EXAM PAPERS PRACTICE

All cells arise from other cells 1

Level: OCR A Level H420
Subject: Biology
Exam Board: Suitable for all boards
Topic: All cells arise from other cells 1
Type: Mark Scheme

To be used by all students preparing for OCR A Level Biology H420 foundation or higher tier but also suitable for students of other boards.

Mark schemes

1 (a) To ensure the colour is the same at the start; **1**

(b) Yes – curve on graph with bromelain present remains approximately constant / rises very slightly;
Would decrease if killing of cells occurred / would increase if cells still dividing; **2**

(c) Use of mouse cells (rather than human);
(Carried out) *in vitro* / not in living organisms;
Only tested on one type of cancer;
Not possible to predict effect on humans (as no data collected); **3 max**

(d) The faster the rate of division the faster the cancer would grow;
By measuring rate of cell division you could see how effective the treatment was; **2**

(c) Not ethical to replace conventional treatment;
As life of patient is at risk (if bromelain not effective); **2**

[10]

2 (a) Chromosomes: **C** = 8 *and* **D** = 4;
DNA: **C** = 300 *and* **D** = 150; **2**

(b) (i) testis / ovary;
accept anther / carpel / stamen / testicle **1**

(ii) to make chromosomes / chromatids / DNA / genetic material visible; **1**

[4]

3 (a) Interphase / S-phase; **1**

(b) **A D C E B;** **1**

(c) Attachment of centromeres / chromosomes / chromatids; Separation of centromeres / chromatids / chromosomes; **2**

(d) Halves chromosome number / haploid;

Diploid / full number restored at fertilisation;
Allow correct reference to variation **max 2**

[6]

4

(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 mark*

2

[6]

5

(a) 1. Rank all STs in ascending order;
2. Find value with same number (of people) above and below.

Accept find middle value

2

(b) Not ethical to fail to treat cancer.

1

(c) Yes since with ipilimumab:

1. Median ST increased by 2.1 months;
2. Percentage of patients showing reduction in tumours increased from 10.3% to 15.2%;

No because:
3. No standard errors shown / no (Student) t- test / no statistical test carried out;
4. (So) not able to tell if differences are (statistically) significant / due to chance (alone);
5. Improvement might only be evident in some patients / no improvement in some patients;
6. Quality of (extra) time alive not reported;

If answers relate only to 'Yes' or 'No', award 2 marks max

4 max

(d) 1. Faulty protein recognised as an antigen / as a 'foreign' protein;
2. T cells will bind to faulty protein / to (this) 'foreign' protein;
3. (Sensitised) T cells will stimulate clonal selection of B cells;
4. (Resulting in) release of antibodies against faulty protein.

3 max

[10]

6 (a) **C**

Auto mark

1

(b) 1. No separation of chromatids/chromosomes/centromeres;

Accept anaphase prevented

Accept nondisjunction

Reject homologous pairs

2. Chromatids/chromosomes all go to one pole/end/sides of cell/not pulled to opposite poles;

3. Doubles chromosome number in cell/one daughter cell gets no chromosomes or chromatids;

Accept DNA for chromosomes

Accept ploidy

Ignore references to 'genetic information'

Ignore simple descriptions of what normally happens in mitosis

2 max

(c) 1. (No, because) at 100 there are still **some** (7%) cancer cells dividing/undergoing mitosis;

Accept idea that all division stops only at 1000

2. So, cancer not destroyed/may continue to grow/spread/form tumours;

Must refer to cancer spreading not cells dividing

3. Best concentration may be between 100 and 1000/need trials between 100 and 1000;

4. This research in culture, don't know effect of KI on people;

Reject 'not tested on humans'

Reject 'done in animals'

5. (Yes, because) above 100 produces little increase in % of cells not dividing/undergoing mitosis/at 100, **most** (93%) cancer cells unable to divide/dead;

Must clearly link lack of monopolar mitotic spindles with cell division

6. Above 100 may be harmful (to body);

*Accept '**above 100/high concentrations** produce harmful side effects/named effects'*

7. Higher concentrations more expensive;

8. (Above 100) will have more effect on (rapidly dividing) cancer cells;

Must relate to 100

4 max

(d) 1. 10 cm^3 of 10 000 nmol dm^{-3}/ (original) solution;

2. 90 cm^3 of water;

If ratio correct but make wrong volume e.g. 1 litre, award 1 mark

2

[9]

7 (a)

	Cell B	Cell C	Cell D
homologous chromosomes are present	✓	✓	
a stage of mitosis		✓	

Mark horizontally

1 mark for each correct row

2

(b) Mark as pairs, do not mix and match

1. (Chromosomes consist of) two chromatids connected at centromere;

   Accept: sister chromatids for two chromatids

2. (Because) DNA has replicated;

OR

3. K is on equator of spindle;

   Ignore: 'middle'

4. (because) attached at centromere;

   Ignore reference to meiosis / bivalents / homologous pairs

2

(c) 1. Crossing over / exchange of alleles /lengths of DNA / recombination;

   Accept: description of crossing over eg sections of chromatids break and re-join

   Accept: reference to chiasma/ chiasmata

2. Between (chromatids of) homologous chromosomes;

   Accept: 'between non-sister chromatids'

   Accept: 'bivalent' for homologous

   Ignore: genes exchanged

2

(d) Separation/segregation of pairs/homologous chromosomes;

Accept: result of meiosis I / result of division of cell B

Accept: pulled to opposite poles for 'separation'

Ignore ref to chromatids

1

(e) (DNA) replication taking place/not finished;

Accept: they are cells in S phase

1

[8]

8

(a) Variable that is changed;

Reject 'the variable that changes'.

1

(b) 1. Idea of a confounding variable;

2. (So) genetically similar;

2. Do not accept 'genetically identical / same DNA'.

3. (So) have similar salt tolerance / response to salt water / response to watering treatment;

4. (So) have similar yield / mass of seeds;

Do not accept 'amount / number of seeds' or 'growth rate'.

2 max

(c) Mitosis;

Ignore cell division

1

(d) 1. Irrigation with sea water / **C** / **D** increased yield compared with no irrigation / **A**;

For 'yield' accept 'mass of seed' throughout.

2. Yield was lower when irrigated with sea water / **C** / **D** compared with fresh water / **B**;

Only penalise once for use of 'amount / number of seeds'.

3. Yield was lower when watered with sea water throughout growth and seed formation / **C** than when watered with sea water just at seed formation / **D**;

Accept use of figures from table.

'It' refers to watering with seawater / mixture.

2 max

(e) 1. Irrigation with sea water / **C** / **D** increases concentration of salt in soil;

Ignore reference to standard deviation / quality of the data.

2. Lower water potential in the soil linked to reduced uptake of water;

3. Salt concentration in the soil might / might not increase in the future;

Mark point 3 includes the principle for mark point 1 so mp3 gains 2 marks (for mp1 and mp3)

4. Might decrease plant growth / yield in the future;

5. Less food / fewer seeds for future planting;

Mp 3 and 4. Allow 'further' for the idea of 'in the future'.

3 max

[9]

9 (a) (i) Centromere;

Accept: if phonetically correct

Reject: centriole

1

(ii) 1. Holds chromatids together;

2. Attaches (chromatids) to spindle;

3. (Allows) chromatids to be separated / move to (opposite) poles / (centromere) divides / splits at metaphase / anaphase;

*3. **Q** Neutral: chromosomes or chromatids split / halved / divided*

3. Reject: reference to homologous chromosomes being separated

Accept 'chromosomes' instead of 'chromatids'

*Ignore incorrect names for **X***

2 max

(iii) (Homologous chromosomes) carry different alleles;

Accept alternative descriptions for 'alleles' eg different forms of a gene / different base sequences

Neutral: reference to maternal and paternal chromosomes

1

(b) (i) (In **Figure 2**)

1. Chromatids have separated (during anaphase);

*1. **Q** Neutral: split / halved / divided*

1. Reject: reference to homologous chromosomes being separated

or

2. Chromatids have not replicated;

1. & 2. Accept 'chromosomes' instead of 'chromatids'

or

3. Chromosomes formed from only one chromatid;

*Accept converse arguments for **Figure 1***

Ignore references to the cell not dividing as in the question stem

Ignore: named phases

1 max

(ii) 1. Three chromosomes;

Ignore shading

2. One from each homologous pair;

Only one mark for three chromosomes shown as pairs of chromatids

2

(iii) Crossing over / alleles exchanged between chromosomes or chromatids / chiasmata formation / genetic recombination;

Accept: description of crossing over eg sections of chromatids break and rejoin

Neutral: random fertilisation

Reject: reference to sister chromatids

Q *Neutral: genes exchanged*

Neutral: mutation

1

[8]

10 (a) 1. (Phosphate) changes shape of TK / changes shape of enzyme / changes the active site;

It = phosphate

Accept 'alters' for changes

Reject that phosphate is an inhibitor

Accept adding energy / affecting charged / affects polar groups (on amino acids)

2. Active site forms / becomes the right shape / can bind to substrate / complementary to substrate / E-S complex can form;

Reject similar / same shape as substrate

2

(b) 1. Faulty TK has functional active site <u>without phosphate</u>;

Accept 'works without phosphate'

2. (So, faulty) TK functional all the time / TK not controlled (by phosphate);

2

(c) 1. Non-competitive inhibitor / binds to site other than active site;

Accept allosteric site

Do not accept 'changes shape' unqualified

2. Causes TK to be in non-functional form / active site not formed / wrong shape / E-S complex not formed;

3. So, (uncontrolled) cell division stopped / slowed / controlled;

2 max

[6]

11

(a) 1. Strands separate / H-bonds break;

*1. **Q** Neutral: strands split*

1. Accept: strands unzip

2. DNA helicase (involved);

3. Both strands / each strand act(s) as (a) template(s);

4. (Free) nucleotides attach;

4. Neutral: bases attach

4. Accept: nucleotides attracted

5. Complementary / specific base pairing / AT and GC;

6. DNA polymerase joins nucleotides (on new strand);

6. Reject: if wrong function of DNA polymerase

7. H-bonds reform;

8. Semi-conservative replication / new DNA molecules contain one old strand and one new strand;

8. Reject: if wrong context e.g. new DNA molecules contain half of each original strand

6 max

(b) (i) 18;

Do not accept 17.5

1

(ii) 10;

1

(iii) 1. Horizontal until 18 minutes;

Allow + / - one small box

2. (Then) decreases as straight line to 0 μm at 28 minutes;

2. Allow lines that start from the wrong place, ending at 0 at 28 minutes

2

(c) (i) Two marks for correct answer of 19.68 or 19.7;;

Accept 19hrs 41mins

One mark for incorrect answers in which candidate clearly multiplies by 0.82;

Allow one mark for incorrect answers that clearly show 82% of 24 (hours)

2

(ii) 1. No visible chromosomes / chromatids / visible nucleus;

1

(iii) **D** (no mark)

1. Lower % (of cells) in interphase / higher % (of cells) in mitosis / named stage of mitosis;
   1. Accept: 'less' or 'more' instead of '%'
   1. Do not accept: higher % (of cells) in each / all stage(s)

2. (So) more cells dividing / cells are dividing quicker;
   2. Accept: uncontrolled cell division
   *2. Do not award if Tissue **C** is chosen*

2

[15]

12 (a) 1. Growth / increase in cell number;
Ignore growth of cells

2. Replace cells / repair tissue / organs / body;
Ignore repair cells
Reject bacteria

3. Genetically identical cells;
'Produces 2 genetically identical cells' does not reach MP1 as well as MP3

4. Asexual reproduction / cloning;
Allow example or description

2 max

(b) (i) (Ensures) representative (sample);
Accept find some cells in mitosis / not in interphase.
Accept 'more reliable' only if linked to percentage (of cells).'Improves reliability' on its own does not gain this mark
Neutral: Large sample

1

(ii) 1. A = metaphase;

2. Chromosome / chromatids lie on equator;
Reject homologous chromosomes Allow centre / middle

3. B = anaphase;

4. Chromatids / chromosomes separating / moving apart / moving to poles;
Reject homologous chromosomes

4

(c) 2 hours / 120 minutes;
Allow 1 mark if working shows candidate understood that mitosis would take 10%

2

[9]

13 (a) (i) Anaphase

1

(ii) 1. Sister / identical chromatids / identical chromosomes;

Reject: Homologous chromosomes separate.

Allow any reference to chromatids / chromosomes being identical e.g. same DNA

2. To (opposite) poles / ends / sides;

2

(b) (i) 1. 8.4 / cells with twice DNA content = replicated DNA / late interphase / prophase / metaphase / anaphase;

Any reference to interphase must suggest towards end of interphase.

'Chromosomes replicate' is not enough for DNA replicates.

2. 4.2 = DNA not replicated / (early) interphase / telophase / cell just divided / finished mitosis;

2

(ii) 2.1;

1

[6]

14 (a) (i) Spindle formed / chromosome / centromere / chromatids attaches to spindle;

Chromosomes / chromatids line up / move to middle / equator (of cell);

Do not award second mark for answers referring to chromosomes 'pairing up'.

Ignore reference to homologous chromosomes unless context suggests pairing which negates second mark.

Neutral: Details on nuclear membrane.

Accept: Diagram for second marking point.

2

(ii) Chromosome / centromere splits / chromatids / 'chromosomes' separate / pulled apart;

To (opposite) sides / poles / centrioles (of cell);

Reject: Homologous chromosomes separate for first marking point.

Accept: Diagram for second marking point.

Chromatids / 'chromosomes' move to poles / sides / centrioles = 2 marks.

2

(b) (i) Form / replace cells quickly / rapidly / divide / multiply / replicate rapidly;

Neutral: Repair cells.

Answers must convey idea of 'speed'.

1

(Ii) Correct answer = 774 minutes / 12 hours 54mins = 2 marks;;

Incorrect answer but indicates 3 cell cycles involved = one mark;

2

(c) Prevents / slows DNA replication / doubling / prevents / slows mitosis;

New strand not formed / nucleotides (of new strand) not joined together / sugar-phosphate bonds not formed;

First marking point must be in context of DNA replication not cell replication.

Do not negate first marking point if role of DNA polymerase is described incorrectly e.g. Reject: 'joins bases / strands together'.

Role of DNA polymerase must be correct for last marking point.

2

[9]

15

(a) 1. Gives rise to new plants / plantlets;

2. So must be able to develop into different tissues / other specialised cell types / differentiate;

1. Ignore references to leaves / callus

2

(b) Two marks for 5 : 1/50 : 10/1 : 0.2;;

One mark for ratio correctly identified but expressed incorrectly as 1 : 5 / 10 : 50 / 0.2 : 1;

2

(c) (i) 1. Meiosis / independent assortment / crossing over;

2. (Fusion of) genetically different gametes / random fertilisation;

2

(ii) Will be clones / produced by mitosis / will be genetically identical / less variation / all plants will have desired characteristics;

If the reference is to identical must be genetically identical, but allow less variation without the reference to genetical.

1

[7]

16

(a) (i) 22;

1

(ii) 1. Odd number of chromosomes / 33 chromosomes (in leaf cell);

2. Chromosomes cannot pair / cannot undergo meiosis / would result in half chromosomes / cannot form haploid cells;

2

(b) (i) Fast growth / produces crop fast / produces large crop;

Do not insist on relative statement.

Accept similar terms for fast. E.g. "better" growth

Do not accept unqualified references to profit.

1

(ii) Leaves less likely to break / higher breaking strength;

1

(c) Low genetic diversity because they are produced by mitosis;

Will all have the same DNA / genes / alleles / will be genetically identical / will be clones;

OR

Low genetic diversity because they are not produced by meiosis;

No crossing over / independent segregation / will not be genetically different;

Independent segregation is the specification term. Accept other such as random assortment.

2

[7]

17 (a) (i) Cells are in interphase;

Accept G phase / S phase.

1

(ii) Cells undergoing mitosis / in telophase / cytokinesis;

Accept all named stages but reject prophase, metaphase or anaphase on their own.

1

(b) 1. 3 hours;

2. Time between beginnings / endings DNA replication / Increases / levelling outs of DNA concentration / for shape (of curve for replication) to be repeated;

3. (DNA) replication takes place once per cell cycle;

Allow close approximation where candidate attempts to be more accurate.

Principle
What is shown on the graph

3

[5]

18 (a) Given only saline;

Otherwise treated exactly the same way;

2

(b) Ethical consideration, e.g., leads to death / suffering of mice;

Large number to improve reliability / reduce sampling error;

Number of mice related to cost / space available / animal husbandry;

2 max

(c) Vary in shape / do not grow uniformly;

Q *Allow descriptions of variation in shape.*

1

(d) 7.44 and 1.74;;

7.42 and 1.72;;

(Ratio) 4.28 : 1;;

(Ratio) 4.31 : 1;;

(Percentage decrease) 76.6%;;

(Percentage decrease) 76.8%;;

Any of the answers shown gain two marks.

An answer of 23.4% or 23.2%
Percentage decrease gains one mark.

Correct method of calculating rate / ratio / percentage increase with an incorrect answer gains one mark.

2 max

(e) Reference to Mitosis;

As chromosomes cannot attach (to spindle) / chromatids cannot separate (on spindle);

Q *Do not penalise confusion between chromosomes and chromatids in second marking point*

Cell division / cell cycle slows down;

Q *Mitosis slows down = 2 marks*

Q *Mitosis stopped = 1 mark*

Q *Mitosis must be spelt correctly*

3

(f) (i) (Degree of) spread / variation from the mean;

1

(ii) Both chemicals (on their own) slow down growth / are effective;

Taxol is more effective than OGF;

Combined treatment (seems) most effective;

SD overlap for OGF with taxol and taxol (on its own) so not conclusive / could be chance / both treatments could be equally effective;

Q *Ignore all references to significance*

4

[15]

19 (a)

Nucleus	Number of chromosomes	Mass of DNA / arbitrary units
At telophase of mitosis	26;	30;
From a sperm cell	13;	15;

4

(b) Cancer cells often have faulty / damaged DNA;

Protein / p53 faulty / not made;

Cell (with faulty / DNA) divides / completes cell cycle;

Uncontrolled division produces cancer;

p53 refers to the protein so do not accept reference to p53 mutating.

3

(c) (i) Interphase / S phase / synthesis phase;

1

(ii) Anaphase / **A**;

1

[9]

20

(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

(c) Cinnamon;

1

(d) 1. Thyme is the most effective / best (at 4 °C);

2. Clove and cinnamon same effectiveness at 4 °C as 35 °C (so suitable);

3. Bay and nutmeg are less effective at 4 °C than 35 °C (so unsuitable).

3

(e) Less kinetic energy
OR
Less movement of oil molecules / of phospholipid molecules

1 max

[10]

21 (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

(b) 1. Homologous chromosomes pair up;

2. Independent segregation;

3. Maternal and paternal chromosomes are re-shuffled in any combination;

4. Crossing over leads to exchange of parts of (non-sister) chromatids / alleles between homologous chromosomes;

5. (Both) create new combinations of alleles;

5

[10]

22 (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]