Question Number	Answer	Additional Guidance	Mark
1(a)	1. nucleus drawn in the correct position and labelled ; 2. mitochondrion or mitochondria drawn in the correct position and labelled ; 3. flagellum drawn in the correct position and labelled ; 4. acrosome drawn in the correct position and labelled ;	 2. N just labelling of the mid-section 3. N a single line 4. N a single line across the head region	(4)

Question Number	Answer	Additional Guidance	Mark
1(b)(i)	for { movement / motility / eq } to reach the { ovum / egg } ;	ACCEPT 'swim or move or propel' sperm towards the egg	(1)

Question Number	Answer	Additional Guidance	Mark
1(b)(ii)	1. (a obic) respiration ; 2. ference to { energy / ATP } for movement ;		(2)

Question Number	Answer	Additional Guidance	Mark
1(b)(iii)	1. contains { enzymes / acrosin / eq } ; 2. digestion of zona pellucida / eq ;	 2. ACCE creation of a pathway through the follicle cells	(2)

Question Number	Answer	Mark
2(a)(i)	13.1 ;	**(1)**

Question Number	Answer	Mark
2(a)(ii)	16.0 / 16 (%) ;	**(1)**

Question Number	Answer	Mark
2(a)(iii)	mitochondria / mitochondrion ;	**(1)**

Question Number	Answer	Additional Guidance	Mark
2(a)(iv)	1. idea of more sperm (cells) with defective flagella ; 2. idea that flagella needed to move sperm (cells) ; 3. idea of more sperm (cells) with defective mid-piece ; 4. idea that if mitochondria are affected there is no { respiration / energy / ATP } (for movement of flagella) ;	1. needs to be comparative ACCEPT only 4% in control 2. ACCEPT swim 4.ACCEPT damaged or fewer mitochondria ACCEPT less energy, less respiration or less ATP	**(4)**

Question Number	Answer	Additional Guidance	Mark
2(b)	1. (acrosome contains) { acrosin / enzyme / eq } ; 2. Reference to acrosome reaction ; 3. idea that { zona pellucida / jelly layer } needs to be digested ; 4. sperm (cell) needs to { reach / fuse with } cell (surface) membrane of egg / eq ;	3. ACCEPT broken down	**(3)**

Question Number	Answer	Additional Guidance	Mark
2(c)	1. idea that smoking causes {damage to sperm / infertility} ; 2. idea of smoking as a variable to be controlled ; 3. idea of making sure that any effects were due to globozoospermia OR idea of difficulty in distinguishing between genetic and environmental factors ;	3. e.g. difficult to tell if it was due to smoking or disease	**(3)**

Question Number	Answer	Additional guidance	Mark
3(a)			**(4)**

Feature	Egg cell only	Sperm cell only	Both	Neither
Acrosome		☒		
Cortical granules	☒			
Flagellum		☒		
Haploid nucleus			☒	

Question Number	Answer	Additional guidance	Mark
3(b)	1. (they carry out) (aerobic) respiration ; 2. provide {ATP / energy / eq} ; 3. to { move / drive the / eq } { flagellum / tail } / eq ;		**(2)**

Question Number	Answer	Additional guidance	Mark
3(c)	1. halves the chromosome number / eq ; 2. to produce a haploid nucleus / eq ; 3. so that at fertilisation the {full complement / diploid number / eq} of chromosomes is restored / eq ; 4. allows genetic variation (in gametes) / eq ; 5. through independent assortment / eq ; 6. through crossing over / eq ;		**(4)**

Question Number	Answer	Additional Comments	Mark
4(a)	(QWC– Spelling of technical terms must be correct and the answer must be organised in a logical sequence) 1. sperm cell {fuses / eq} with egg cell (*membrane*) ; 2. reference to {*cortical granules* / *vesicles* / *lysosomes}* ; 3. idea of (cortical granules) {moving towards / fusing with } egg cell (surface) *membrane* ; 4. reference to *exocytosis* (of *cortical granules* / *vesicles* / *lysosomes)* ; 5. idea of contents (of *cortical granules*) {secreted /released into jelly layer / eq} OR reference to *cortical reaction* ; 6. idea of { hardening / thickening / eq } of { *zona pellucida* / jelly layer } OR formation of *fertilisation membrane* ; 7. reference to change in charge across egg cell membrane ;	QWC emphasis is on spelling of technical terms 1. N the fusion of the nuclei 4. N for description of acrosome reaction 5. ACCEPT enzymes / chemicals NOT released into ovum 6. ACCEPT fertiliZation	**(4)**

Question Number	Answer	Additional Comments	Mark
4(b)	1. reference to both { independent / random } assortment and { crossing-over/chiasma(ta) } ; 2. independent assortment gives rise to {new / different / eq} combinations of (paternal and maternal) chromosomes ; 3. crossing over involves swapping of {sections / eq} of {chromatids /chromosomes} ;	3. N swapping genes ACCEPT new combinations of alleles (on a chromosome) / recombinants	**(2)**

Question Number	Answer	Additional Comments	Mark
4(c)(i)	1. Idea that temperature is a controlled variable e.g. constant temperature removes this variable, so temperature does not affect {results / length of pollen tube} ; 2. idea that (pollen tube) { growth / enzymes / proteins /eq } affected by temperature ; 3. idea that at this temperature { enzymes / proteins } will not be denatured / pollen not destroyed at this temperature / 22.5°C optimum temperature ; 4. idea that the investigation is valid ;	1. CEPT the idea of only changing one variable and keeping all the others constant – or so that only methylpurine affecting pollen tubes NOT 'a control' 4. NOT reliable IGNORE fair test, accurate, precise	**(2)**

<table>
<tr><th>Question Number</th><th>Answer</th><th>Additional Comments</th><th>Mark</th></tr>
<tr><td>4(c) (ii)</td><td>1. idea of { no significant / small / 1mm / eq } increase in { mean length / growth } up to 0.0001 mol dm^{-3} ;

2. idea of negative correlation described e.g. {decrease in length of / shorter/ reduced growth of} pollen tubes as concentration increased OR over stated range from 0.0001 to 0.01 ;

3. idea of greatest { change / drop / eq } between 0.0010 and 0.0100 mol dm^{-3} / eq ;

4. credit correct manipulation of the data to illustrate decrease ;</td><td>IGNORE units.

2. CCEPT reference to decreases at specific concentrations of methylpurine
IGNORE negative correlation unqualified

3. NOT references to pid decrease.

4. Some examples given bel
<table><tr><td>Conc. change</td><td>Difference (mm)</td><td>% all decreases</td></tr><tr><td>0.0000 – 0.0100 – mp2</td><td>(94-28) 66</td><td>70 / 70.2 %</td></tr><tr><td>0.0001 – 0.0100</td><td>(95-28) 67</td><td>71 / 70.5 %</td></tr><tr><td>0.0001 – 0.0010</td><td>(95-90) 5</td><td>5 / 5.3 %</td></tr><tr><td>0.0010 – 0.0100 – mp3</td><td>(90-28) 62</td><td>69 / 68.9 %</td></tr></table></td><td>(3)</td></tr>
</table>

<table>
<tr><th>Question Number</th><th>Answer</th><th>Additional Comments</th><th>Mark</th></tr>
<tr><td>4(c)(iii)</td><td>1. { less / no } transcription / idea of inhibition of RNA polymerase ;

2. { less / no } { translation / protein synthesis/ protein made / eq } ;

3. idea that protein needed for (pollen tube) growth e.g. less protein leads to reduced growth (of pollen tubes) ;</td><td>

2 & 3 ACCEPT reference to enzyme instead of protein

IGNORE repair</td><td>(2)</td></tr>
</table>