This is a Class 1 exam

Lebanon Evangelical School
for Boys and Girls
Loueizeh - Baabda

Stage Exam 04

12FEB2024

Do NOT write in this box. Your MARK will be placed here.

Subject :	A Level : Biology 1
Class :	11A and 12A
Teacher :	Miss Rahmeh Hilal
Duration :	1 hour

Your name :		*Time taken to complete exam*
Your Class :		
Exam Room :		
How many sheets, including cover sheet :		

- Do not open this paper until the teacher in charge instructs you to do so.
- The most important thing to remember in taking an exam is NEVER PANIC.
- If you are caught cheating in this exam, you will be awarded zero for ALL exams that are taken on this day.

Q1.

Meiosis and mitosis are both types of nuclear division that take place in eukaryotic organisms.

(a) Put a cross ☒ in the box next to the correct word or words to complete each of the following statements.

(i) DNA synthesis takes place before

(1)

- ☐ **A** both meiosis and mitosis
- ☐ **B** meiosis only
- ☐ **C** mitosis only
- ☐ **D** neither meiosis nor mitosis

(ii) Crossing over takes place during prophase I in

(1)

- ☐ **A** both meiosis and mitosis
- ☐ **B** meiosis only
- ☐ **C** mitosis only
- ☐ **D** neither meiosis nor mitosis

(b) Put a cross ☒ in the box next to the row in the table that correctly describes the result of meiosis and the result of mitosis.

(1)

	Meiosis	Mitosis
☐ A	two daughter cells with one copy of each chromosome	four daughter cells with two copies of each chromosome
☐ B	two daughter cells with one copy of each chromosome	four daughter cells with one copy of each chromosome
☐ C	four daughter cells with one copy of each chromosome	two daughter cells with two copies of each chromosome
☐ D	four daughter cells with one copy of each chromosome	two daughter cells with one copy of each chromosome

(c) Suggest why neither meiosis nor mitosis take place in prokaryotic organisms.

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(Total for question = 5 marks)

Q2.

Organisms are made of cells. There are differences in the ultrastructure of prokaryotic and eukaryotic cells. There are also differences between plant and animal cells.

(a) Place a cross (☒) in the box next to the correct words to complete each of the following statements.

(i) Ribosomes are found in

(1)

☐ **A** animal cells only

☐ **B** eukaryotic cells only

☐ **C** prokaryotic cells only

☐ **D** eukaryotic and prokaryotic cells

(ii) Amyloplasts are found in

(1)

☒ **A** animal cells only

☒ **B** plant cells only

☒ **C** prokaryotic cells only

☒ **D** eukaryotic and prokaryotic cells

(iii) Mitochondria are found in

(1)

☐ **A** animal cells only

☐ **B** eukaryotic cells only

☐ **C** prokaryotic cells only

☐ **D** eukaryotic and prokaryotic cells

(iv) Centrioles are found in

(1)

☐ **A** animal cells only

☐ **B** all eukaryotic cells

☐ **C** prokaryotic cells only

☒ **D** eukaryotic and prokaryotic cells

(b) Eukaryotic cells contain membrane bound organelles. The diagram below shows one of these organelles.



(i) Place a cross (☒) in the box next to the name of this organelle.

(1)

☐ **A** centrioles

☐ **B** Golgi apparatus

☐ **C** mitochondrion

☐ **D** rough endoplasmic reticulum

(ii) Describe the function of this organelle.

(3)

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(Total for question = 8 marks)

Q3.

Some scientists believe that mitochondria evolved from prokaryotic organisms.

They think that a prokaryotic organism entered a single-celled eukaryotic organism and lived inside it. The two organisms evolved to become dependent on each other.

(a) In the space below, draw and label a diagram to show the structure of a mitochondrion.

(4)

(b) Give **two** similarities between the structure of a mitochondrion and the structure of a prokaryotic organism.

(2)

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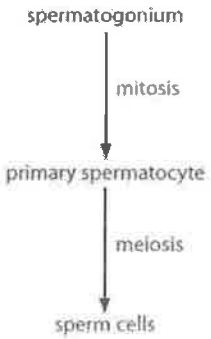
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(Total for question = 6 marks)

Q4.

(a) The diagram below shows some of the stages in the production of sperm cells.



Primary spermatocytes are formed from a spermatogonium once there have been several divisions by mitosis.

Explain why several divisions of mitosis are involved in the production of sperm cells.

(2)

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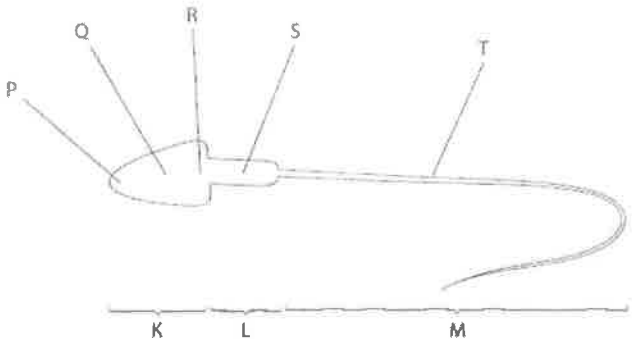
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(b) The diagram below shows an outline of a sperm cell.



(i) Put a cross (☒) in the box next to the letter that shows the location of the acrosome.

(1)

☐ A P
☐ B Q
☐ C R
☐ D S

(ii) Put a cross (☒) in the box next to the letter that shows the location of the mitochondrion.

(1)

☐ **A** P
☐ **B** Q
☐ **C** S
☐ **D** T

(iii) The structure labelled K is 5 μm long.
The ratio of the length of structures K : L : M is 1.0 : 0.6 : 10.0.
Calculate the total length of a sperm cell.
Show your working.

(3)

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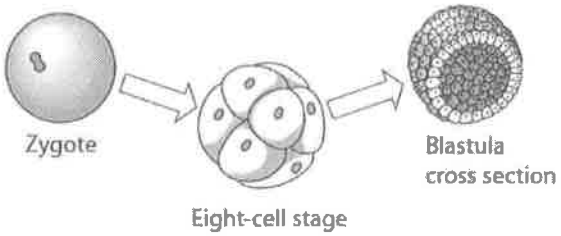
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Q5.

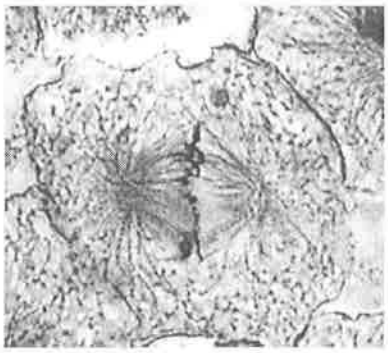
After fertilisation in animals, the zygote divides by mitosis.

After several divisions, a hollow ball of cells is produced. In vertebrate animals this is called a blastula.

This process is shown in the diagram below.



(a) The photograph below shows a cell of a blastula of the whitefish, *Coregonus*, at one stage of mitosis.



Magnification ×1000

Put a cross ☒ in the box next to the correct word to complete the following statement.

The stage of mitosis shown in the photograph is

(1)

☐ **A** anaphase

☐ **B** metaphase

☐ **C** prophase

☐ **D** telophase

(c) The cells of a blastula are totipotent. Suggest why it is important that these cells are totipotent.

(2)

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(Total for question = 3 marks)

Q6.

Reproduction in plants involves meiosis and mitosis.

(a) Explain the importance of meiosis in plants.

(2)

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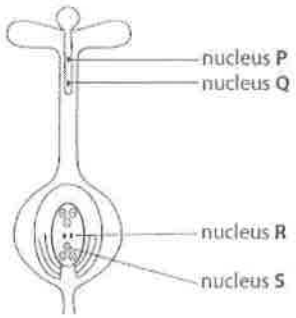
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(b) The diagram below shows a pollen grain growing on the female reproductive organ of a plant.



(i) Put a cross (☒) in the box next to the row in the table that correctly describes the nuclei **P**, **Q**, **R** and **S**.

(1)

	Nucleus P	Nucleus Q	Nucleus R	Nucleus S
☐ A	diploid	diploid	diploid	diploid
☐ B	diploid	haploid	haploid	haploid
☐ C	haploid	haploid	haploid	diploid
☐ D	haploid	haploid	haploid	haploid

(ii) Put a cross (☒) in the box next to the order of tissues through which the pollen tube grows.

(1)

☒ **A** stigma → micropyle → style

☒ **B** stigma → style → micropyle

☒ **C** style → micropyle → stigma

☒ **D** style → stigma → micropyle

(iii) As the pollen tube grows, nucleus **P** divides by mitosis.
Explain the importance of this division.

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(Total for question = 7 marks)

Q7.

Mammals reproduce sexually. This involves fertilisation to produce a zygote.

(a) Explain the importance of fertilisation in sexual reproduction.

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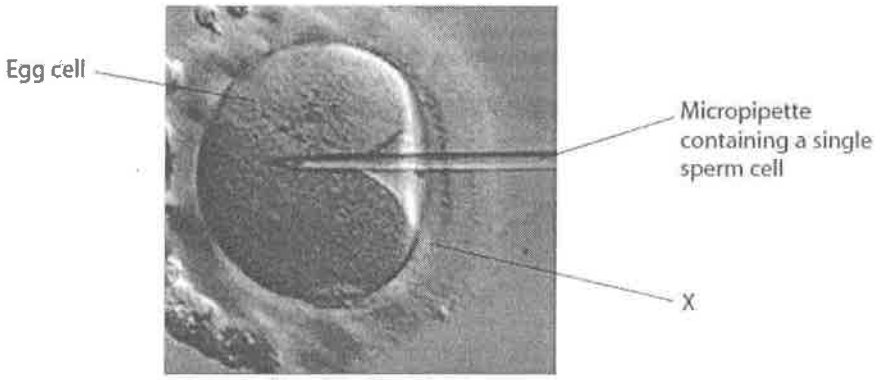
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(b) Damaged or faulty sperm cells can reduce the chance of fertilisation occurring.

To increase the chance of fertilisation, a technique called intracytoplasmic sperm injection (ICSI) can be used.
This technique involves injecting a single sperm cell into the cytoplasm of an egg cell, as shown in the photograph below.



Magnification ×400

(i) Name the structure labelled X that surrounds the egg cell.

(1)

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(ii) Suggest why a sperm cell with a damaged acrosome would **not** be able to fertilise an egg cell.

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(c) In fertilisation, the fusion of the sperm cell membrane with the egg cell membrane is followed by changes in the egg cell.

Describe a process that would **not** occur with the ICSI technique.

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(Total for question = 9 marks)

Q8.

Smoking cigarettes increases the risk of developing lung cancer.

Identical twins can provide evidence for the relative effects of the factors that affect a phenotype.

Identical twins develop from one fertilised egg.

(a) Explain why studies of identical twins can provide evidence for the relative effects of the factors that affect a phenotype.

(2)

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(b) Non-identical twins are produced from the fertilisation of two eggs.
Concordance is the probability that each twin will have the same characteristic if it is present in one of the twins.
The table below shows the concordance of lung cancer in identical and non-identical twins.

Type of twin	Concordance of lung cancer (%)
Identical	20
Non-identical	11

Using information in the table, comment on the relative contributions of genotype and the environment to the probability of developing lung cancer.

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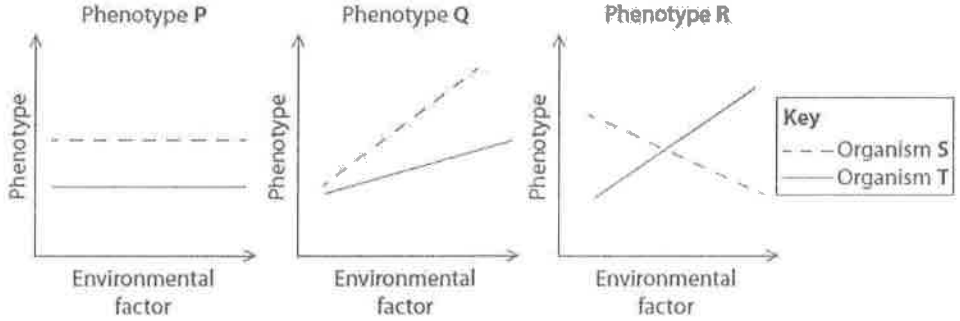
(Total for question = 6 marks)

Q9.

The phenotype of an organism can be the result of an interaction between the genotype and the environment.

(a) The graphs below show the effect of an environmental factor on three different phenotypes, **P**, **Q** and **R**.

The graphs show the effect of this factor on the phenotype of two organisms, **S** and **T**. These two organisms belong to the same species. Each organism has a different genotype.

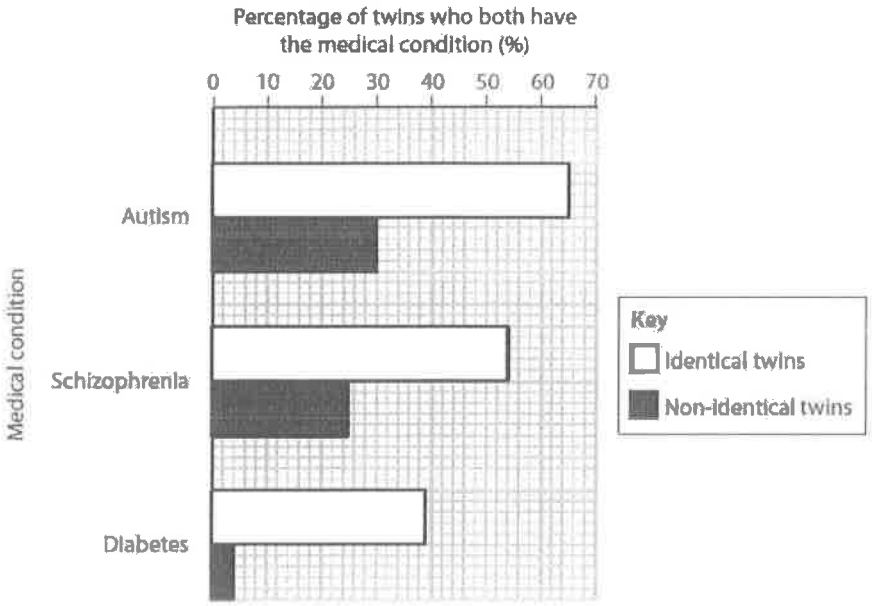


Place a cross ☒ in the box to show which phenotypes result from an interaction between the genotype and the environment.

(1)

- ☐ A P and Q
- ☐ B P and R
- ☐ C Q and R
- ☐ D P, Q and R

(b) The graph below shows three medical conditions and the percentage of identical and non-identical twins who both have the medical condition.



Place a cross ☒ in the box to complete the following sentence. The graph shows that compared with schizophrenia and diabetes, autism is affected

(1)

- ☐ **A** least by the genotype and least by the environment
- ☐ **B** least by the genotype and most by the environment
- ☐ **C** most by the genotype and least by the environment
- ☐ **D** most by the genotype and most by the environment

(c) Investigations have shown that the behaviour of a person can result from interaction between the genotype for monoamine oxidase A (MAOA) and the environment.

(i) Describe how interaction between the genotype for MAOA and the environment can affect behaviour.

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(ii) Explain why the data from these investigations is often difficult to interpret.

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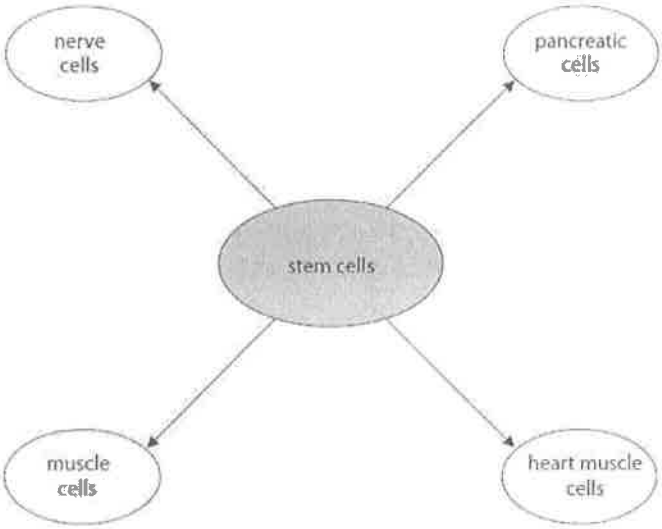
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(Total for question = 7 marks)

Q10.

Stem cells have the potential to be used in the treatment of a number of diseases.

The diagram below shows some of the cells that have been made from stem cells.



The table below shows some proteins made by these cells.

Cells	Some proteins made by these cells	
nerve cells	ATP synthase	myelin basic protein
pancreatic cells	ATP synthase	insulin
heart muscle cells	ATP synthase	myosin
muscle cells	ATP synthase	myosin

(a) Compare stem cells that are totipotent with stem cells that are pluripotent.

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*(b) Using the information in the diagram and the table, explain how the four different cell types are formed from the stem cells.

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(c) Discuss how regulatory authorities control the use of embryonic stem cells in research.

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(Total for question = 11 marks)

Q1.

Question Number	Answer	Additional Guidance	Mark
(a)(i)	**A** both meiosis and mitosis	***B** is incorrect because the DNA has to replicate before both mitosis and meiosis* ***C** is incorrect because the DNA has to replicate before both mitosis and meiosis* ***D** is incorrect because the DNA has to replicate before both mitosis and meiosis*	(1)
(a)(ii)	**B** meiosis only	***A** is incorrect because there is no prophase I in mitosis* ***C** is incorrect because crossing over there is no prophase I in mitosis* ***D** is incorrect because crossing over occurs in meiosis, prophase I*	(1)

Question Number	Answer	Additional Guidance	Mark
(b)	**C** four daughter cells with one copy of each chromosome / two daughter cells with two copies of each chromosome	***A** is incorrect because mitosis results in two daughter cells with two copies of each chromosome and meiosis results in four daughter cells with one copy* ***B** is incorrect because mitosis results in two daughter cells with two copies of each chromosome and meiosis results in four daughter cells with one copy* ***D** is incorrect because mitosis results in two daughter cells with two copies of each chromosome and meiosis results in four daughter cells with one copy*	(1)

Question Number	Answer	Additional Guidance	Mark
(c)	1. because they do not have a nucleus ; 2. because they do not have (linear) chromosomes ; 3. **meiosis** does not take place because they do not {reproduce sexually / produce gametes} ;	2. ACCEPT because they have circular DNA 3.ACCEPT **meiosis** does not take place as they reproduce by binary fission	(2)

Q2.

Question Number	Answer	Mark
(a)(i)	D eukaryotic and prokaryotic cells ;	(1)

Question Number	Answer	Mark
(a)(ii)	B - plant cells only ;	(1)

Question Number	Answer	Mark
(a)(iii)	B - eukaryotic cells only ;	(1)

Question Number	Answer	Mark
(a)(iv)	A - animal cells only ;	(1)

Question Number	Answer	Mark
(b)(i)	B - Golgi apparatus ;	(1)

Question Number	Answer	Additional Guidance	Mark
(b)(ii)	1. modification of { proteins / enzymes } ; 2. detail of modification e.g. addition of carbohydrate, production of { glycoprotein / glycolipid } ; 3. packaging of { proteins / enzymes } (by the Golgi apparatus) ; 4. idea of production of { secretory vesicles / lysosomes } ;	2. ALLOW addition of sugars or lipids, or reference to glycosylation	(3)

Q3.

Question Number	Answer	Additional Guidance	Mark
(a)	Drawing mark 1. two membranes drawn with inner membrane folded ; Labelling marks 2. outer membrane and {inner membrane / cristae} ; Any two from: 3. inter-membrane space; 4. matrix ; 5. stalked particles 6. (circular)DNA ; 7. (70S)ribosomes ;	1.IGNORE labels when assessing drawing mark 1.IGNORE shape of mitochondrion 1.IGNORE number of folds IGNORE labels of phosphate granules/lipid droplets DO NOT ACCEPT other structures including granum/stroma/thylakoid/starch grain/nucleus/cytoplasm/mesosome 2.NOT cell membrane/cell wall 2. NOT cisternae instead of cristae 2.ACCEPT double membrane/envelope 3. and 4. Need to be labelled in the correct position but no additional drawing needed 5.6. and 7. A drawing (not detailed) to represent them is needed as well as label being in correct position. (Quality of drawing is not being assessed in these marking points). 5. Drawn attached to cristae 6. and 7. Drawn in matrix and not attached to membrane	(4) EXP

Question Number	Answer	Additional Guidance	Mark
(b)	1. (loop of) DNA ; 2. (70S / small) ribosomes ;	IGNORE answers about features that they don't have 1.IGNORE plasmid /genetic material	(2) GRAD

Q4.

Question Number	Answer	Additional guidance	Mark
(a)(ii)	1. to increase the number of **primary spermatocytes**; 2. idea that large numbers of sperm cells are produced ;	1. the cells must be named 2. ACCEPT many more sperm are produced 2. ACCEPT increase the number of sperm	(2)

Question Number	Answer	Mark
(b)(i)	**The only correct answer is A – P** *B is incorrect because the acrosome is in the front of the head* *C is incorrect because the acrosome is in the front of the head* *D is incorrect because the acrosome is in the head*	(1)

Question Number	Answer	Mark
(b)(ii)	**The only correct answer is C – S** *A is incorrect because the mitochondrion is located in the neck* *B is incorrect because the mitochondrion is located in the neck* *D is incorrect because the mitochondrion is located in the neck*	(1)

Question Number	Answer	Additional guidance	Mark
(b)(iii)	1. (L=) 0.6 × 5 / 3 (μm) ; 2. (M=) 10 × 5 / 50 (μm) ; 3. (total length =) 58 (μm) ;	**Correct answer alone gains three marks**	(3)

Q5.

Question Number	Answer	Mark
(a)	B metaphase	(1)

Question Number	Answer	Additional Guidance	Mark
(c)	1. totipotent cells are {undifferentiated / unspecialised} (cells) ; 2. idea that totipotent cells can give rise to {all / any / eq} cell type ;	**2 ACCEPT** embryonic AND extra-embryonic tissues	(2)

Q6.

Question Number	Answer	Additional guidance	Mark
(a)	1. to {generate / increase / eq} genetic variation (within a species) ; 2. idea of resulting in increased survival chances (of the species) ; 3. to produce haploid {nuclei / cells} / halve the chromosome number ;	3. ACCEPT to produce gametes	(2)

Question Number	Answer	Mark
(b)(i)	The only correct answer is **D** **A** is incorrect because all the nuclei are haploid **B** is incorrect because **P** is also haploid **C** is incorrect because **S** is also haploid	(1)

Question Number	Answer	Mark
(b)(ii)	The only correct answer is **B** **A** is incorrect because the pollen tube grows through the style to reach the micropyle **C** is incorrect because the pollen lands on the stigma and then grows through the style **D** is incorrect because the pollen lands on the stigma and then grows through the style	(1)

Question Number	Answer	Additional guidance	Mark
(b)(iii)	1. (mitosis in nucleus **P**) results in two {haploid / male} nuclei ; 2. reference to **double fertilisation** ; 3. one (male) nucleus is needed to fuse with the {female gamete / egg cell / nucleus S /female nucleus} to form the zygote ; 4. one (male) nucleus is needed to fuse with {the other / polar / R} nuclei to form (primary) endosperm (nucleus) ;	ACCEPT male gametes as eq to male nuclei throughout 3. ACCEPT fertilise as eq to fuse with 4. **NOT** polar bodies	(3)

Q7.

Question Number	Answer	Additional Guidance	Mark
(a)	1. idea of producing { genetic variation / genetically varied offspring / eq } ; **OR** idea of combining { genes / alleles / chromosomes } from two parents ; 2. the diploid number (of chromosomes) is restored / eq ;	1 **ACCEPT** genetic diversity	(2)

Question Number	Answer	Additional Guidance	Mark
(b)(i)	zona pellucida ;		(1)

Question Number	Answer	Additional Guidance	Mark
(b)(ii)	1. acrosome {contains / produces} { acrosin / enzymes } ; 2. idea that if the acrosome was damaged the {follicle cells would not be moved / digestion through zona pellucida would not occur / eq} ; 3. sperm cannot {penetrate the zona pellucida / reach the secondary oocyte / fuse with seconday oocyte membrane} ; 4. nucleus (of sperm) cannot enter seconday oocyte / eq ;	**NB** At least **ONE** mark point must be in the context of what cannot happen, for three marks to be awarded 2 **ACCEPT** jelly layer 3 **ACCEPT** jelly layer egg cell 4 **ACCEPT** egg cell	(3)

Question Number	Answer	Additional Guidance	Mark
(c)	1. reference to cortical reaction ; 2. cortical granules fuse with secondary oocyte membrane / eq ; 3. cortical granules are released / eq ; 4. zona pellucida {becomes impenetrable / thickens / hardens / eq } ;	2 **ACCEPT** egg cell there will be a change in charge of the secondary oocyte membrane 4 **ACCEPT** jelly layer for z. p. **ACCEPT** fertilisation membrane will form	(3)

Q8.

Question Number	Answer	Additional Guidance	Mark
(c)(i)	1. idea that identical twins have the same genotype ; 2. idea that any differences between identical twins would be due to environmental factors ;	1. ACCEPT same alleles, NOT 'same genes' or 'same genetic material' or 'same genetic make up' or 'same DNA'	(2)

Question Number	Answer	Additional Guidance	Mark
(c)(ii)	1. both genotype and environment contribute ; 2. (evidence for genetic contribution) a higher concordance for identical than non-identical (twins) ; 3. evidence to support environmental contribution e.g. identical twins do not show 100% concordance ; 4. idea that environmental contribution is greater than genetic contribution ; 5. evidence for greater environmental contribution such as low concordance values :		(4)

Q9.

Question Number	Answer	Mark
(a)	The only correct answer is C A is not correct because Phenotype P is not affected by the environment B is not correct because Phenotype P is not affected by the environment D is not correct because Phenotype P is not affected by the environment	(1) COMP

Question Number	Answer	Mark
(b)	The only correct answer is D A is not correct because autism is affected most by the genotype and most by the environment B is not correct because autism is affected most by the genotype C is not correct because autism is affected most by the environment	(1) COMP

Question Number	Answer	Additional Guidance	Mark
(c)(i)	1. {Genotype/eq} determines levels of MAOA; 2. idea of environmental influence as {stress / maltreatment / abuse /violence/ maternal rejection / lack of continuity in people looking after child / eq} ; 3. (only) individuals with low levels of MAOA affected (by environment) / eq ; 4. interaction results in antisocial behaviour / convictions / eq ; 5. males more affected than females (by this interaction) ;	PIECE TOGETHER ANSWERS	(3) EXP

Question Number	Answer	Additional Guidance	Mark
(c)(ii)	1. behaviour is affected by other genes / polygenic inheritance/ eq ; 2. idea other environmental factors / lifestyle factors/eq may be involved;	1. ACCEPT idea that behaviour can't be easily quantified 2. ACCEPT difficult to eliminate/control other environmental factors/difficult to measure stress/abuse/eq	(2) EXP

Q10.

Question Number	Answer	Additional guidance	Mark
(a)	1. both {divide indefinitely / are unspecialised / eq} ; 2. idea that totipotent stem cells can become all cell types but pluripotent stem cells can become {many / most} cell types ;	**Piece together answers if necessary** 1.ACCEPT undifferentiated 1.ACCEPT no Hayflick limit 2. ACCEPT totipotent can give rise to all cells, pluripotent cannot give rise to placental / extraembryonic cells	(2)

Question Number	Answer	Additional guidance	Mark
(b)	1. mitosis to increase number of cells / eq ; 2. idea of responding to {chemical / environmental} stimulus ; 3. reference to **differential gene expression** ; 4. credit example from question of genes switched on ; 5. credit example from question of genes switched off ; 6. idea of {transcription / mRNA produced} at active genes ; 7. {proteins / polypeptides / eq} produced (from this mRNA) ; 8. idea that this protein (permanently) modifies cell **OR** idea that this protein determines {cell structure / function } ;	**QWC focus on clarity of expression** 2.**ACCEPT** hormone / external stimulus 4. e.g. gene for production of insulin switched on in pancreatic cells 5. e.g. gene for production of insulin switched off in nerve cells / muscle cells / heart muscle cells 7. **ACCEPT** mRNA is translated	(6)

Question Number	Answer	Additional guidance	Mark
(c)	1. idea they {monitor research / ensure research is necessary} ; 2. idea that they issue licences (for stem cell research); 3. idea they monitor sources of stem cells ; 4. ensure that only early stage embryos are used (as sources of stem cells) ; 5. prevent unethical use of stem cells ;	1. **ACCEPT** to ensure experiments are not unnecessarily repeated 2.**ACCEPT** idea of giving permission for the research 2.**ACCEPT** idea that guidelines are adhered to 4. in the UK this is up to 14 days 4. **ACCEPT** to determine the maximum age of embryos that can be used 5. e.g. human cloning, genetic manipulation 5.IGNORE designer babies, playing God, right to life	(3)