

Mark schemes

Q1.

- (a) 1. Replication of (circular) DNA;
Accept nucleoid
Reject chromosome
Reject mitosis
2. Replication of plasmids;
3. Division of cytoplasm (to produce daughter cells);
Ignore genetically identical

3

- (b) 6.8×10^{-13} ;

1

- (c) Correct answer of 660 = **2 marks**;;

Accept for 1 mark, 18 (fg minute^{-1})

OR

0.30 (fg s^{-1})

OR

Correct use of interpolation lines

2

- (d) Principle of marking pairs: Named environmental variable; Correct effect on growth rate;

Examples

1. Increased (concentration of) glucose;
2. Increased respiration;
3. Increased (concentration of) oxygen;
4. Increased respiration;
5. Increased temperature;
6. Increased enzyme activity;
7. Increased (concentration of) phosphate;
8. Increased ATP/DNA/RNA;
9. Increased (concentration of) nucleotides;
10. Increased DNA synthesis;

4 max

[10]

Q2.

- (a) 1. Chromosomes (are) becoming visible/distinct;
 2. Because (still) condensing;

OR

*Accept 'chromosomes are condensed' for 2 marks.
 Accept shorten or thicken for 'condensed'*

3. Chromosomes (arranged) at random/not lined up;
 4. Because no spindle (activity);

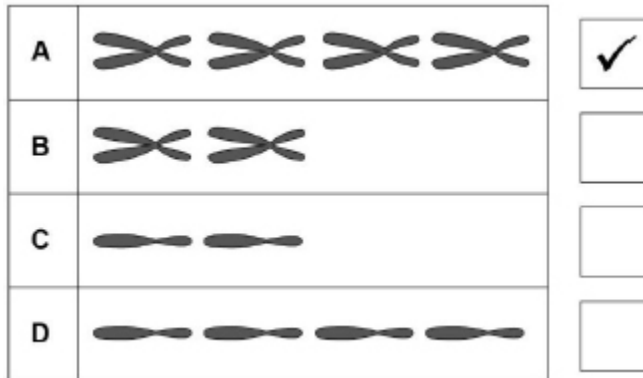
OR

Because not attached to spindle fibres;

*Link marking points-
 1 and 2
 3 and 4*

2

- (b) A;



1

- (c) Locus/loci;

1

Q3.

- (a) Correct answer for 2 marks, 1.286;;
 Accept for 1 mark,
 1.28571429 (correct answer not to 3 decimal places)

OR

1.285 (incorrect rounding to 3 decimal places)

OR

Evidence of 0.02142857

OR

Evidence of 19 **and** 4 **and** 700

OR

Evidence of 15 **and** 1800 **and** 2500

OR

Evidence of 15 **and** 700

2

- (b) 1. C = prophase **and**
 D = metaphase **and**
 E = anaphase;
2. (In) prophase, chromosomes condense;
Accept chromatin for 'chromosomes' and for 'condense', shorten and thicken
3. (In) prophase **OR** metaphase, centromeres attach to spindle fibres;
4. (In) metaphase, chromosomes/pairs of chromatids at equator/centre of spindle/cell;
5. (In) anaphase, centromeres divide;
6. (In) anaphase, chromatids (from each pair) pulled to (opposite) poles/ends (of cell);
Accept for 'chromatids', chromosomes but reject homologous chromosomes
7. (In) prophase/metaphase/anaphase, spindle fibres shorten;
If mark point 1 is not credited = 4 max
Do not carry forward error from 1.
Accept letters for stages as indicated in 1.
Accept for 'shorten', contract

5 max

[7]

Q4.

- (a) Correct answer of 960 to 1025 (mg) for 2 marks;;

Accept for 1 mark,

$m = 4.18$ to 5.00

2

- (b) Mark each column;;

Number of	Mass of DNA /
-----------	---------------

chromosomes	arbitrary units
	50
80	
40	12.5

2

(c) Independent segregation

OR

Crossing over;

Accept labelled diagram

Accept (eggs produced) have different combinations of maternal and paternal chromosomes

1

(d) 120;

1

(e) 1. Too many/extra set/three copies of chromosomes;

Accept 1 paternal, 2 maternal

2. (Homologous) chromosomes do not pair

OR

(Homologous) chromosomes do not separate (evenly);

Accept divide for separate

3. (So) no meiosis;

2 max

[8]

Q5.

(a)

Mark in pairs as (1 and 2 OR 3 and 4)

1. Chromosomes/centromeres cannot attach (to spindle)

OR

Chromosomes cannot line up (on spindle);

2. (So, no) metaphase;

OR

3. Chromatids cannot separate (on spindle);

Accept description of 'cannot separate' e.g cannot move to poles

Ignore 'split'

4. (So, no) anaphase; 2
- (b) 1. Cancer cells divide more/uncontrollably/rapidly
OR
 Healthy cells divide less/slowly; 1

Q6.

- (a) 1. (Trend of) slowing growth from before birth to 21 days
OR
 (Trend of) decreasing percentage undergoing mitosis from before birth to 21 days
OR
 (Trend of) decreasing percentage undergoing DNA replication from before birth to 21 days;
Accept 'day -6' for 'before birth'.
For '21 days' accept 'until the end of the investigation'.
2. DNA replication happens before mitosis
OR
 Heart growth slowing **until** (fully) developed
OR
 These cells lost the **ability to** divide;
*Accept 'Heart growing/developing before birth **and** becomes (fully) developed'.*
Accept reference to only unipotent cells/cardiomyocytes dividing (at 21 days). 2

Q7.

- (a) 1. Where dividing cells are found / mitosis occurs;
OR
 No dividing cells / mitosis in tissue further away / more than 5 mm from tip;
OR
 To get (soft) tissue that will squash;
OR
 Length that will fit under cover slip;
Accept most dividing cells
2. Single / thin layer of cells / spread out cells **so** light passes through (making cells / nuclei visible);
Accept thin layer of tissue
Ignore to see cells clearly 2
- (b) 3.57 / 3.6 / 3.7 / 3.71 / 3.8 (%);;
If the answer includes additional decimal places, award the marks if it would round to a correct answer

There are 3 cells in anaphase

Accept for 1 mark, 101.25 / 101 (students estimate in minutes)

OR

3.75 (difference between scientist estimate and student's estimate in minutes)

Ignore plus or minus signs

2

(c) Cytokinesis;

1

(d) Description;

Explanation;

E.g,

1. Examine large number of fields of view / many cells;

Mark as pairs only

Accept large number / 20 or more for many

2. To ensure representative sample;

Accept typical / reliable

OR

3. Repeat count;

4. To ensure figures are correct;

OR

5. Method to deal with part cells shown at edge /count only whole cells;

6. To standardise counting;

2 max

(e) 1. Stops anaphase / cell division / mitosis;

Accept prevents telophase / cytokinesis

2. (By) stopping / disrupting / spindle fibres forming / attaching / pulling;

Ignore affects anaphase

3. Preventing separation of (sister) chromatids;

Ignore chromosomes separate / split

Accept chromatids split

4. (So) no new cells added (to root tip);

3 max

[10]

Q8.

- (a) 1. The (individual) chromosomes are visible because they have condensed;
Both parts of each answer are required – evidence and explanation.
For 'they' accept 'chromosomes/chromatin/DNA'
Accept 'tightly coiled' or 'short and thick' for condensed but do not accept 'contracted'.
Ignore references to nucleus/nucleolus/nuclear membrane.
2. (Each) chromosome is made up of two chromatids because DNA has replicated;
Both parts of each answer are required – evidence and explanation.
Accept 'sister chromatids' for 'two chromatids'.
Ignore references to nucleus/nucleolus/nuclear membrane.
3. The chromosomes are not arranged in homologous pairs, which they would be if it was meiosis;
Both parts of each answer are required – evidence and explanation.
Accept not meiosis because bivalents/chiasmata/crossing over not seen.
Ignore references to nucleus/nucleolus/nuclear membrane.

2 max

- (b) Automarked q – ✓ prophase

1

- (c) 1. Water moves into the cells/cytoplasm by osmosis;
Reject water moving into chromosomes/nucleus.
2. Cell/cytoplasm gets bigger;
Accept idea of cell/cytoplasm has greater volume/swells/expands.
Ignore references to pressure changes, turgidity and chromosomes being more dilute.
Ignore references to changing water/fluid contents of the cell.
Allow ECF for 'nucleus expands' but not for 'chromosomes expand'.

2

- (d) Differences in base sequences

OR

Differences in histones/interaction with histones

OR

Differences in condensation/(super)coiling;

Answer must be in context of differences in arrangement of chromosomes not just related to the properties of the stain.

Accept spec section 8 ideas e.g. different methylation/acetylation

Accept different genes

Reject different alleles

1

(e) (Two chromosomes that) carry the same genes;

Reject 'same alleles'

Accept 'same loci' (plural) or 'genes for the same characteristics'

1

Q9.

(a) Binary fission;

Reject mitosis

1

(b) 1. Keep lid on Petri dish

OR

Open lid of Petri dish as little as possible.

2. To prevent unwanted bacteria contaminating the dish.

OR

L. monocytogenes may be dangerous / may get out.

OR

3. Wear gloves

OR

Wear mask

OR

Wash hands;

4. To prevent contamination from bacteria on hands / mouth

OR

Prevent spread of bacteria outside the lab;

OR

5. Use sterile pipette

OR

Flame the loop

OR

Flame the neck of the container of the culture;

6. To maintain a pure culture of bacteria

4 max

Q10.

(a) (During prophase)

1. Chromosomes
coil / condense / shorten / thicken / become visible;
2. (Chromosomes) appear as (two sister) chromatids joined at the centromere;

(During metaphase)

3. Chromosomes line up on the equator / centre of the cell;
4. (Chromosomes) attached to spindle fibres;
5. By their centromere;

(During anaphase)

6. The centromere splits / divides;
7. (Sister) chromatids / chromosomes are pulled to opposite poles / ends of the cell / separate;

(During telophase)

8. Chromatids / chromosomes
uncoil / unwind / become longer / thinner.

*No marks for naming the stages**Reject references to homologous chromosomes / pairing of chromosomes**Ignore references to spindle formation during prophase*

5 max

Q11.

- (a)
1. Push hard – spread / squash tissue;
 2. Not push sideways – avoid rolling cells together / breaking chromosomes.

Neutral – to see cells clearly

2

(b) No (no mark)
Yes (no mark)

1. Chromosomes / chromatids are (in two groups) at poles of spindle / at ends of spindle;
Do not accept 'ends of cell'
2. V-shape shows that (sister) chromatids have been pulled apart

at their centromeres / that centromeres of (sister) chromatids have been pulled apart.

2

(c) 28.8 / 29.

If incorrect, allow:

$$\frac{6}{200} \times 960 = 1 \text{ mark}$$

2

[6]

Q12.

(a) (D)CBEA.

1

(b)

Step	Reason
(Taking cells from the root tip)	Region where mitosis / cell division occurs;
(Firmly squashing the root tip)	To allow light through / make tissue layer thin;

2

(c) (Increase)

1. Chromosomes / DNA replicates;
(First decrease)
2. Homologous chromosomes separate;
(Second decrease)
3. Sister chromatids separate.

3

(d) 1. (DNA would) double / go to 2 (arbitrary units).

1

[7]