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

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

Question Number	Answer	Additional guidance	Mark
1(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
1(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
2(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
2(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
2(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>2(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>2(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>

Question Number	Answer	Additional Comments	Mark
3(a)(i)	1. Idea that temperature is a controll variable / idea that temperature could affect {results / length of pollen tube} ; 2. dea that (pollen tube) { growth / enzymes / proteins /eq } affected by temperature ; 3. idea that the investigation is valid ;	1. N as a control 3. NOT reliable IGNORE fair test, accurate, precise	**(2)**

Question Number	Answer	Additional Comments	Mark
3(a) (ii)	1. idea of increase from { 0/1 } to 10 (µg dm^{-3}) ; 2. greatest length at 10 (µg dm^{-3})/ greatest increase between 1 and 10 (µg dm^{-3}) ; 3. idea of decrease between { 10/50 } and 200 (µg dm^{-3}) ; 4. shorter at 200 (µg dm^{-3}) compared with 0 / eq ; 5. idea of greatest {change / drop} between 100 and 200 (µg dm^{-3}) ; 6. credit correct manipulation of the data (e.g. change in length in µm calculated by subtraction), e.g. decreases by 76 µm between 100 and 200 µg dm^{-3} ;	IGNORE UNITS 2. 'Greatest increase betwe 1 and 10' scores mp1 as well as mp2 6. Other example Conc. change / Difference (µm) 0-1 / 0-1 / 1-1 / 10-50 / - 10-200 / -13 50-100 / -2 100-200 / -7 0-200 / -	**(3)**

Question Number	Answer	Additional Comments	Mark
3(a) (iii)	mitosis / nuclear division / DNA synthesis ;		**(1)**

Question Number	Answer	Additional Comments	Mark
3 *(b)	QWC– Spelling of technical terms must be correct and the answer must be organised in a logical sequence 1. idea that generative nucleus divides to form two male gametes ; 2. by mitosis ; 3. pollen tube fuses with embryo sac / eq ; 4. reference to double fertilisation ; 5. (one) male { gamete / nucleus } fuses with egg (cell) <u>nucleus</u> ; 6. to produce diploid zygote; 7. other male nucleus fuses with two polar nuclei ; 8. to produce triploid endosperm ;	QWC emphasis on logical sequence 1. CCEPT 'haploid' for 'male' and 'nuclei' for 'gametes' 5. NOT ov e 7. CCEPT fusion nucleus, NOT polar bodies	**(4)**

Question Number	Answer	Additional Comments	Mark
3 (c)	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) / correct reference to recombinants	**(2)**

Question Number	Answer	Mark
4 (a) (i)	as a comparison / as a control / to show that it is {incubation temperature / not some other factor} affecting spindle fibre formation ;	**(1)**

Question Number	Answer	Mark
4 (a) (ii)	1. as temperature increases (from 25^{o}C) to 33°C the number of cells showing spindle fibre formation increases / positive correlation between 25^{o}C and 33°C ; 2. as temperature increases from 33°C (to 37°C) there is no effect on number of cells showing spindle fibre formation / same values at 33°C and 37°C ; 3. credit correct manipulation of the data e.g. with a rise in temperature of 5^{o}C (between 28 and 33^{o}C) the number of cells showing spindle formation rises by 3 ;	**(2)**

Question Number	Answer	Mark
4 (b) (i)	1. idea that (only) 35°C statement is supported ; 2. idea that data either side of 35^{o}C both show all 5 (cells undergoing spindle fibre formation) ; 3. idea that only from 33^{o}C do all 5 (cells show spindle fibre formation) ;	**(2)**

Question Number	Answer	Mark
4 (b) (ii)	1. idea that 31°C statement may not be supported ; 2. idea that it could be between 2 and 5 ;	**(2)**

Question Number	Answer	Mark
*** 4 (c QWC**	Take into account quality of written communication when awarding the following points. **Mark as pairs** 1. shape qualified e.g. hydrodynamic, streamlined ; 2. idea of reduced resistance ; 3. {*acrosome* / *vesicle*} containing {*enzyme* / *acrosin*}; 4. involved in {digestion / break down} of the {*zona pellucida* / jelly layer} ; 5. {*haploid* / eq} *nucleus* ; 6. allows restoration of {diploid / full complement / 46 / eq} *chromosomes* at *fertilisation* ; 7. *mitochondria* qualified e.g. large number, correct location ; 8. to supply {ATP / energy} for {movement / eq} ; 9. {*flagellum* / eq} present ; 10. for propulsion / swimming / motility / eq ; 11. {markers / receptors} in cell surface *membrane* ; 12. to bind to egg cell surface *membrane* / detect chemicals released by *ovum* / eq ;	**(6)**