

## Stem Cells and Epigenetics - Mark Scheme

Q1.

Question Number	Acceptable Answer	Additional Guidance	Mark
<b>(i)</b>	<p>An answer that makes reference to any two of the following:</p> <ul style="list-style-type: none"> <li>• alcohol intake increases collagen synthesis (1)</li> <li>• combined intake has greatest effect (1)</li> <li>• a greater level of collagen indicates a greater amount of fibrosis (1)</li> </ul> <p>AND</p> <ul style="list-style-type: none"> <li>• therefore the higher the alcohol intake the greater the level of fibrosis (1)</li> </ul>		<b>(3)</b>
<b>(ii)</b>	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> <li>• exposure to alcohol may result in { changes of methylation of DNA / modification of histones } (1)</li> <li>• so that the collagen gene is more likely to be { activated / expressed / transcribed } (1)</li> </ul>	Allow reference to other correct epigenetic modifications	<b>(2)</b>

Q2.

Question Number	Answer	Additional Guidance	Mark
<b>(i)</b>	<p>An answer that makes reference to two of the following:</p> <ul style="list-style-type: none"> <li>• a cell that is undifferentiated</li> <li>• that can give rise to specialised cells</li> <li>• that can divide to produce more stem cells</li> </ul>	<p>ALLOW unspecialised cell</p> <p>ALLOW differentiated cells</p> <p>ALLOW can divide continuously / have no Hayflick limit</p>	<b>(2)</b>

Question Number	Answer	Additional Guidance	Mark
(ii)	<p>An answer that makes reference to the following:</p> <p><u>Similarity</u></p> <ul style="list-style-type: none"> <li>both increase the number of cells</li> </ul> <p>(1) <u>Differences</u></p> <ul style="list-style-type: none"> <li>mitosis produces diploid cells and meiosis produces haploid cells</li> <li>meiosis produces cells that are genetically different to each other whereas mitosis produces genetically identical cells</li> <li>mitosis results in 8 spermatocytes from each stem cell whereas meiosis results in 4 sperm cells from each spermatocyte</li> </ul>	<p>ALLOW cells contain { 23 pairs of / 46 } chromosomes after mitosis and 23 chromosomes after meiosis</p> <p>ALLOW mitosis results in 2 daughter cells whereas meiosis results in 4 daughter cells</p>	(4)

Q3.

Question Number	Answer	Additional Guidance	Mark
	<ol style="list-style-type: none"> <li>idea of stimulus e.g. chemical;</li> <li>idea that some genes are { active / switched on / expressed } ;</li> <li>idea of { transcription / mRNA produced } at active genes ;</li> <li>mRNA is { translated / used } to produce protein ;</li> <li>idea that this protein modifies cell OR idea that this protein determines { cell structure / function } ;</li> </ol>	<p>2. IGNORE genes being 'turned on'</p>	(4)

Q4.

Question Number	Answer	Mark
	C unspecialised cells that can differentiate to give rise to almost any type of cell in the body, excluding totipotent cells ;	(1)

Q5.

Question Number	Acceptable Answer	Additional Guidance	Mark
<b>(a)</b>	<p>A description that makes reference to the following:</p> <ul style="list-style-type: none"> <li>no UV (1)</li> <li>water added but not from tank with fish in it that have eaten snails (1)</li> </ul>		<b>(2)</b>

Question Number	Acceptable Answer	Additional Guidance	Mark
<b>(b)(i)</b>	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> <li>calculating increase above control for 'fish' and for 'UV' (1)</li> <li>adding effects of 'fish' and 'UV' (1)</li> </ul>	fish exposure effect is 12% (above control) and (UV is) 28%	<b>(2)</b>

Question Number	Acceptable Answer	Additional Guidance	Mark
<b>(b)(ii)</b>	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> <li>interferes with DNA replication (1)</li> <li>(potentially) leading to mutations (1)</li> </ul>		<b>(2)</b>

Q6.

Question Number	Answer	Additional Guidance	Mark
	<p>An explanation that makes reference to four of the following:</p> <ul style="list-style-type: none"> <li>• (AFP II) { gene / allele } { activated only in liver cells / deactivated in cells other than liver cells } (1)</li> <li>• transcription (of AFP II) occurs only in liver cells (1)</li> <li>• { translation / protein synthesis } (of AFP II) takes place only in liver cells (1)</li> <li>• the protein is { secreted from liver cells / transported around the body } (1)</li> <li>• (presence of protein in all tissues) prevents { freezing / ice } in all parts of the body (1)</li> </ul>	<p>ALLOW "switched on/off" This deactivation could be due to DNA methylation / histone modification</p> <p>Ref to liver cells required only once if context / chain of argument is clear.</p>	<p><b>(4)</b></p>

Q7.

Question Number	Answer	Additional Comments	Mark
(a)	<ol style="list-style-type: none"> <li>idea of using part of the seedling ;</li> <li>idea of using agar ;</li> <li>(agar contains) growth substances / hormones / eq ;</li> <li>Idea of using aseptic technique ;</li> <li>Idea of covering the top of the container to prevent contamination OR loss of water ;</li> <li>Idea of supplying light ;</li> <li>allow a suitable length of time for growth e.g. 1 to 6 weeks ;</li> <li>look for { roots / leaves / (complete) plant } forming ;</li> </ol>	<ol style="list-style-type: none"> <li>ACCEPT cuttings, explants IGNORE cells unqualified</li> <li>ACCEPT named plant growth substance</li> </ol>	(4)

Question Number	Answer	Additional Comments	Mark												
(b)(i)	<ol style="list-style-type: none"> <li>percentage of seedlings (showing totipotency) decreases as age increases up to 21 days / negative correlation up to 21 days / eq ;</li> <li>as age increases { after 21 / from 21-28 / at 28} days percentage of seedlings showing totipotency increases / eq ;</li> <li>28 days is an anomalous result ;</li> <li>credit correct manipulation of the data ;</li> </ol>	<p>4. Some examples are shown below</p> <table border="1"> <thead> <tr> <th>Days</th> <th>Difference (%)</th> </tr> </thead> <tbody> <tr> <td>7-28</td> <td>(76-60) 16</td> </tr> <tr> <td>7-14</td> <td>(76-56) 20</td> </tr> <tr> <td>7-21 - <i>mp1</i></td> <td>(76-40) 36</td> </tr> <tr> <td>14-21</td> <td>(56-40) 16</td> </tr> <tr> <td>21-28 - <i>mp2</i></td> <td>(40-60) (+) 20</td> </tr> </tbody> </table> <p>IGNORE calculated percentage of percentage</p>	Days	Difference (%)	7-28	(76-60) 16	7-14	(76-56) 20	7-21 - <i>mp1</i>	(76-40) 36	14-21	(56-40) 16	21-28 - <i>mp2</i>	(40-60) (+) 20	(2)
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Question Number	Answer	Additional Comments	Mark
(b) (ii)	<ol style="list-style-type: none"> <li>{ repeats / larger number of seedlings } { at each age / in each group } / eq ;</li> <li>more ages of seedlings used / use seedlings older than 28 days / test 35 day old seedlings / eq ;</li> <li>repeat 28-day group / repeat any anomalous results / eq ;</li> </ol>	1. ACCEPT repeated the whole experiment	(2)

Question Number	Answer	Additional Comments	Mark
(c) (i)	as phenol concentration increases from { 7 to 21 / 7 to 14 / 14 to 21 } days, percentage of seedlings showing totipotency decreases / negative correlation up to 21 days / eq ;		(1)

Question Number	Answer	Additional Comments	Mark
(c) (ii)	(as phenol concentration increases) at 28 days percentage of seedlings showing totipotency increases / eq ;	ACCEPT reference to after 21 days	(1)

Question Number	Answer	Additional Comments	Mark
(d)	<ol style="list-style-type: none"> <li>totipotent cells can { give rise to / differentiate to become } { any cell / extra embryonic tissues / eq } ;</li> <li>pluripotent cannot { give rise to / differentiate to become } { all cells in the body / extra embryonic tissues / eq } ;</li> <li>idea that only totipotent cells can give rise to other totipotent cells ;</li> <li>idea that totipotent cells can give rise to an entire human being, pluripotent cells cannot ;</li> </ol>	<p>NOT 'turns into', 'becomes', 'develops into' but penalise once only</p> <ol style="list-style-type: none"> <li>ACCEPT specialised for differentiated</li> <li>1 &amp; 2 IGNORE reference to embryonic cells/tissues unless it makes the response incorrect, ACCEPT placental cells/tissues</li> <li>ACCEPT can give rise to most cells</li> </ol>	(2)

Q8.

Question Number	Answer	Mark
<b>(a)(i)</b>	C – pluripotency ;	<b>(1)</b>

Question Number	Answer	Additional guidance	Mark
<b>(a)(ii)</b>	<ol style="list-style-type: none"> <li>1. idea of appropriate stimulus e.g. chemical, hormone ;</li> <li>2. idea of activation of some genes ;</li> <li>3. only the activated genes are transcribed / mRNA made only at active genes / eq ;</li> <li>4. mRNA translated (on ribosomes) ;</li> <li>5. protein made / eq ;</li> <li>6. which {determines / eq} cell {structure / function} / permanently modifies cell / eq ;</li> <li>7. reference to cell differentiation ;</li> </ol>		<b>(4)</b>

Question Number	Answer	Additional guidance	Mark
<b>(b)</b>	<ol style="list-style-type: none"> <li>1. idea of genetically identical cells (to patient) ;</li> <li>2. no risk of rejection / eq ;</li> <li>3. no need to take immunosuppressant drugs / eq ;</li> <li>4. less risk of infection / eq ;</li> </ol>	2. NOT less likely	<b>(2)</b>

Question Number	Answer	Additional guidance	Mark
<b>(c)</b>	<ol style="list-style-type: none"> <li>1. no destruction of embryos / eq ;</li> <li>2. embryo has potential to become a human life / eq ;</li> <li>3. {religious / ethical } objections / eq ;</li> </ol>		<b>(2)</b>