PEARSON EDEXCEL IGCSE BIOLOGY · 4BI1

# BIOLOGY



## MARK SCHEME

### SECTION 3: REPRODUCTION AND INHERITANCE (PACK 1)

| SCORE | PERCENTAGE |
| --- | --- |
| /249 | % |

STEMUP

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# Mark Scheme

Q1.

| Question Number | Answer | Mark |
|---|---|---|
| **(a)(i)** | The only correct answer is C as they are the microvilli<br><br>A is not correct as it is not the microvilli<br><br>B is not correct as it is not the microvilli<br><br>D is not correct as it is not the microvilli | **1** |

| Question Number | Answer | Mark |
|---|---|---|
| **(a)(ii)** | The only correct answer is B as this is a mitochondrion<br><br>A is not correct as it is not a mitochondrion<br><br>B is not correct as it is not a mitochondrion<br><br>D is not correct as it is not a mitochondrion | **1** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)** | An answer that makes reference to four of the following points:<br>• folded / long to increase surface area / (1)<br>• contains many villi to increase surface area (1)<br>• contains microvilli to increase surface area (1)<br>• contains lacteal to absorb lipid / eq (1)<br>• contains capillaries to absorb glucose / amino acids / minerals /eq (1)<br>• capillaries / blood flow maintain diffusion / concentration gradient / eq (1)<br>• thin wall/ one cell thick for fast diffusion/ short diffusion distance / eq (1) | must have structure and explanation | **4** |

| Question Number | Answer | additional guidance | Mark |
|---|---|---|---|
| **(c)** | A description that makes reference to three following points:<br>• oxygen to foetus from mother / eq (1)<br>• digested food / nutrients / amino acids / glucose / fatty acids to foetus from mother / eq (1)<br>• removes waste (products) / urea / carbon dioxide from foetus to mother / eq (1)<br>• provides antibodies for baby / foetus /eq (1)<br>• produces hormones / progesterone / eq (1) | If write blood transferred from mother to foetus penalise once -1<br>allow minerals named mineral / vitamin / named vitamin | **3** |

Q2.

| Question Number | Answer | additional guidance | Mark |
|---|---|---|---|
| **(a)** | • so semen contained sperm / (bull is) (sexually) mature / sperm in semen / gone through puberty / fully developed / eq | **accept converse**<br><br>ignore cannot produce semen | **1 grad** |

| Question Number | Answer | additional guidance | Mark |
|---|---|---|---|
| **(b)** | An explanation that includes two of the following points<br><br>• collect semen / sperm from **penis** of bull (1)<br><br>• insert **straw** into / inject semen (into cow) (1)<br><br>• put (it / semen / sperm) in **vagina / uterus** /womb /cervix(1) | <br><br><br>semen injected into uterus scores m2 and mp3 | **2 exp** |

| Question Number | Answer | additional guidance | Mark |
|---|---|---|---|
| **(c)(i)** | • preserve (sperm )/ keep (sperm) alive / viable / prevent growth of microorganisms / slow down metabolism / eq | allow last longer<br><br>ignore denatured | **1 grad** |

| Question Number | Answer | Mark |
|---|---|---|
| **(c)(ii)** | • provide females (produce milk) / will produce cows / eq | **1 grad** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(d)** | • 500 000 ÷ 2.4 million = 0.2083<br>• 0.2083 × 100 = **20.83% / 21.0% / 20.8%** | award full marks for correct numerical answer without working<br><br>allow 1 mark for ÷ 2.4 million | **2 grad** |

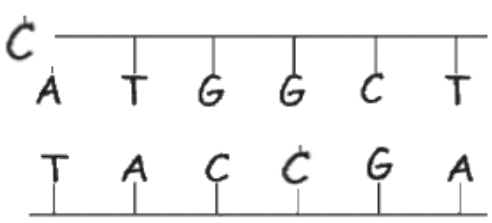
| Question Number | Answer | Mark |
|---|---|---|
| **(e)** | A description that makes reference to three of the following points<br>• use semen (from each bull) to fertilise (many / similar) cows (1)<br>• collect / measure milk yields / eq (1)<br>• from each daughter / offspring of these cows / mother of bull (1)<br>• select bull with highest (average) milk yield (across all daughters) (1) | **3 exp** |

| Question Number | Answer | Mark |
|---|---|---|
| **(f)** | An explanation that makes reference to two of the following points:<br>• (milk that contains) (most) fat (1)<br>• (most) protein (1)<br>• (most) vitamins (1)<br>• (milk that contains) (most) calcium (1) | **2 exp** |

| Question Number | Answer | additional guidance | Mark |
|---|---|---|---|
| **(g)(i)** | A description that makes reference to four of the following points:<br>• nucleus from (**body) cell of bull** (1)<br>• insert this nucleus into enucleated egg cell (1)<br>• electric shock (1)<br>• mitosis / cell division (1)<br>• <u>embryo</u> into uterus / womb (1)<br>• surrogate mother (1) | **reject from udder**<br>**reject egg cell from bull** | **4 exp** |

| Question Number | Answer | Mark |
|---|---|---|
| **(g)(ii)** | An explanation that makes reference to two of the following points<br>• **genetically** identical / no **genetic** variation / same (combination of) alleles (1)<br>• quicker process (1) | **2 exp** |
| | | Total =18 marks |

Q3.

| Question Number | Answer | Mark |
|---|---|---|
| **(a)** |  | **1** |

| Question Number | Answer | Mark |
|---|---|---|
| **(b)(i)** | The only correct answer is C 7.5<br><br>*A is not correct as is not 2.5*<br><br>*B is not correct as is not 4.5*<br><br>*D is not correct as is not 8.5* | **1** |

| Question Number | Answer | Mark |
|---|---|---|
| **(b)(ii)** | An explanation that makes reference to the following points:<br><br>• lower / eq (1)<br><br>• denatured / change in shape of active site / eq (1)<br><br>• urea does not bind (into active site) / fewer E/S complexes / eq (1) | **2** |

| Question Number | Answer | additional guidance | Mark |
|---|---|---|---|
| **(c)** | A description that makes reference to five of the following points:<br><br>• nitrogen fixing / fixation (1)<br><br>• (nitrogen fixing / fixation) nitrogen gas to ammonia (1)<br><br>• nitrifying / nitrification (1)<br><br>• (nitrifying / nitrification) ammonia to nitrite / nitrite to nitrate / ammonia to nitrate (1)<br><br>• denitrifying /denitrification (1)<br><br>• (denitrifying /denitrification) nitrate to nitrogen gas / reduces nitrogen available to plants / eq (1) | **Allow** nitrogen to nitrates / amino acids /eq<br><br>eg nitrifying bacteria convert nitrate to nitrogen gas scores mp 3 but not mp 4 | **5** |
| | | Total = 9 marks | |

Q4.

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a)** | An explanation that makes reference to two of the following.<br>• less oxygen (transported) (1)<br>• to muscles (1)<br>• less respiration / less ATP production / less energy release / more lactic acid / more anaerobic respiration (1) | | **2** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(i)** | UUACCGCCGAGU (2) | one mark for one incorrect pairing or use of T instead of U<br>e.g. UUACC**A**CCGAGU – one mark<br>**TT**ACCGCCGAG**T** – one mark | **2** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(ii)** | A description that makes reference to four of the following.<br>• <u>transcription</u> occurs in nucleus (1)<br>• production of messenger RNA / mRNA (from DNA) (1)<br>• translation occurs on ribosome / mRNA binds to ribosome / mRNA goes to ribosome (1)<br>• tRNA brings / has amino acids (1)<br>• codon binds to anticodon / codons are complementary to anticodons / (complementary) triplets on tRNA and mRNA bind / eq (1)<br>• polypeptide produced / amino acids joined together /amino acid chain produced / eq (1) | **Ignore** protein produced / synthesised | **4** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(iii)** | An answer that makes reference to four of the following.<br><br>*Pros* ***(max 3)***<br>• patients produce red blood cells / can exercise / are not breathless / have more energy / eq (1)<br>• independent life / transfusions not needed / better quality of life / no need to keep visiting hospitals / eq (1)<br>• no rejection (1)<br>• less risk of infectious disease (from blood) (1)<br>• permanent treatment / long lasting / lasts a lifetime / cure / works for at least 15 months (1)<br><br>*Cons* ***(max 3)***<br>• need to spend long time in isolation (for treatment) / eq (1)<br>• side effects (1)<br>• small sample size / only tested on two people / needs further testing / more repeats / eq (1)<br>• could cause mutations in DNA / cause cancers (1)<br>• need to be tested for more than 15 months / for longer / eq (1) | **Accept** converse<br><br>**Accept** blood transfusions need frequent hospital visits need to be done often<br><br>**Accept** transfusions have risk of infections<br><br>**Accept** transfusions need to be done for life<br><br>**Accept** need 15 months / several months in hospital<br>**Accept** few side effects from transfusions<br><br>**Accept** might not work for everyone / no mention of age / sex / health state/ eq<br><br>**Accept** time period is too short to tell | **4** |
| | | | **(Total mark for question = 12 marks)** |

Q5.

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a)** | lymphocytes / eq | **Ignore** white blood cells<br>**Reject** phagocytes | **1** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(i)** | An answer that makes reference to one of the following:<br><br>• both alleles expressed (1)<br><br>• both alleles affect the phenotype (1)<br><br>• both alleles show their characteristics / traits (1) | **Accept** both alleles work together / both alleles work together to form a third phenotype / phenotype depends upon both alleles | **1** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(ii)** | **The correct answer is D (A, B, AB and O )**<br><br>A is incorrect as the cross could also produce AB and O<br><br>B is incorrect as the cross could produce also AB and O<br><br>C is incorrect as the cross could also produce A, and B | | **1** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(c)** | $4.7(4) \times 10^{7}$ (2) | **one mark** for 47400000 **or** 47.4 million **or** 47 million<br>**or** other incorrect standard forms using 47(4)<br><br>**Correct answer gains all marks** | **2** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(d)** | An explanation that makes reference to the following:<br>• artificial cells are not (bi)concave / red blood cells are (bi)concave (1)<br>• artificial cells have smaller SA(:vol ratio) / red blood cells have larger SA (:vol ratio) (1)<br>• artificial cells absorb / bind / release less oxygen / red blood cells absorb bind more oxygen / release more oxygen / eq (1)<br>• artificial cells do not pass through capillaries easily / eq / red blood cells pass through capillaries more easily / eq (1) | **Accept** artificial cells carry less oxygen / red blood cells carry **more** oxygen<br>**Accept** artificial cells have slower diffusion (of oxygen) / red blood cells have faster diffusion (of oxygen) | **3** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(e)** | An explanation that makes reference to the following:<br>• no platelets (1) | **Allow** no fibrinogen | **1** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(f)** | An explanation that makes reference to two of the following:<br>• no / less water uptake / eq (1)<br>• by osmosis / due to osmotic effects (1)<br>• so cells do not burst / eq (1) | **Accept** converse<br>**Accept** equal water movement in and out<br>**Accept** correct ref to water potential | **2** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(g)(i)** | An explanation that makes reference to two of the following:<br>• stem cells can divide / perform mitosis (1)<br>• stem cells can differentiate / specialise / stem cells can become any cell / other cell types (1) | **Accept** stem cells are undifferentiated / unspecialised | **2** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(g)(ii)** | An answer that makes reference to two of the following:<br>• (there are) no antigens (present) / eq (1)<br>• so antibodies will not be produced / no rejection / no immune response / eq (1)<br>• any recipient / more people can receive blood group O (1) | **Accept** no surface proteins<br>**Accept** blood group A/ B / AB can receive the blood / O is the universal donor | **2** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(h)** | An answer that makes reference to two of the following:<br>• urea (1)<br>• digested food / named example (1)<br>• carbon dioxide (1)<br>• hormone / named hormone (1)<br>• mineral / ion / (not sodium / sodium chloride / salt) / vitamins (1)<br>• protein / clotting factors / fibrinogen / antibodies / eq (1) | e.g amino acids / glucose / fatty acids / LDLs<br>**Accept** named minerals / vitamins | **2** |

Q6.

| Question Number | Answer | Mark |
|---|---|---|
| **(a)** | spinal cord / chord | **1 cler** |

| Question Number | Answer | Mark |
|---|---|---|
| **(b)(i)** | C 0.5<br><br>*A is incorrect because 0.5 is the answer*<br>*B is incorrect because 0.5 is the answer*<br>*D is incorrect because 0.5 is the answer* | **1 comp** |

| Question Number | Answer | Mark |
|---|---|---|
| **(b)(ii)** | A diagram that makes reference to the following points:<br>• one circle and one square shown (1)<br>• two shapes unshaded (1) | **2 grad** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(c)** | An explanation that makes reference to three of the following points:<br>• prevents translation / no translation (1)<br>• prevents ribosomes attaching (to mRNA) (1)<br>• prevents / no, codon binding to anticodon (1)<br>• prevents amino acids joining / amino acid chain not made (1)<br>• huntingtin / protein / polypeptide not made (1) | **Allow** tRNA does not bind to mRNA<br><br>**Allow** less huntingtin / protein made | **3 exp** |
| | | | Total 7 marks |

Q7.

| Question Number | Answer | additional guidance | Mark |
|---|---|---|---|
| **(a)** | A description that makes reference to four of the following points:<br>• nucleus from (body) cell of male horse (1)<br>• insert this (nucleus) into enucleated egg cell / empty egg cell / eq (1)<br>• <u>electric</u> shock / electricity (1)<br>• mitosis / cell division / cell divides /eq (1)<br>• <u>embryo</u> into <u>uterus / womb</u> (1)<br>• <u>surrogate</u> mother (1) | reject from udder<br>reject egg cell from male horse | **4** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)** | An explanation that makes reference to three of the following points<br>• no sperm / gametes produced / eq (1)<br>• no fertilisation / cannot impregnate female / eq (1)<br>• but in cloning all chromosome / genes / DNA / nucleus comes from body cells (diploid male) / cloning uses body cell /eq (1) | Allow converse for mp1 and mp 2 | **3** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(c)** | An answer that makes reference to one of the following points<br>• to keep value of male / sire / eq (1)<br>• prevent inbreeding / maintain genetic diversity / maintain genetic variation / prevent genetic disease / disorder / eq<br>• limit number of offspring from each sire / stallion / eq (1)<br>• to prevent fraud / confirm paternity / eq / (1)<br>• ethical issues use of embryo / eq (1)<br>• many attempts needed to get successful clone / eq (1)<br>• idea of unfairness/ unequal competition / cheating / eq (1) | cloning will increase inbreeding and reduce diversity | **1** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(d)** | An answer that makes reference to the following<br>• clones are <u>genetically</u> identical / have same <u>genotype</u> / eq (1) | Allow converse<br>GM produces <u>genetic</u> change / introduces <u>new genes</u> / <u>genetic</u> variation | **1** |

Q8.

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a)** | An answer that makes reference to three of the following points:<br>• (DNA is) double stranded / helix (1)<br>• (DNA has) thymine / T / does not have uracil / U (1)<br>• (DNA has) deoxyribose (1)<br>• (DNA is) long(er) / large(r) | **Allow** converse<br>(RNA) is single stranded<br>(RNA) has uracil / U / does not have thymine / T<br>(RNA) has ribose<br>(RNA is) shorter | **3** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)** | A description that makes reference to five the following points:<br>• transcription occurs in the nucleus (1)<br>• transcription uses <u>DNA</u> to make <u>RNA</u> / eq (1)<br>• DNA unzips / one strand is copied / eq (1)<br>• transcription makes / produces <u>messenger</u> RNA / <u>m</u>RNA (1)<br>• translation takes place at the ribosomes / in cytoplasm (1)<br>• translation involves <u>messenger</u> RNA / <u>m</u>RNA **and** <u>transfer RNA</u> / <u>t</u>RNA (1)<br>• anticodons bind to codons / eq (1)<br>• translation produces amino acid chain / protein / polypeptide / eq (1) | Transcription uses DNA to make messenger RNA = two marks<br>Anticodons on tRNA bind to codons on mRNA = two marks | **5** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(c)** | An answer that makes reference to the following points:<br>• (if read in threes) = $4^3$ **or** 4 x 4 x 4 (1)<br>• = 64 (1)<br>• (64 is) greater / more than 20 (combinations) required / needed / eq (1)<br>• (if read in twos) = $4^2$ **or** 4 x 4 = 16 (1) | 64 is greater than 20 is two marks | **3** |

Q9.

| Question Number | Answer | Mark |
|---|---|---|
| **(a) (i)** | The only correct answer is C 5<br><br>*A is not correct because it does code for 1 amino acid*<br><br>*B is not correct because it does code for 3 amino acids*<br><br>*D is not correct because it does code for 15 amino acids* | **1** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a) (ii)** | GUA AGU UAA GUA AAG (2) | **One error scores 1**<br><br>Allow **one mark for**<br>GTA AGT TAA GTA AAG | **2** |

| Question Number | Answer | Additional Guidance | Mark |
|---|---|---|---|
| **(a) (iii)** | An explanation that makes reference to the following two points:<br>• each triplet / codon codes for **one** amino acid / eq (1)<br>• codons are discrete / independent of each other / nucleotides / bases are not shared between codons / eq (1)<br>• example of triplet reading frames, e.g. CAT TCA / eq (1) | **Allow** one codon / triplet determines each **/ one** amino acid<br><br>**Allow** nucleotides / bases are not shared between amino acid (codes)<br><br>**Allow** triplets read CAT TCA etc / or CAT/TCA | **2** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)** | A description that makes reference to four of the following points:<br>• (mRNA arrives at) ribosome (1)<br>• mRNA has codons / is a template (1)<br>• ribosome moves along mRNA strand (1)<br>• tRNA brings amino acids (to ribosome) (1)<br>• anticodon (on tRNA) binds with codon (on mRNA) / tRNA binds with mRNA (1)<br>• amino acid chain produced / amino acid joined / polypeptide (1) | **Allow** ribosome moves along to next codon<br><br>**Allow** codon is complementary to anticodon | **4** |

| Question Number | Answer | Mark |
|---|---|---|
| **(c)** | the / its genes / DNA / genetic material (1) | **1** |
| | | Total 10 marks |

Q10.

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a)** | **C is the correct answer (UAAGGCUCA)**<br><br>A is incorrect as T is not present in RNA<br><br>B is incorrect as T is not present in RNA<br><br>D is incorrect as the sequence is not complementary | | **1** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)** | **C is the correct answer (translation anticodon)**<br><br>A is incorrect because it is not transcription<br><br>B is incorrect because it is not transcription<br><br>D is incorrect because it is not a codon | | **1** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(c)** | An explanation that makes reference to three of the following:<br><br>• mutation is a <u>rare / random</u> change to DNA / genetic material (1)<br><br>• change in nucleotides / bases / triplets / eq (of DNA) (1)<br><br>• change (in sequence of) amino acids (in proteins / polypeptide) (1)<br><br>• changing enzyme / protein / producing different protein / enzyme / eq (1) | <br><br><br><br><br>**Accept** codons<br><br><br><br>**Accept** changing active site / changing shape of protein | **3** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(d)(i)** | An description that makes reference to three of the following:<br><br>• use of quadrat / gridding of area / eq (1)<br>• random (selection of areas) (1)<br>• count butterflies / eq (1)<br>• repeat / means / eq (1) | <br><br><br><br>**Accept** quadrats for two marks (mp1 and mp4) | **3** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(d)(ii)** | A discussion that makes reference to five of the following:<br><br>1. increase in abnormal butterflies / more abnormal butterflies after 10 months (1)<br>2. (due to) longer exposure to radioactivity / eq (1)<br>3. larger increase in number of abnormal / mutated offspring (compared with adult after 10 months) (1)<br>4. mutations / genes / eq passed on to offspring (1)<br>5. recessive mutations may be carried by adults / eq (1)<br>6. if heterozygotes / carriers mate they may produce abnormal offspring / eq (1)<br>7. other factors could cause the abnormalities / abnormalities may not be due to mutations /not genes / DNA(1)<br>8. there is no control experiment / no data before the accident / no idea of normal number of abnormalities / eq (1)<br>9. radioactivity not measured / monitored / radioactivity may change / decay / eq (1)<br>10. do not know number of butterflies sampled / eq (1) | **Accept** adult / offspring / both<br><br>**Accept** longer exposures increases number of mutations<br><br>**Accept** more abnormal offspring than abnormal adults<br><br>**Accept** adults increase by 15.7 and %, offspring increase by 41.9 %<br><br>**Accept** no idea of health of butterflies / disease<br><br>**Accept** no data from area with no radioactivity<br><br>**Accept** no idea how long radioactivity lasted / changed<br><br>**Accept** experiment has not been repeated / small sample size | **5** |

Q11.

| Question number | Answer | Mark |
|---|---|---|
| **(a)** | A description that makes reference to three of the following points:<br><br>• helix (1)<br>• double stranded (1)<br>• paired bases (1)<br>• A with T and C with G (1) | **3** |

| Question number | Answer | Mark |
|---|---|---|
| (b)(i) | A | 1 |

| Question number | Answer | Mark |
|---|---|---|
| (b)(ii) | $4^3 = 64$ | 1 |

| Question number | Answer | Mark |
|---|---|---|
| (c)(i) | A description that makes reference to three of the following points:<br><br>• change in the order of bases/equivalent (1)<br>• leads to different codon (1)<br>• different amino acid in protein (1)<br>• different-shaped enzyme/change to active site/enzyme not made/equivalent (1) | 3 |

| Question number | Answer | Mark |
|---|---|---|
| (c)(ii) | An explanation that makes reference to two of the following points:<br><br>• change in base may code for same amino acid (1)<br>• amino acid may not be involved in active site (1)<br>• enzyme still made/still functions/equivalent (1)<br>• could be recessive allele (1)<br>• so not expressed in phenotype (1) | 2 |

| Question number | Answer | Mark |
|---|---|---|
| (c)(iii) | An answer that makes reference to x-rays/ultraviolet radiation/gamma radiation/tar/ carcinogens/equivalent | 1 |

**(Total for question = 11 marks)**

Q12.

| Question Number | Answer | Mark |
|---|---|---|
| (a) | • Hh / Hh and Hh / hH / hH and hH / hH and Hh / Hh and hH | 1 |

| Question Number | Answer | Mark |
|---|---|---|
| (b) | • 2.1 : 1 Allow 21 : 10, 2 : 1 | 1 |

| Question Number | Answer | Mark |
|---|---|---|
| (c) | An answer that makes reference to two of the following points:<br>• small sample size / too few crosses / eq (1)<br>• random / chance (of fertilisation) (1)<br>• of fertilisation / fusion of gametes / eq (1)<br>• fewer yellow (than predicted) / more brown (than predicted) (1)<br>• no HH offspring survive / ratio is 2 Hh : yellow to 1 hh brown / yellow mice more likely die / brown mice less likely to die (1)<br>• mutations (may have occurred) (1) | **4** |

Q13.

| Question Number | Answer | Mark |
|---|---|---|
| (a) | **A** asexual reproduction<br>*B is not correct as it increases genetic variation*<br>*C is not correct as it increases genetic variation*<br>*D is not correct as it increases genetic variation* | **1 comp** |

| Question Number | Answer | additional guidance | Mark |
|---|---|---|---|
| **(b)** | An explanation that makes reference to five of the following points:<br>• different (sequence of) bases in DNA / eq (1)<br>• changes mRNA / codons (1)<br>• transcription (1)<br>• change tRNA / anticodons /(sequence of)amino acids (1)<br>• translation (1)<br>• changes structure / shape of protein /eq (1)<br>• changes active site (1)<br>• enzyme not functional / no binding / no enzyme substrate complex formed/ eq (1) | changes shape of active site = 2 marks | **5 exp** |

| Question Number | Answer | Mark |
|---|---|---|
| **(c)** | An explanation that makes reference to four of the following points:<br>• as some triplets / codons code for same amino acid / degenerative /eq (1)<br>• no change in protein / polypeptide / enzyme produced (1)<br>• active site not changed /affected (1)<br>• mutation / allele may be recessive (1)<br>• so not expressed in phenotype / if heterozygous / dominant allele present / eq (1)<br>• mutation may occur in a non-coding sequence of DNA /eq (1) | **4 exp** |
| | | Total 10 marks |

Q14.

| Question Number | Answer | Mark |
|---|---|---|
| **(a)(i)** | The only correct answer is C thread-like hyphae<br><br>*A is incorrect because fungi lack chloroplasts*<br><br>*B is incorrect because fungi do not store starch*<br><br>*D is incorrect because fungi walls are made of chitin* | **1** |

| Question Number | Answer | Mark |
|---|---|---|
| **(a)(ii)** | The only correct answer is D maltose<br><br>*A is incorrect because amino acids are products of protease digestion*<br><br>*B is incorrect because fatty acids are products of lipase digestion*<br><br>*C is incorrect because glycerol is a product of lipase digestion* | **1** |

| Question Number | Answer | Mark |
|---|---|---|
| **(a)(iii)** | A description that makes reference to five of the following points:<br><br>• transcription / transcripts / transcribes (1)<br><br>• mRNA/messenger RNA **and** leaves nucleus / mRNA/messenger RNA **and** enters cytoplasm (1)<br><br>• ribosomes (1)<br><br>• tRNA/transfer RNA (brings) attached amino acids (1)<br><br>• codons / anticodons / complementary bases (1)<br><br>• translation / translated / translates / amino acid chain / polypeptide chain (1) | **5** |

| Question Number | Answer | Mark |
|---|---|---|
| **(b)(i)** | 70.475 to 70.5 | **1** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(ii)** | (70.5 – 50 =) 20.5 | Allow (answer from 3(b)(i) – 50)<br>eg: 70.4 – 50 = 20.4 | **1** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(iii)** | An answer that makes reference to four of the following points:<br>• same surface area / mass / thickness / area / size (1)<br>• remove soil from square (before weighing) (1)<br>• control <u>temperature</u> / oxygen / moisture / water (1)<br>• (soil) same mass / same amount / same volume / same type / same soil / decomposers / bacteria / fungi (1)<br>• repeat / use more squares / obtain average / remove anomalies (1)<br>• increase range of pH / use different pHs / more pHs (1) | Ignore more time<br>Mp3 Ignore light / carbon dioxide<br>Mp4 Ignore sterile soil | **4** |

Q15.

| Question Number | Answer | Mark |
|---|---|---|
| **(a)** | An answer that makes reference to two of the following points:<br>• so that sperm can swim / can reach egg / otherwise they cannot swim / otherwise they cannot reach egg / eq (1)<br>• can fertilise egg / fertilisation can occur / (if abnormal) will not fertilise egg (1)<br>• so (initial) fertility is not reduced / or (if abnormal) fertility of these men will (already) be reduced (1) | **2** |

| Question Number | Answer | Mark |
|---|---|---|
| **(b)(i)** | An explanation that makes reference to two of the following points:<br>• thickens / maintains, uterine wall / lining / endometrium / maintains pregnancy / eq (1)<br>• inhibits FSH production / prevents more eggs maturing / eq (1)<br>• inhibits LH production / prevents ovulation / eq (1) | **2** |

| Question Number | Answer | Mark |
|---|---|---|
| **(b)(ii)** | • male sex hormone / increase male hormone level (1)<br>• because progestin reduces testosterone / eq (1) | **1** |

| Question Number | Answer | Mark |
|---|---|---|
| **(b)(iii)** | • testes / testicles (1) | **1** |

| Question Number | Answer | Mark |
|---|---|---|
| **(c)(i)** | • reduce sperm production / eq (1) | **1** |

| Question Number | Answer | Mark |
|---|---|---|
| **(c)(ii)** | • to measure if sperm count fell / below 1 million per $cm^3$ / fertility dropped / eq (1) | **1** |

| Question Number | Answer | Mark |
|---|---|---|
| **(c)(iii)** | • prevent fertilisation / eq, as sperm production may be above 1 million per $cm^3$ / still high / eq (1) | **1** |

| Question Number | Answer | Mark |
|---|---|---|
| **(d)** | • to ensure sperm production stays below 1 million per $cm^3$ / stays low / eq (1)<br>• to see if, the treatment / progestin works / lowers sperm production (1) | **1** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(e)** | • 98.4 x 320/100 = 314.88<br>• = 320 - 315<br>• 5 (2)<br>100 - 98.4 = 1.6 %<br>1.6 × 320 / 100 = 5.12 = 5 (2) | **Allow** 1 mark for 315<br>or 1.6 in working<br>**Allow** 5.1 or 5.12<br>award full marks for correct answer no working | **2** |

| Question Number | Answer | Mark |
|---|---|---|
| **(f)** | An answer that includes any 4 of the following points<br><br>*(For / positive about method)*<br><br>• reduces pregnancy / 98.4 % work / (very) effective / eq (1)<br><br>• 75% / most men / partners / couples, happy to continue (1)<br><br>• do not need to be remember to take / eq (1)<br><br>• does not require surgery / reversible (1)<br><br>• no need for women to take hormones (1)<br><br>*(Against / negative about method)*<br><br>• side effects / acne / mood disorders / skin infections / skin irritation / eq (1)<br><br>• does not protect against STI / named disease / eq (1)<br><br>• suppression phase takes a long time / 26 weeks / eq (1)<br><br>• may not be reversible / reduce long term male fertility / may take time to reverse / eq (1) | **4** |
| | total =16 marks | |

Q16.

| Question Number | Answer | additional guidance | Mark |
|---|---|---|---|
| **(a)** | An explanation that makes reference to two of the following:<br><br>• (two) different parent plants / cross with another plant / eq (1)<br><br>• (produce different) gametes (1)<br><br>• parent plants /gametes have different genotypes / alleles / genes / genetic material / DNA / eq(1)<br><br>• (gametes) fuse / combine / fertilisation (1) | allow other flower | **2** |

| Question Number | Answer | additional guidance | Mark |
|---|---|---|---|
| **(b)(i)** | An explanation that makes reference to the following:<br>• less competition for light / get enough / sufficient / more light / eq (1)<br>• less competition for water / get enough / sufficient water / more water eq (1)<br>• less competition for minerals / named mineral / get enough / sufficient minerals/ more minerals /eq (1) | allow one mark for less competition unqualified<br>ignore space / $CO_2$ | **3** |

| Question Number | Answer | Mark |
|---|---|---|
| **(b)(ii)** | • can grow in suitable / same conditions / habitat as parent ( which successfully grew there) / has plant to <u>cross-pollinate</u> with / eq (1) | **1** |

| Question Number | Answer | additional guidance | Mark |
|---|---|---|---|
| **(c)** | An explanation that makes reference to three of the following:<br>• warmth / optimum temperature for enzyme action / increased temperature for chemical reactions / eq (1)<br>• water to mobilise enzymes / for chemical reactions / eq (1)<br>• oxygen for respiration / eq (1)<br>• light to stimulate growth / break dormancy / eq (1) | must have factor and reason<br>not light for photosynthesis | **3** |

| **Question Number** | Answer | additional guidance | **Mark** |
|---|---|---|---|
| **(d)** | An explanation that makes reference to two the following:<br>• (bright colours to) attract animals / humans / easily seen / eq (1)<br>• to eat the fruits / consume / eq (1)<br>• as they contain glucose / sugars / eq (1) | ignore attract insects | **2** |

| Question Number | Answer | additional guidance | Mark |
|---|---|---|---|
| **(e)** | An answer that makes reference to :<br>• from fruit eaten and egested by/ passed through humans / from faeces / seeds not digested /eq (1) | no credit for more nitrates / minerals | **1** |

| Question Number | Answer | additional guidance | Mark |
|---|---|---|---|
| **(f)** | An answer that makes reference to :<br>• heat / warmth / high temperature (for evaporation) / dries out (tissue)/ eq (1) | not just evaporation of water | **1** |

| Question Number | Answer | Mark |
|---|---|---|
| **(g)** | A description that makes reference to three of the following:<br>• use watch / clock / measure record to time fall (1)<br>• from same height (1)<br>• repeat / calculate mean time (1)<br>• use same mass seeds / same seeds / same species / eq (1)<br>• with and without fluff / different amounts of fluff/ eq (1) | **3** |

Q17.

| Question Number | Answer | Mark |
|---|---|---|
| **(a)(i)** | The only correct answer is C<br>A is not correct as pollen grains are not made in A<br>B is not correct as pollen grains are not made in B<br>D is not correct as pollen grains are not made in D | **1** |

| Question Number | Answer | Mark |
|---|---|---|
| **(a)(ii)** | The only correct answer is B<br>A is not correct as it is not the stigma<br>C is not correct as it is not the stigma<br>D is not correct as it is not the stigma | **1** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)** | An explanation that makes reference to three of the following points:<br>• tube grows down style (1)<br>• tube enters the ovary / ovule (1)<br>• tube enters via micropyle (1)<br>• transports <u>nucleus</u> / male gamete to ovary / ovule / down style (1)<br>• idea of fertilisation (1) | **Allow** pollen nucleus / male gamete, <u>fuses</u> with egg nucleus / female gamete / egg cell<br>**Allow** gametes fuse | **3** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(c)(i)** | 80 (2) | 600 ÷ 3 = 200<br>360 ÷ 3 = 120<br><br>200 – 120 = 80<br><br>**600-360=240**<br>240÷3=80<br><br>**one mark** for 240 **or** (200 **<u>and</u>** 120)<br><br>award full marks for correct numerical answer without working | **2** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(c)(ii)** | An answer that makes reference to two of the following points:<br><br>• with <u>both</u> (chemicals) there is less growth (1)<br><br>• (because) fewer proteins made / less protein synthesis (1)<br><br>• with actinomycin, no mRNA is made / <u>DNA</u> not transcribed (1)<br><br>• with cycloheximide, amino acids cannot be joined together / eq (1)<br><br>• growth with actinomycin is higher than cycloheximide, as some mRNA is present / is then translated (1) | **Allow** stopping transcription stops mRNA production<br><br>**Allow** correct reference to any process associated with translation e.g. prevents ribosome binding to RNA/ mRNA and tRNA cannot pair up /codons cannot join with anticodons / such as tRNA does not bring amino acids | **4** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(d)** | An answer that makes reference to three of the following points:<br><br>• microscope / lens / magnifying glass (1)<br><br>• slide / tile / eq (1)<br><br>• cover slip (1)<br><br>• stain / dye (1) | **Allow** petri dish / watch glass | **3** |
| | | | Total 14 marks |

Q18.

| Question Number | Answer | Mark |
|---|---|---|
| **(a)** | An explanation that makes reference to two of the following points:<br>• less oxygen (1)<br>• (less) respiration (1)<br>• (less) energy / ATP (1) | **2** |

| Question Number | Answer | Mark |
|---|---|---|
| **(b)** | An explanation that makes reference to three of the following points:<br>• DNA unzips / separates / one strand copied / eq (1)<br>• complementary / base pairing /eq (1)<br>• template (1)<br>• mRNA produced / eq (1)<br>• transcription (1) | **3** |

| Question Number | Answer | additional guidance | Mark |
|---|---|---|---|
| **(c)** | • no nucleus / DNA / no ribosomes/ mitochondria /eq | ign amino acids / genetic material | **1** |

| Question Number | Answer | Mark |
|---|---|---|
| **(d)** | • can pass across placenta (1) | **1** |

| Question Number | Answer | | Mark |
|---|---|---|---|
| **(e)(i)** | An answer that makes reference to the following points:<br>• parent genotype dd x Dd (1)<br>• gamete d (and d) and D or d (1)<br>• offspring genotype Dd and dd (1) | allow Punnett square any letter TE max 2 | **3** |

| Question Number | Answer | Mark |
|---|---|---|
| **(e)(ii)** | • 50% / 0.5 / half / 50:50 **not if contradicts ei** | **1** |

| Question Number | Answer | Mark |
|---|---|---|
| **(f)** | An explanation that makes reference to three of the following points:<br>• memory cells (1)<br>• remain in mother's blood (1)<br>• recognise / identify antigen / binds with antigen (1)<br>• more antibodies produced/ produced faster / sooner (1)<br>• secondary immune response (1) | **3** |

| Question Number | Answer | Mark |
|---|---|---|
| **(g)** | • **in** the uterus / womb | **1** |

| Question Number | Answer | Mark |
|---|---|---|
| **(h)** | • (adult) (rhesus) positive / positive / eq | **1** |
| | Total 16 marks | |

Q19.

| Question Number | Answer | Mark |
|---|---|---|
| **(a)** | • no GH / water / saline / eq | **1 grad** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)** | increase in mass between 100 and 500 days<br><br>divide by 400 = g per day<br><br>485-230 = 255 ÷ 400<br><br>= 0.6375 / 0.638 / 0.64<br><br>**allow any answer between 0.6375 and 0.65** | award full marks for correct numerical answer<br><br>allow 1 mark for ÷ 400 | **2 grad** |

| Question Number | Answer | Mark |
|---|---|---|
| **(c)** | An answer that makes reference to two of the following points:<br>• temperature (1)<br>• (mass of) food / diet / type of food /eq (1)<br>• water (1)<br>• size of cage (1)<br>• time (1)<br>• volume of solution/eq (1) | **2 exp** |

| Question Number | Answer | Mark |
|---|---|---|
| **(d)** | An explanation that makes reference to two of the following points:<br>• avoids making wrong conclusion based on one / few result(s) / conclusion is valid / eq(1)<br>• can calculate mean / average (1)<br>• results are <u>reliable</u> / increase <u>reliability</u> (1)<br>• anomalous results recognised / eq(1) | **2 exp** |

| Question Number | Answer | additional guidance | Mark |
|---|---|---|---|
| **(e)** | An answer that makes reference to three of the following points:<br>• (more) mRNA made (1)<br>• (more) translation (1)<br>• (more) proteins / polypeptides made (1)<br>• enzymes / muscle / tissue (1) | **ignore more cells** | **3 exp** |
| | | Total 10 marks | |

Q20.

<table>
<tr><th>Question Number</th><th>Answer</th><th>Mark</th></tr>
<tr><td>(a)</td><td>
<table>
<tr><th>Hormone</th><th>Name of structure that secretes hormone</th><th>Functions of hormone</th></tr>
<tr><td>FSH</td><td>pituitary (1)</td><td>1. stimulate follicle growth / mature eggs / develop eggs / eq (1)<br><br>2. stimulates oestrogen secretion</td></tr>
<tr><td>LH / Lutenising hormone (1)</td><td>pituitary</td><td>1. cause ovulation / egg / ovum release / eq / stimulate progesterone release (1)<br><br>2. stimulates development of corpus luteum</td></tr>
<tr><td>oestrogen / estrogen (1)</td><td>ovaries</td><td>1. repairs lining of uterus<br><br>2. stimulates LH secretion</td></tr>
<tr><td>progesterone</td><td>ovaries / corpus luteum / placenta (1)</td><td>1. maintains the lining of uterus<br>2. inhibits LH</td></tr>
</table>
</td><td>6 exp</td></tr>
</table>

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)** | An answer that makes reference to one of the following points:<br><br>• blood loss once a month / monthly period / eq (1)<br><br>• breakdown of uterus lining / breakdown of endometrium / eq | <br><br><br><br><br><br>**Allow** passing out / shedding / loss of uterus lining / endometrium | **1 grad** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(c)** | • 51 - 12 = 39<br>• 39 x 52 x 7 = 14 196 days<br>39 x 365 = 14 235<br>39 x 365.25 = 14 24.75<br>• 14 196 ÷ 28 = 507<br>• = **510** to 2 sig figs (3)<br>**OR**<br>• 51 – 12 = 39<br>• 365 / 28 = 13(.04)<br>• 13.04 x 39 = 508<br>• = **510** to 2 sig figs (3) | Award full marks for correct numerical answer without working<br>**Allow** one mark for x 39 **OR** for ÷ 28<br>**Allow** answer between 507 and 510 for 2 marks e.g. 507 / 508 / 509 | **3 exp** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(d)** | An answer that makes reference to one of the following points:<br>• not all eggs fertilised / eq (1)<br>• no sexual intercourse / eq (1)<br>• contraception / eq (1)<br>• no implantation / eq (1)<br>• miscarriages / eq (1)<br>• some eggs not fertile / eq (1) | **Allow** eggs fertilised by abnormal sperm | **1 exp** |
| | | | Total 11 marks |

Q21.

| Question Number | Answer | **Mark** |
|---|---|---|
| **(a)** | XY / X and Y / YX / Y and X | **1** |

| Question Number | Answer | Mark |
|---|---|---|
| **(b)(i)** | The only correct answer is D ZZ<br><br>*A is incorrect because XY are the sex chromosomes of a human male*<br><br>*B is incorrect because ZW are the sex chromosome of a female bird*<br><br>*C is incorrect because ZY are not the sex chromosomes of a male bird* | **1** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(ii)** | • determine probability of having one female<br><br>• raise to the power of 4<br><br>= 0.0625 / 6.25% / 1/16<br>1 in 16 (2) | award full marks for correct numerical answer without working<br><br>p of one female = 0.5<br><br>$(0.5)^4$<br><br>Allow one mark for 0.5 / ½ / 50% / 1 in 2 in working | **2** |

<table>
<tr><th>Question Number</th><th>Answer</th><th>Additional guidance</th><th>Mark</th></tr>
<tr><td>(c)(i)</td><td>
<table>
<tr><th>Hormone</th><th>Source</th><th>Function</th></tr>
<tr><td>FSH</td><td>pituitary (1)</td><td>(stimulate follicle growth)</td></tr>
<tr><td>LH</td><td>(pituitary)</td><td>ovulation / egg release / release of oestrogen / release of progesterone / develop corpus luteum (1)</td></tr>
<tr><td>oestrogen</td><td>ovary / ovaries / corpus luteum / placenta (1)</td><td>(repair uterus lining)</td></tr>
<tr><td>progesterone</td><td>(ovary)</td><td>maintain uterus lining/wall / prevents shedding of uterus lining /wall<br>inhibit FSH / inhibit LH / inhibit lactation (1)</td></tr>
</table>
</td><td>Two answers must be correct for the mark<br>eg: (LH) ovulation and inhibits oestrogen = 0<br><br>Ignore maintains pregnancy</td><td>4</td></tr>
</table>

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(c)(ii)** | An answer that makes reference to the following:<br>• FSH = Q<br>• LH = R<br>• oestrogen = P<br>• progesterone = S (3) | three or four correct = 3<br>two correct = 2<br>one correct = 1<br>more than one letter on a line = 0 | **3** |