

BIOWELSH WORKSHEET FOR WJEC GCE A LEVEL BIOLOGY
UNIT 4 – VARIATION, INHERITANCE AND OPTIONS
TOPIC 4.1 HUMAN REPRODUCTION: WORKSHEET 1 (BW-A2-4.1-W1) MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Mark in red ink. One tick equals one mark, except in the extended response question, where a level of response scheme is used.

Write each question total in the box at the end of the question, and copy the totals onto the grid on the front cover of the worksheet. Add them to give the worksheet total out of 132.

Marking rules

Look at all of the work. Where the scheme says working is needed, the working must be seen. Mark crossed-out work if it has not been replaced. Give credit for correct, relevant answers that are not listed in the scheme.

Extended response question

Read the whole answer first. Decide which level descriptor fits the answer best, judging the overall quality. Then choose the mark within the level: the top mark when the answer matches both the content and the communication statements well, the middle mark when most of the content is there and the communication statement is partly met, and the bottom mark when only the content statements are matched.

Marking abbreviations

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt
ORA = or reverse argument
owtte = or words to that effect

Notation: / separates alternatives; { } groups alternatives within a point; words in () are not needed for the mark; underlined words are essential; (1) is one mark.

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)			P epididymis (1) Q urethra (1)	2			2		
	(b)			Stores spermatozoa / spermatozoa mature and become motile there (1)	1			1		
	(c)			Fructose is a respiratory substrate for the spermatozoa (1) Respired in the mitochondria of the midpiece to release energy / ATP for the tail to beat / swimming (1)		2		2		
	(d)			The vagina is acidic (1) The alkaline fluid neutralises the acid, which would otherwise damage / denature proteins in the spermatozoa / reduce their motility (1)			2	2		
	(e)			The seminal vesicles and prostate gland are beyond the cut, so they still add fluid / semen (1) Spermatozoa cannot pass from the testes / epididymis beyond the cut, so the semen contains no spermatozoa (1)		2		2		
				Question 1 total	3	4	2	9	0	0

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)			A interstitial cells / cells of Leydig; B spermatogonia; C primary spermatocytes; D spermatids All four correct = 2 marks Two or three correct = 1 mark	2			2		1
	(b)			Sertoli cell (1) Any two (×1) from: - Provides nutrients to the developing spermatozoa (1) - Protects them / forms a barrier from the blood and the immune system (1) - Phagocytoses the cytoplasm lost by spermatids (1) - Secretes fluid that carries spermatozoa along the tubule (1)	3			3		
	(c)			Mature spermatozoa / sperm tails in the lumen (1) Cells mature as they move from the outside / basement membrane towards the lumen, so the most mature are released there (1)		2		2		
	(d)			Testosterone is a hormone, so it is secreted into the blood to reach other target organs (1) Being between the tubules, it also diffuses into the tubules to stimulate spermatogenesis (1)			2	2		
				Question 2 total	5	2	2	9	0	1

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)			J mitosis; K meiosis I (first meiotic division); L meiosis II (second meiotic division) All three correct = 2 marks Two correct = 1 mark	2			2		
	(b)			46, 23, 23 All three correct = 2 marks Two correct = 1 mark		2		2		
	(c)			200 (1)		1		1	1	
	(d)			At fertilisation two gametes fuse (1) So the zygote is diploid / has 46 chromosomes and the chromosome number stays constant from generation to generation (1)	2			2		
	(e)			16 (1) Independent assortment: each pair of homologous chromosomes lines up independently in meiosis I, so there are 2^4 combinations (1)		1	1	2	1	
				Question 3 total	4	4	1	9	2	0

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)			A (primary / secondary) oocyte; B zona pellucida; C follicle / granulosa cells; D fluid-filled cavity / antrum (follicular fluid) All four correct = 2 marks Two or three correct = 1 mark	2			2		1
	(b)			105 (µm) (2) Award 1 mark for 42 000 ÷ 400 / 42 mm converted to 42 000 µm		2		2	2	1
	(c)			Graafian follicle (1) Ovulation (1)	2			2		
	(d)			Corpus luteum (1) Progesterone (1) Accept progesterone and oestrogen	2			2		
	(e)			They supply nutrients / signals / hormones to the growing oocyte, which has no blood supply of its own (1)			1	1		
				Question 4 total	6	2	1	9	2	2

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)			The primary oocyte completes meiosis I (just before ovulation) (1) The division is unequal: the secondary oocyte gets most of the cytoplasm and a small first polar body is formed (1) Meiosis II is completed only if / when a spermatozoon enters (at fertilisation) (1)	3			3		
	(b)			So the secondary oocyte / ovum keeps a large amount of cytoplasm / food reserves / organelles to support the zygote / early embryo (1)			1	1		
	(c)			495 (2) Award 1 mark for $38 \times 365 = 13\,870$ days / $13\,870 \div 28 = 495.4$		2		2	2	
	(d)			0.050 / 0.05 (%) (1) $495 \div 1\,000\,000 \times 100$; allow ecf from (c)		1		1	1	
	(e)			They degenerate / die / are broken down without being released (atresia) (1)			1	1		
	(f)			Any two ($\times 1$) from: - Spermatogenesis produces four functional gametes from each primary cell; oogenesis produces one (plus polar bodies) (1) - Spermatogenesis is continuous from puberty; oogenesis starts before birth and is cyclical / stops at menopause (1) - Meiosis is completed in the testis; oogenesis stops at metaphase II until fertilisation (1) - Divisions are equal in spermatogenesis; unequal in oogenesis (1) - Millions of spermatozoa a day compared with one oocyte a month (1)	2			2		
				Question 5 total	5	3	2	10	3	0

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)			A acrosome: contains (hydrolytic) enzymes that digest the zona pellucida (1) C midpiece with mitochondria: aerobic respiration releases ATP for the tail (1) D tail / flagellum: beats to move the spermatozoon towards the oocyte (1) 1 mark for each correct row: name and function both needed	3			3		
	(b)			0.97 / 1.0 (hours) (2) Award 1 mark for $175 \div 3 = 58.3$ minutes		2		2	2	
	(c)			No enzymes are released in the acrosome reaction (1) So the spermatozoon cannot digest a path through the follicle cells / zona pellucida and cannot reach / fuse with the oocyte membrane (1)		2		2		
				Question 6 total	3	4	0	7	2	0

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)			Any four (×1) from: • Acrosome reaction: acrosome membrane fuses with the plasma membrane and releases enzymes (1) • Enzymes digest a path through the zona pellucida (1) • Membrane of the spermatozoon fuses with the membrane of the secondary oocyte; the head / nucleus enters (1) • Cortical reaction: cortical granules release enzymes that make the zona pellucida thicken / harden into a fertilisation membrane (1) • The secondary oocyte completes meiosis II, forming the ovum and a second polar body (1) • Male and female haploid nuclei fuse to form a diploid zygote (1)	4			4		
	(b)			Prevents more than one spermatozoon entering / polyspermy (1) Otherwise the zygote would have too many chromosomes / be triploid, and would not develop normally (1)		2		2		
	(c)			The blastocyst sinks into / attaches to the endometrium (uterus lining) (1) The outer layer / trophoblast cells secrete enzymes that digest the endometrium and grow villi into it (1) It begins to secrete hCG / receives nutrients from the endometrium; the placenta forms here (1)	2	1		3		
	(d)			Cilia beat to move the zygote / embryo along the oviduct to the uterus (1) If cilia are damaged, it moves too slowly and reaches the blastocyst stage before arriving in the uterus, so it implants in the oviduct wall (1)			2	2		
				Question 7 total	6	3	2	11	0	0

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
8	(a)			Anterior pituitary (gland) (1) Reject posterior pituitary	1			1		
	(b)			Day 14 (1) The LH surge / peak in LH concentration triggers ovulation (1)		2		2		
	(c)			Oestrogen from the developing follicle rises to a high concentration / peak at day 13 (1) High oestrogen stimulates the anterior pituitary to release (more) LH (1) This is positive feedback, producing the LH surge (1)		3		3		
	(d)			Progesterone (and oestrogen) from the corpus luteum are high (1) They inhibit the release of FSH and LH from the anterior pituitary / negative feedback, so no new follicles develop (1)		2		2		
	(e)			The corpus luteum degenerates (because LH is low and there is no hCG), so progesterone falls (1) The endometrium is no longer maintained and breaks down, so menstruation starts at the end of the cycle (1)		1	1	2		
				Question 8 total	1	8	1	10	0	0

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
9	(a)			36.71 (°C) (1) Accept 36.7		1		1	1	
	(b)			Ovulation occurred at about day 14 (1) The corpus luteum formed and secreted progesterone, which raises body temperature (1)		2		2		
	(c)			She did not become pregnant (1) The corpus luteum degenerated so progesterone fell; in pregnancy hCG would maintain the corpus luteum and progesterone would stay high (1)			2	2		
	(d)			Any two (×1) from: - The rise is only seen after ovulation has already happened (1) - The change is very small (0.3 °C), so errors in measuring are significant (1) - Temperature is affected by illness / alcohol / sleep / time of waking (1) - Cycles vary in length, so the day of ovulation varies from cycle to cycle (1)			2	2		2
				Question 9 total	0	3	4	7	1	2

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
10	(a)			Axes correct way round with labels and units: x = weeks after fertilisation; y = hCG / thousand units dm^{-3} (1) Suitable linear scales using more than half of the grid (1) All ten points plotted correctly $\pm$ half a small square (1) Points joined with ruled straight lines (1)		2	2	4	4	4
	(b)			Produced by the embryo / trophoblast / chorion / placenta (1) hCG maintains the corpus luteum (1) So the corpus luteum keeps secreting progesterone, which maintains the endometrium and prevents menstruation (1)	3			3		
	(c)			The placenta has developed and now secretes progesterone (and oestrogen) itself (1) So the corpus luteum is no longer needed to maintain the endometrium (1)			2	2		
				Question 10 total	3	2	4	9	4	4

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
11	(a)			X maternal / mother's blood; Y fetal / foetus's blood (1) Both needed		1		1		1
	(b)			Many villi give a large surface area (1) Thin layer / few cells between the blood of mother and foetus gives a short diffusion distance (1) Maternal blood flows around the villi and fetal blood flows through them, maintaining concentration gradients (1)	1	2		3		
	(c)			Two from: carbon dioxide / urea / water / hormones (1) Both needed	1			1		
	(d)	(i)		21 (%) (1) Accept 17 to 25 from readings (fetal about 78 %, adult about 57 %)		1		1	1	
		(ii)		Fetal haemoglobin has a higher affinity for oxygen than adult haemoglobin (1) So at the low partial pressure in the placenta, oxygen dissociates from the mother's haemoglobin and is loaded by the foetus's haemoglobin (1)		2		2		
				Question 11 total	2	6	0	8	1	1

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
12	(a)			Their blood groups / antigens may be different, so the mother's antibodies could agglutinate / destroy fetal red blood cells (1) The mother's blood pressure is much higher and would damage the fetal blood vessels (1)	2			2		
	(b)			By pinocytosis / endocytosis (not by diffusion, as they are large molecules) (1) They give passive immunity to diseases the mother is immune to, while the baby's immune system develops (1)		1	1	2		
	(c)			Alcohol / ethanol is a small, lipid-soluble molecule, so it diffuses through the membranes of the placental cells (1)			1	1		
	(d)			Early in pregnancy, progesterone is secreted by the corpus luteum in the ovary (maintained by hCG) (1) Removing the ovaries then removes the source of progesterone, so the endometrium breaks down and the embryo is lost (1) Later the placenta secretes enough progesterone and oestrogen itself to maintain the endometrium, so the ovaries are not needed (1)		1	2	3		
				Question 12 total	2	2	4	8	0	0

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
13	(a)			Posterior pituitary (gland) (1) Reject anterior pituitary	1			1		
	(b)			Progesterone inhibits contraction of the muscle of the uterus (myometrium) during pregnancy (1) When it falls, the uterus can respond to oxytocin and contract (oestrogen increases its sensitivity) (1)	1	1		2		
	(c)			The number of contractions increases as the rate of infusion increases (1) Increase is steep up to about 8 mU minute ⁻¹ then levels off at about 4.4 contractions per 10 minutes (1)		2		2		
	(d)			There is little further increase in contractions above this rate (1) Too frequent / strong contractions could reduce the blood supply to the placenta / foetus / cause distress; higher doses add risk with no benefit (1)			2	2		
	(e)			The response (contraction) increases the size of the original stimulus (stretching of the cervix) (1) Which releases more oxytocin, so contractions become stronger and more frequent until the baby is born (1)		2		2		
				Question 13 total	2	5	2	9	0	0

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
14	(a)			340 (%) (2) Award 1 mark for $(185 - 42) \div 42 \times 100$ Accept 330 to 350 from readings		2		2	2	
	(b)			Suckling stimulates receptors / nerve endings in the nipple, which send impulses to the hypothalamus (1) The anterior pituitary is stimulated to release (more) prolactin (1)		2		2		
	(c)			Prolactin: stimulates milk production / secretion by the mammary glands (1) Oxytocin: stimulates milk ejection / release, by contraction of muscle cells around the milk glands (1)	2			2		
	(d)			High progesterone (and oestrogen) from the placenta inhibit milk production during pregnancy (1) When the placenta is delivered, their concentrations fall, so prolactin can stimulate milk production (1)			2	2		
				Question 14 total	2	4	2	8	2	0

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
15				Indicative content	3	3	3	9		
				A FSH and LH in a natural cycle A1 FSH from the anterior pituitary stimulates the development of follicles in the ovary A2 Developing follicles secrete oestrogen, which repairs / thickens the endometrium A3 Oestrogen inhibits FSH (negative feedback), so normally only one follicle matures A4 High oestrogen stimulates an LH surge (positive feedback) A5 The LH surge causes ovulation (about day 14) and the formation of the corpus luteum A6 LH maintains the corpus luteum, which secretes progesterone						
				B The IVF stages and Graph 15.1 B1 Daily FSH makes several follicles develop at the same time, so several oocytes can be collected B2 Oestradiol rises from about 200 to 5400 pmol dm ⁻³ because many follicles are secreting oestrogen B3 The increase speeds up as follicles grow; very high values show many follicles B4 hCG acts like the LH surge, so the oocytes complete maturation (meiosis I) ready for release B5 Oocytes are collected before ovulation would occur (about 36 hours), so they are not lost into the body cavity B6 Fertilisation in the laboratory and culture to a blastocyst lets embryos be checked before transfer						

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				C Implantation and maintaining pregnancy C1 The endometrium must be thick and well supplied with blood, maintained by progesterone C2 Trophoblast cells secrete enzymes and villi grow into the endometrium C3 The embryo secretes hCG, which maintains the corpus luteum so progesterone stays high C4 High progesterone prevents menstruation and inhibits FSH and LH, so no further ovulation C5 The placenta develops and takes over secretion of progesterone and oestrogen (from about week 10 to 12) C6 Progesterone may be given as a supplement after IVF because the corpus luteum can be weak						
				7-9 marks Indicative content of this level is detailed information from all three lists. The candidate constructs an articulate, integrated account, correctly linking relevant points in a logical sequence. The answer fully addresses the question with no irrelevant inclusions or significant omissions. Scientific conventions and vocabulary are used appropriately and accurately.						
				4-6 marks Indicative content of this level is detailed information from two of the lists, or less detail from all three. The candidate constructs an account correctly linking some relevant points, showing some reasoning. The answer addresses the question with some omissions. Scientific conventions and vocabulary are usually used appropriately and accurately.						
				1-3 marks Indicative content of this level is some information from at least one of the lists, or a little information from more than one. The candidate makes some relevant points, showing limited reasoning. The answer addresses the question with significant omissions. Use of scientific conventions and vocabulary is limited.						

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				0 marks The candidate does not make any attempt or give a relevant answer worthy of credit.						
				Question 15 total	3	3	3	9	0	0

UNIT 4: VARIATION, INHERITANCE AND OPTIONS, TOPIC 4.1
SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	3	4	2	9	0	0
2	5	2	2	9	0	1
3	4	4	1	9	2	0
4	6	2	1	9	2	2
5	5	3	2	10	3	0
6	3	4	0	7	2	0
7	6	3	2	11	0	0
8	1	8	1	10	0	0
9	0	3	4	7	1	2
10	3	2	4	9	4	4
11	2	6	0	8	1	1
12	2	2	4	8	0	0
13	2	5	2	9	0	0
14	2	4	2	8	2	0
15	3	3	3	9	0	0
TOTAL	47	55	30	132	17	10



A Tutor Meets Tutee project

BioWelsh mark scheme BW-A2-4.1-W1 (MS). Not an official WJEC mark scheme.

