# Replication and division of nuclei and cells

## Mark Scheme 5

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|---|---|
| **Level** | International A Level |
| **Subject** | Biology |
| **Exam Board** | CIE |
| **Topic** | The Mitotic Cell Cycle |
| **Sub Topic** | Replication and division of nuclei and cells |
| **Booklet** | Theory |
| **Paper Type** | Mark Scheme 5 |

**Time Allowed :** **58 minutes**

**Score :** **/ 48**

**Percentage :** **/100**

**Grade Boundaries:**

| A* | A | B | C | D | E | U |
|---|---|---|---|---|---|---|
| >85% | '77.5% | 70% | 62.5% | 57.5% | 45% | <45% |

1 **(a) (i)** anaphase / early telophase **;** [1]

**(ii)** chromosomes / chromatids, move to / at, poles / centrosomes **;**
**2** attached to, spindle / microtubules **;**
**3** by, centromeres / kinetochores **;** **A** centromeres leading
**4** pulled by, microtubules / spindle fibres / AW **;**
**A** contracting / shortening / disassembling [2 max]

**(iii)** *these points are independent*
**1** cannot follow, movement of chromosomes / AW **;**
e.g. 'processes in mitosi
**2** can only view dead material **;**
**3** sections have to be thin **;**
**4** overstaining obscures details (of chromosomes) **;** **A** artefacts
**5** cannot see, all of the chromosomes / whole chromosomes **;** [2 max]

**(b) (i)** **1** carcinogen / cancer-causing / named carcinogen (in tobacco smoke / tar) **;**
e.g. benzpyrene / phenol / nicotine *check any others*
**2** mutation / change to DNA **;**
**3** ref to named gene **;** e.g. oncogene / tumour suppressor
**4** in (bronchial) epithelium **;**
**5** uncontrolled, cell division / mitosis / cell cycle **;** **R** 'rapid'
**6** grows into, mass of cells / lumen of airway(s) / lung tissue **;**
**A** squeezes against blood vessels / enters lymphatic vessels
**7** growth of blood capillaries (into tumour) **;**
**A** angiogenesis / vascularisation / ref to thrombospondin
**8** no programmed cell death **;** [3 max]

**(ii)** must be a sign or symptom
**1** coughing up blood **;**
**2** persistent cough / coughing a lot **;**
**3** coughing up increased volume of sputum / AW **;**
**4** chest / shoulder / back, pain **;**
**5** wheezing / breathlessness / breathing difficulty **;**
**6** weight loss **;**
**7** AVP **;** e.g. fatigue **R** tiredness max]

**[Total: 10]**

2 **(a)** so they have the same number of chromosomes (as parent cell) **;**

*idea that* cells would be rejected (if genetically different) **;**
ref. to role of the immune system in removing genetically different cells **;** [2]

**(b)** *reject 'smoking' or 'radioactive transmissions' unqualified*

(chemical) carcinogen(s) / named **;**
*any two named chemical carcinogens to max 2 if term carcinogen not used*
e.g. benzpyrene / ethidium bromide / phenol / tar *check any others*

UV **;**
X rays **;**
ionising radiation **;**
gamma rays **;**
radon **;**
virus(es) / correctly named virus **;** **A** HIV / HPV / HTLV / HSV **R** named disease
genetic / hereditary, factors **;** [2 max]

**(c)** **(i)** cytokinesis **;** [1]

**(ii)** chromosomes, uncoil / become diffuse / decondense / AW **;**
**A** chromosomes unwind / become long and thin
**A** chromosomes become chromatin
**A** cell enters interphase
spindle breaks down / microtubules disassemble / AW **;** **R** disappears

nuclear envelope, reforms / forms / forming **;** **A** nuclear membrane **R** (re)appears
nucleolus / nucleoli, reform(s) / forms / forming **;** **R** (re)appears

cell membrane, drawn together / furrows / AW **;**
*idea of* role of, microfilaments / AW, in 'drawstring' effect **;**

division of cytoplasm / cell separation / cleavage / cleavage furrow develops **;**
**A** cytokinesis *if not credited in* ***(i)***
cell membrane fuses **;** [3 max]

**(iii)** divide / replicate, uncontrollably **;** **ignore** quickly / fast
**A** uncontrolled mitosis **R** grow uncontrollably
do not, differentiate / become specialised **;** **A** loss of function
form an (irregular) mass (of cells) / AW **;** **A** (a) growth
promotes growth of blood vessels / AW **;**
AVP **;** e.g. ref to genes / no programmed cell death / loss of contact inhibition [2 max]

**[Total: 10]**

| | | | | |
|---|---|---|---|---|
| **3** | **(a)** | **(i)** | so that, the bacteria were not killed / enzymes not denatured ; | [1] |
| | | **(ii)** | 1. bacteria put into (solution of) sodium alginate<br><br>2. place mixture in syringe<br><br>3. add drops of mixture to calcium chloride solution<br><br>4. calcium ions replace sodium ions (to form beads)<br><br>5. bacteria trapped in beads | [3 max] |
| | **(b)** | **(i)** | *note comparison between blue line and black line*<br>*ignore references to red line - agar*<br><br>1. both increase up to, 18 / 24, hours<br><br>2. both similar, initially / up to 18 hours<br><br>3. biggest difference at 24 hours / rate of increase for immobilis cells greater than free cells between 18 and 24 hours ;<br><br>4. after 24 hours immobilised cells rate decreases while free cel rate continues to increase or after 39 hours free cells rate is greater than immobilised cells rate ;<br><br>5. free cells final concentration is still lower than highest val attained by immobilised cells ;<br><br>6. use of comparative figures | [4 max] |
| | | **(ii)** | 1. (could be) less surface area (t volume ratio) in cubes than beads ;<br><br>2. (could be) a greater diffusion distance to centre of cubes th beads ;<br><br>3. agar may be less permeable (to substrate) than alginate<br><br>4. something in agar may inhibit bacterial enzymes<br><br>5. some protease adsorb by agar ; | [2 max] |

| | | | | |
|---|---|---|---|---|
| | **(c)** | **(i)** | 82.14 / 82.1 / 82 (%) ; ;<br><br>*allow one mark for suitable working if incorrect answer* | [2] |
| | | **(ii)** | 1. can use alginate (beads) many times<br><br>2. (reduces cost of), materials / energy / labour<br><br>3. fewer bacterial cultures needed / less time spent immobilisi bacteria ;<br><br>4. more protease produced (per hour) (using alginate)<br><br>5. can run fermentation for longer time<br><br>6. less time wasted between fermentations<br><br>*answers must imply comparison* | [3 max] |
| | | | | **[Total:15]** |

**4** **(a** *ignore references to prophase at D/during metaphase*

chromosomes arrange, on metaphase plate/at equator/on equatorial plate; **R** middle of cell
chromosomes with two (sister) chromatids/AW;
chromosomes attached to spindle at centromeres; **[max 2]**

*at E/during anaphase*

centromere(s), break/divide/duplicate; **R** replicate/split chromosomes/ chromatids, move/separate to opposite poles; **R** ends
ref microtubules/spindle (fibres), with centromeres leading;

**[max 2]**

**(b)** chromosomes uncoil/AW; e.g. become longer and thinner
nuclear, membrane/envelope reforms/AW;
new cell membrane formed;
cell plate/(new) cell wall/middle lamella, forms;
cytokinesis; **R** if say cytoplasm constricts as ref to animal cells **[max 3]**

**(c)** mitotic index decreases from 0.11 to 0.016, as distance from tip increases/from 0.1 to1.9mm;
any ref to comparision plus distance from tip figs ;;
e.g. steep/AW decrease 0.6 to 0.7 mm
small/AW decrease 0.7 to 1.3 mm
slight/AW increase 1.3 to 1.8 mm
**A** for 1 mark if describe main pattern plus 2 overall ref points
**R** rapid or slow increases and decreases
**if mm not used at least once, penalise once** **[max 3]**

**(d)** during, interphase/S phase/before, mitosis/prophase, replication of DNA;
semi-conservative replication;
some ref to base pairing/any example, to template strand;
(during anaphase), sister chromatids are separated/move to opposite poles/go into separate cells";
new cells have same number, and kind of chromosomes/AW e.g. same, genes/DNA/chromosomes as parents; **[max 3]**

**[Total: 13]**