned
ignore multiplied / reproduced

1

(b) fertilisation occurs / fusion (of gametes)

accept converse for asexual, eg none in asexual / just division in asexual

1

so leading to mixing of genetic information / genes / DNA / chromosomes

genes / DNA / chromosomes / genetic information comes from 1 parent in asexual
ignore characteristics

1

one copy (of each allele / gene / chromosome) from each parent
or
gametes produced by meiosis
or
meiosis causes variation

meiosis must be spelt correctly

1

[5]

13 (a) asexual

1

(b) mitosis

1

(c) genes

1

[3]

14

(a) cell division / bacterium divides / multiplies / reproduces

allow asexual / mitosis

ignore growth

1

(b) 18

1

18 000 / 18 × 10^3 / 1.8 × 10^4

*do **not** accept 1.8 / 1.8 ^{04} / 1.8^4*

allow ecf from wrong count

1

(c) to kill / destroy other microorganisms / named type
or to prevent contamination

ignore germs / viruses

1

to prevent other microorganisms affecting the results
or other microorganisms would be counted

allow to give accurate / reliable results

1

(d) prevent growth of pathogens / disease-causing microorganisms / dangerous microorganisms

*do **not** accept microorganisms <u>become</u> pathogenic*

ignore germs / viruses

ignore general safety / biohazards / harmful products produced by bacteria

1

(e) to improve the reliability of the investigation / check for anomalies

*do **not** accept accuracy / precision / fairness / validity*

ignore averages / repeatability / reproducibility

1

[7]

15 (a) any **one** from

- chromosomes in pairs
- inherited one of each pair from each parent
- one of each pair in egg **and** one of each pair in sperm
- so sex cells / gametes can have half the number

allow need to pair during cell division / meiosis

1

(b) any **two** from:

- code
- combination / sequence of amino acids
- forming specific / particular proteins / examples

*If **no other mark** gained allow reference to controlling characteristics / appearance for **1** mark*

2

(c) (i) C

1

(ii) 30

1

(d) (i) for growth / repair / replacement / asexual reproduction

*do **not** accept incorrect qualification, eg growth of cells **or** repair of cells*

they equals cells therefore do not accept they grow etc

1

(ii) 44 **or** 22 pairs

1

[7]

16 (a) 2 and 3

1

(b) cell **P** has an X chromosome; cell **R** has a Y chromosome

1

(c) any **two** from:

- (formed from) different egg / 2 eggs
- (formed from) different sperm / 2 sperm
- have different genes / alleles / chromosomes / DNA
  allow genetics

2

(d) (i) stem cells

1

(ii) the cells divide

1

the cells differentiate

1

(iii) (medical) research / named eg growing organs
or

medical / patient treatment
allow (embryo) cloning
*do **not** allow designer babies / more babies*

1

(iv) any **one** from:

- ethical / moral / religious objections
  ignore cruel / not natural / playing God
- potential harm to embryo
  allow deformed
  ignore harm to mother

1

[9]

17 (a) chromosomes

1

(b) diagram showing four separate chromosomes two long and two short (as in diagram 1)
allow each chromosome shown as two joined chromatids
*do **not** allow if chromosomes touching each other*

1

(c) (i) any **two** from:

- can grow into any type of tissue / named tissue
- used in medical research
- used to treat human diseases
- large numbers can be grown

2

(ii) any **two** from:

- expensive
- grow out of control / ref cancers
- may be rejected
- need for drugs (for rest of life)

2

[6]

18 any **four** from:

- cells used to treat diseases do not go on to produce a baby
- produces identical cells for research
- cells would not be rejected
- allow cells can form different types of cells
- (immature) egg contains only genetic information / DNA / genes / chromosomes from mother **or** there is only one parent
- asexual / no mixing of genetic material / no sperm involved / no fertilisation **or** chemical causes development
- baby is a clone
- reference to ethical / moral / religious issues

  allow ethically wrong
  NB *<u>cloning</u> is illegal gains **2** marks*
  ignore unnatural
- risk of damage to the baby

  in correct context

[4]

19 (a) A = meiosis

accept 'mieosis'
*do **not** accept 'miosis'*

1

B = mitosis

*do **not** accept 'meitosis' etc*

1

(b) fertilisation allow conception

1

(c) (i) 23

1

(ii) 46

1

[5]

20 **one** mark for each of the following comparisons to a maximum of **6**

*candidates **must** make a clear comparison*

meiosis	**mitosis**
sexual	asexual
gametes	growth
ovary **or** testes **or** gonads	all other cells
half number of chromsomes	same number of chromosomes
haploid **or** 23 chromosomes	diploid **or** 46 chromosomes
reassortment **or** variation possible **or** not identical	no reassortment **or** no variation **or** identical
4 cells produced	2 cells produced
2 divisions	1 division

[6]

21 (a) (i)

if two nuclei drawn then maximum two marks

1

6 chromosomes

1

same 3 homologous pairs

1

nuclear membrane drawn

1

(ii) 3 chromosomes

1

1 from each homologous pair

1

(b) (i)

parent line must be separate

heterozygous parents Tt × Tt

*maximum of **2** marks if parental genotype is wrong*

gametes correct T t T t

1

genotypes TT Tt Tt tt

1

(ii) correct analysis of chance i.e. 1 in 4
or 25%

1

(iii) 50% **or** 1 in 2

1

[10]

22 (a) (i) meiosis

1

(ii) mitosis

1

(c) (i) **X** pituitary

1

Y FSH

1

(ii) stimulates LH production

1

inhibits FSH production / production of **Y**

1

[6]

23 (a) **A A a a**

Aa allele correctly separated

1

B b B b

Bb allele arranged to form four different pairings
all four pairings must be correct for the second mark

1

(b) **A** **A**

the two cells the same as the parent cell

a **a**

B **B**

b **b**

1 mark for each cell

2

(c) (i) 46

accept 23 pairs

1

(ii) 23

accept half if c(i)

1

(iii) 46

accept save as c(i)

1

[7]

24 (a) circles round right hand **X** and **Y** gametes

*put two ticks **or** crosses by the circles*

2

(b) 50:50 **or** 1:1 **or** 50% **or** 0.5 **or** ½ equal **or** evens

credit even

*do not accept 2:1 **or** 50 / 50*

1

(c) (i) 23

1

(ii) 23

credit the same as the one above to be marked consequential

1

(d) DNA

do not accept nucleic acid

1

(e) same

1

[7]

25 (a) 23

1

(b) chromosome nucleus gene cell
2 3 1 4

1

(c) (i) any **one** from

(cells which are bigger) take up more space

(cells) have to get bigger **or** mature to divide

1

(ii) chromosomes duplicate **or**
make exact copies of self

accept forms pairs of chromatids

1

nuclei divide

*accept chromatids **or***
chromosomes separate

1

identical (daughter) cells formed

accept for example, skin cells make
*more skin cells **or** cells are clones*

1

(d) any **two** from

Differentiation mark

babies need **or** are made of different types of cells **or** cells that have different functions

accept different cells are needed
for different organs

Division or specialisation mark

as fertilised egg starts to divide each cell specialises to form a part of the body

accept specialised cells make different parts of the body

Growth mark

specialised cells undergo mitosis to grow further cells

*accept cells divide **or** reproduce to form identical cells*

2

[8]