

All cells arise from other cells 2

Level: AQA A Level 7402

Subject: Biology

Exam Board: Suitable for all boards

Topic: All cells arise from other cells 2

Type: Mark Scheme

To be used by all students preparing for AQA A Level Biology 7402 foundation or higher tier but also suitable for students of other boards.

Mark schemes

- 1**
- (a) DNA replicated/two DNA strands/molecules;
Coiled/condensed/wound up (to make visible);
Giving/made of (two) chromatids;
Attached at centromere;
Accept linear so eukaryote; with histone;
Accept have become shorter and fatter
- 2 max
- (b) (i) Stage **A**, anaphase/prophase;
Chromatids/chromosomes moving to poles/chromosomes condensed/
coiled/wound up;
Points not linked but need correct description with stage in this case.
Accept prophase because the image could be interpreted as such
- 2
- (ii) Stage **B**, metaphase;
Chromosomes on equator/attaching to spindle;
Points not linked
Accept equator of cell
Reject centre of cell
Accept chromatids for chromosomes
- 2
- [6]**
- 2**
- (a) (i) where mitosis / division / growing / occurs
(*reject growing cells*)
- 1
- (ii) to distinguish chromosomes / chromosomes not visible
without stain;
- 1
- (iii) to let light through / thin layer;
- 1
- (b) (i) $74 + 18 / 982$;
 $= 9.4\% / 9\%$;
- 2
- (allow 1 mark for identifying prophase & metaphase i.e.92 or correct method using wrong figures)*



- (ii) genetic differences / different types of garlic;
time of day;
chance;
age of root tip;
water availability;
temperature;
nutrient availability;
- (environmental factors = 1 but cannot be awarded in addition to a named environmental factor)*

2 max

[7]

3

- (a) (i) Prophase;
- (ii) Chromosomes / chromatids moved apart;
- (iii) *A wide range of processes occurs during interphase. This list is by no means exhaustive, but we would expect to see answer such as:*

1

1

Increase in volume of cell / volume of cytoplasm / increase in mass / cell bigger;
increase in number of organelles;
synthesis of protein / named protein;
DNA replication / increase / chromosomes copied;
ATP synthesis / respiration;

max 2

- (b) Divide real length of bar (in mm) / 10 by 0.02;
- (c) $12 / 200 \times 24$ / single error in otherwise correct method;
1.44 hours (1 hour 26 min);

1

2

[7]

4

- (a) Chromosomes attach to equator / middle of cell / spindle;
Prophase;
Anaphase;
DNA replication / synthesis / chromosome copying / duplication;
Telophase;

5

- (b) (i) Meiosis;

1

- (ii) 32;

1

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- (a) Later fertilisation / cell fusion; (NOT just 'sexual reproduction')
Restoring diploid / original number / not doubling chromosome number;
ALLOW ref '1/2 + 1/2'

2

- (b) Any three pairs from:
need comparison of meiosis and mitosis each time

| Meiosis | Mitosis |
|--|--|
| (Homologous) chromosomes associate in pairs | (Homologues) independent / do not pair (IGNORE ref. separation) |
| Crossing-over / chiasmata formation | No crossing-over; |
| Two / (nuclear stages) divisions / → 4 offspring cells | One / (nuclear stage) division / → 2 offspring cells; |
| <u>Genetically</u> different (product) | Genetically identical (product); |

IGNORE refs. To location

max 3

[5]

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- (a) replication / duplication / doubling of chromosomes / replication of DNA / transcription of DNA;

1

- (b) (i) cell to show correct number of chromosomes;
correct shape and position of centromere;

2

- (ii) as (i) except everything halved – *Ignore crossing over*,
(if mitosis and meiosis reversed, allow 1 if otherwise correct)

2

- (c) to replace cells;

1

[6]

7

- (a) (i) benign does not cause cancer / does not invade other tissues causing damage / with benign cancer, pieces which break off do not start new tumours elsewhere in body / metastasis;

1

- (ii) may damage organ concerned;
may cause blockages / obstructions;
may damage / exert pressure on other organs;

max 2



- (b) (i) because sun's radiation contains ultra violet radiation;
this causes mutation of genes which control division; 2
- (ii) because fair skin has little melanin which protects
against u.v. radiation; 1
- (iii) because cancer has genetic component / may have inherited
(onco)gene / gene which gives predisposition to / causes cancer; 1

[7]

8

- (a) produced by mitosis;
genetically identical;
*(accept identical genes / same genotype / WNA / genetic
information)(reject same genes, same genetic code)* 2
- (b) cells lost ability to control development / no longer totipotent /
cells have differentiated / become specialised; 1
- (c) (many) offspring with favourable characteristics / high meat / milk yield;
pedigree embryos into non-pedigree mothers / not risking pedigree
mothers / rare breeds conserved;
sex / gender selection; 2 max

[5]

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- (a) (i) (D) B E A C; 1
- (ii) metaphase; 1
- (b) interphase / S phase; 1
- (c) (i) 0.06×100 ;
6%;
(correct answer 2 marks) 2
- (ii) more(cancer cells) killed, cancer cells divide more (often)
(so are more likely to be killed, more susceptible); 1
- (iii) longer time to recover;
reduced rate of mitosis / divide more slowly /
increased doubling time; 2

[8]



- 10** (a) mitosis;
genetically / genes / genotype identical;
(reject same genes)
(ignore references to asexual reproduction) 2
- (b) (different)
environmental conditions / named environmental factor / mutation; 1
- (c) dispersal / prevent overcrowding / competition / colonise ;
increased number of (proven) offspring; *(not quicker)* 2
- [5]**
- 11** (a) 1 two strands therefore semi-conservative replication (possible);
2 base pairing / hydrogen bonds holds strands together
3 hydrogen bonds weak / easily broken, allow strands to separate;
4 bases (sequence) (exposed so) act as template / can be copied;
5 A with T, C with G / complementary copy;
6 DNA one parent and one new strand; 4 max
- (b) 1 chromosomes shorten / thicken / supercoiling;
2 chromosomes (each) two identical chromatids / strands / copies
(due to replication);
3 chromosomes / chromatids move to equator / middle of the spindle / cell;
4 attach to individual spindle fibres;
5 spindle fibres contract / centromeres divide / repel;
6 (sister) chromatids / chromosomes (separate)
move to opposite poles / ends of the spindle;
7 each pole / end receives all genetic information /
identical copies of each chromosome;
8 nuclear envelope forms around each group of chromosomes /
chromatids / at each pole; 7 max
- (c) cancer cells killed, normal body cells survive;
cancer cells low oxygen (as blood supply cannot satisfy demand); 2
- [13]**
- 12** (a) (i) anaphase; 1
- (ii) sister / identical chromatids (separate);
move to opposite poles / ends / sides; 2



- (b) (i) interphase; 1
- (ii) ATP production / protein synthesis / replication of centrioles; 1
- (iii) 1.2; 1
- (c) short duration of interphase; 1
- [7]

- 13** (a) (i) 8 'chromatids' each side; spindle drawn; 2
- (ii) 4 chromosomes; 1 from each homologous pair; 2
- (b) produces haploid cells / chromosome number halved; fertilisation maintains the diploid / chromosome number (in next generation); 2
- [6]

- 14** (a) genetically identical cells / individuals; 1
- (b) mitosis; 1
- (c) no differentiation at this stage / same genes being expressed; 1
- (d) brown - genes / DNA / genetic 'information' from the nucleus (expressed); 1
- (e) embryo cell diploid, egg cell haploid; contain different alleles / forms of the colour gene; 2
- (f) damage to nucleus / cells during transfer; 1
- [7]

- 15** (a) (i) prophase; chromosomes thickening / becoming visible; 2
- (ii) anaphase; chromatids / chromosomes moving to opposite poles / ends of spindles; 2



- (b) DNA replication;
synthesis or proteins / build-up of energy stores / growth /
increase in cytoplasm;
replication of organelles / named example;

2 max

[6]

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- (a) (cut out gene using an) endonuclease / restriction enzyme;
reference to specificity / recognition site;
sticky ends;
use the same enzyme to cut;
plasmid / virus / potato DNA;
fixed by ligase;
method of introducing vector e.g. micropipette / virus injects DNA /
remove plant cell wall;

6 max

- (b) different genes are expressed;
producing different enzymes / proteins;

2

[8]

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- (a) mass of undifferentiated / unspecialised / totipotent cells;
uncontrolled cell division;
(not 'repeated')

metastasis / (cells break off and) form new tumours /
spread to other parts of body;

3

- (b) cancer takes time to develop / exposure when young but cancer
triggered later; other organs destroyed before death occurs /
metastasis affects other organs;
immune system less effective in old people;
longer time of exposure to UV / accumulation of mutagenic effect;

1 max

- (c) dark skin / melanin / pigment stops UV light / prevents burning;
so less cancer risk in dark skinned people / less likely to develop tumours;
(allow converse)

2

[6]

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- (i) smoking and drinking increase risk;
risk increases for nonsmokers with more alcohol;
20-40 cigarettes increases risk;
at all levels of alcohol consumption;
4 or more drinks increase risk in all groups;
worst risk with combination of 40+ cigarettes and 4 or more drinks;
smoking and drinking together have a greater effect than either
on its own;
over 40 cigarettes and no alcohol greater than 1 or 2 alcoholic
drinks / valid comment about anomaly;

3 max



- (ii) other environmental factor / e.g. passive smoking;
genetic predisposition / inherited from parents;
mutation;

1 max

[4]

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- (a) (i) **A** anaphase;

1

- (ii) **(C) B,A,D**;

1

- (iii) (original) chromosome / DNA has been replicated;
each chromosome consists of two chromatids /
chromatids attached at centromere;

(accept reference to condensed state of chromosomes)

2

- (b) (i) it has doubled / now 8;

1

- (ii) chromosome / DNA replication but no separation
/ anaphase / cell division;

1

[6]

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- (a) Sequence: C,A,D,B;

1 mark per correct box to 3 max

3 max

- (b) (i) Q;

1

- (ii) Cell/nucleus has divided / is dividing (into two);

Accept – mitosis (occurring)

Ignore refs to chromosomes dividing

1

[5]

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- (a) Centromere;

1

- (b) Same size;

Same shape;

Same genes;

In same sequence/locus/loci;

2 max

(c) Chromatids separate;

(Chromatids) pulled to opposite ends of cell;

By spindle fibres;

Become part of new nuclei;

2 max

[5]

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(a) 1 Cut gene out of cell / make gene using mRNA / obtain gene with restriction enzymes;

2 Cut DNA using restriction enzyme / plasmid cut with restriction enzyme;

3 Correct reference to sticky ends;

4 Join DNA using ligase / insert gene into vector;

5 Plasmid / named vector transferred to cell;

6 Method of transfer e.g. heat shock;

7 Reference to marker gene;

8 Select bacteria containing new gene;

max 6

(b) Cells can metastasise / break off / spread to other parts of the body;

Remaining cells continue to divide forming a new tumour / secondary;

2

(c) Antibodies specific;

Normal cells have different antigen / cancer cell has particular antigen;

Enzyme **only** present in cancer cells so drug **only** activated at / near cancer cells;

3

(d) All cells contain DNA;

Would stop / inhibit DNA replication in normal cells;

Stops / inhibits cell division;

Named example on growth / repair e.g. no new blood cells made / no wound healing;

4

[15]