

BIOWELSH WORKSHEET FOR WJEC GCE A LEVEL BIOLOGY
UNIT 4 – VARIATION, INHERITANCE AND OPTIONS
TOPIC 4.2 PLANT REPRODUCTION: WORKSHEET 1 (BW-A2-4.2-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 145.

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)			A stigma; B anther; C filament; D ovule; E nectary; F sepal All six correct = 3 marks Four or five correct = 2 marks Two or three correct = 1 mark	3			3		1
	(b)			E secretes nectar / sugar solution which attracts insects / pollinators (as a food reward) (1) F protects the flower when it is in bud (1)	2			2		
	(c)			They are inside the flower / near the centre (above the nectary) (1) So an insect reaching for nectar brushes against the anthers and picks up pollen, and touches the stigma, depositing pollen from another flower (1)		2		2		
	(d)			Any two (×1) from: • Cut on a white tile / cutting mat, cutting away from the fingers / body (1) • Hold the flower with forceps, not the fingers (1) • Remove the parts from the outside inwards, one whorl at a time (1) • Use a hand lens to see small parts such as the stigma and anthers (1) • Arrange / stick the parts in rings on card and count the parts in each whorl (1)			2	2		2
				Question 1 total	5	2	2	9	0	3

Question				Marking details	Marks available																	
					AO1	AO2	AO3	Total	Maths	Prac												
2	(a)			P anther and Q filament (1) Both needed	1			1														
	(b)			Any two (×1) from: - Long (flexible) filaments / anthers hang outside the flower so pollen is shaken out by the wind (1) - Flowers are held high on a long stalk above the other plants, in the wind (1) - Petals are small / not brightly coloured, so they do not block the anthers or stigmas; no need to attract insects (1) - Anthers are large, producing large amounts of pollen (1)		2		2														
	(c)			Small and light / wind; larger and heavier / insect (1) Smooth / dry / wind; sculptured / spiky / sticky / insect (1) Very large amounts / wind; smaller amounts / insect (1) 1 mark for each correct row: both columns needed Example of a full-mark answer<table><tr><th>Feature</th><th>Wind-pollinated</th><th>Insect-pollinated</th></tr><tr><td>Size and mass of pollen grain</td><td>small and light</td><td>larger and heavier</td></tr><tr><td>Surface of pollen grain</td><td>smooth and dry</td><td>sculptured, spiky or sticky</td></tr><tr><td>Amount of pollen made</td><td>very large amounts</td><td>smaller amounts</td></tr></table>	Feature	Wind-pollinated	Insect-pollinated	Size and mass of pollen grain	small and light	larger and heavier	Surface of pollen grain	smooth and dry	sculptured, spiky or sticky	Amount of pollen made	very large amounts	smaller amounts	3			3		
Feature	Wind-pollinated	Insect-pollinated																				
Size and mass of pollen grain	small and light	larger and heavier																				
Surface of pollen grain	smooth and dry	sculptured, spiky or sticky																				
Amount of pollen made	very large amounts	smaller amounts																				
	(d)			The stigma of a flower is receptive before its own anthers release pollen / the male and female parts mature at different times (1) So the stigma receives pollen from a different plant (the upper flowers on a spike are female when the lower ones are shedding pollen and pollen is carried upwards away from them by the wind) (1)		2		2														

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(e)			Increases genetic variation / mixes alleles from different plants / prevents inbreeding / homozygosity (1) So some offspring are more likely to survive / adapt to a changing environment / new conditions (1)	2			2		
				Question 2 total	6	4	0	10	0	0

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)			A fibrous layer; B tapetum; C pollen grain; D vascular bundle All four correct = 2 marks Two or three correct = 1 mark	2			2		1
	(b)			Provides nutrients to the developing pollen grains / pollen mother cells (1) Accept provides materials for the outer wall of the pollen grain	1			1		
	(c)			The cells of the fibrous layer lose water / dry out and shrink unevenly (1) This sets up tension that pulls the wall apart at the line of dehiscence (where the wall is thin) (1)		2		2		
	(d)	(i)		Pollen mother cell (1) Meiosis (1) Reject mitosis	2			2		
		(ii)		12 (1)		1		1	1	
		(iii)		Mitosis (1) Generative nucleus and tube nucleus (1) Both nuclei needed for the second mark		2		2		
				Question 3 total	5	5	0	10	1	1

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)			Any two (×1) from: - Only the outlines of tissues / tissue boundaries are drawn (1) - No individual cells are drawn (1) - Single, continuous / clear lines with no shading (1) - Proportions of the tissues are kept the same as on the slide (1)		2		2		2
	(b)	(i)		1200 (µm) (2) Award 1 mark for 1 eyepiece unit = 25 µm / 2500 ÷ 100		2		2	2	1
		(ii)		× 100 (2) Award 1 mark for 120 000 ÷ 1200 / 120 mm converted to 120 000 µm Allow ecf from (b)(i)		2		2	2	1
		(iii)		The eyepiece graticule stays the same size while the specimen is magnified more (1) So each eyepiece unit represents a smaller distance on the slide (1)			2	2		1
	(c)			Measure several / at least five anthers (from different flowers) and calculate a mean (1)			1	1	1	1
				Question 4 total	0	6	3	9	5	6

Question				Marking details	Marks available															
					AO1	AO2	AO3	Total	Maths	Prac										
5	(a)			J ovary wall; K locule / cavity of the ovary; L ovule All three correct = 2 marks Two correct = 1 mark	2			2		1										
	(b)	(i)		P meiosis (1) Q mitosis (1)	2			2												
		(ii)		24, 12, 12, 12 All four correct = 2 marks Two or three correct = 1 mark Example of a full-mark answer<table><tr><th>Cell or nucleus</th><th>Number of chromosomes</th></tr><tr><td>megaspore mother cell</td><td>24</td></tr><tr><td>one megaspore</td><td>12</td></tr><tr><td>egg cell (female gamete)</td><td>12</td></tr><tr><td>one polar nucleus</td><td>12</td></tr></table>	Cell or nucleus	Number of chromosomes	megaspore mother cell	24	one megaspore	12	egg cell (female gamete)	12	one polar nucleus	12		2		2	1	
Cell or nucleus	Number of chromosomes																			
megaspore mother cell	24																			
one megaspore	12																			
egg cell (female gamete)	12																			
one polar nucleus	12																			
		(iii)		Any three (×1) from: - Egg cell / female gamete at the micropyle end (1) - Two synergids beside the egg cell / at the micropyle end (1) - Two polar nuclei in the centre (1) - Three antipodal cells at the opposite end from the micropyle / chalazal end (1) Name and position both needed for each mark	3			3												
	(c)			One pollen mother cell gives four pollen grains, but a megaspore mother cell gives only one functional megaspore (three degenerate) (1)		1		1												
				Question 5 total	7	3	0	10	1	1										

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)			Self-pollination: transfer of pollen from an anther to a stigma of the same flower / same plant (1) Cross-pollination: transfer of pollen from an anther of one plant to a stigma of a different plant of the same species (1)	2			2		
	(b)			57.0 (%) (2) Award 1 mark for $(14.2 - 6.1) \div 14.2 \times 100$ Must be to 1 decimal place for 2 marks		2		2	2	
	(c)			To show whether the plants can produce pods / seeds by self-pollination (1) It separates the effect of the type of pollen from the effect of the bag / handling, as group 3 was bagged like group 4 (1)			2	2		2
	(d)			Groups 1 and 4 (cross-pollinated) have more than twice as many pods as groups 2 and 3 (self-pollinated) / 14.2 and 14.8 compared with 6.1 and 7.0 (1) Bees carry pollen from other plants, so they cross-pollinate the flowers (1) Cross-pollination gives more fertilised ovules / more seeds per pod (3.4 to 3.6 compared with 2.9 to 3.0) (1)		1	2	3		
	(e)			Seeds can still be produced when pollinators are absent / rare / in bad weather / in a new area with no other plants of the species (1) Accept keeps a successful / well-adapted combination of alleles			1	1		
				Question 6 total	2	3	5	10	2	2

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)			510 (1) Accept 510.0		1		1	1	
	(b)			4.25 / 4.3 ($\mu\text{m minute}^{-1}$) (2) Award 1 mark for $510 \div 120$ Allow ecf from (a)		2		2	2	
	(c)	(i)		The water potential of the solution is lower / more negative than that of the pollen (1) Water leaves the pollen by osmosis, so it cannot take up water / swell to push out the tube (1)			2	2		
		(ii)		Any two ($\times 1$) from: - Source / species / age of the pollen (1) - Volume of the drop of solution (1) - Time before measuring (1) - Light intensity / humidity (1) - Method of measuring / same magnification (1)			2	2		2
	(d)			The tube nucleus controls the growth of the tube / synthesis of the (hydrolytic) enzymes that digest the style (1) The male nuclei travel down the tube to the embryo sac for (double) fertilisation (1)	2			2		
				Question 7 total	2	3	4	9	3	2

Question				Marking details	Marks available													
					AO1	AO2	AO3	Total	Maths	Prac								
8	(a)			A pollen tube; B micropyle; C (outer) integument; D egg cell / female gamete; E polar nuclei; F antipodal cells All six correct = 3 marks Four or five correct = 2 marks Two or three correct = 1 mark Reject ovum / egg for D	3			3										
	(b)			The tip of the pollen tube bursts and releases the two male nuclei into the embryo sac (1) One male nucleus fuses with the egg cell / D to form a diploid zygote (1) The second male nucleus fuses with the two polar nuclei / E to form a triploid (primary) endosperm nucleus (1) Reject ovum	3			3										
	(c)			10, 20, 30 All three correct = 2 marks Two correct = 1 mark Example of a full-mark answer<table><tr><td>Cell or nucleus</td><td>Number of chromosomes</td></tr><tr><td>male nucleus</td><td>10</td></tr><tr><td>zygote</td><td>20</td></tr><tr><td>endosperm nucleus</td><td>30</td></tr></table>	Cell or nucleus	Number of chromosomes	male nucleus	10	zygote	20	endosperm nucleus	30		2		2		
Cell or nucleus	Number of chromosomes																	
male nucleus	10																	
zygote	20																	
endosperm nucleus	30																	
	(d)			Pericarp: ovary wall (1) Endosperm: polar nuclei / E (after fusion with a male nucleus) (1)		2		2										
				Question 8 total	6	4	0	10	0	0								

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
9	(a)			A testa; B hilum; C micropyle; D cotyledon; E plumule; F radicle All six correct = 3 marks Four or five correct = 2 marks Two or three correct = 1 mark	3			3		
	(b)			The endosperm has been absorbed / used up during seed development (1) The food store is in the cotyledons (1)	1	1		2		
	(c)			105 (%) (2) Award 1 mark for $(3.28 - 1.60) \div 1.60 \times 100$		2		2	2	
	(d)			Water enters through the micropyle, the seed swells and the testa splits / softens (1) Water activates enzymes / allows hydrolysis of stored food / provides a solvent for transport of soluble products to the growing regions (1)		2		2		
				Question 9 total	4	5	0	9	2	0

Question				Marking details	Marks available														
					AO1	AO2	AO3	Total	Maths	Prac									
10	(a)			A pericarp (fused with testa) / fruit wall; B aleurone layer; C endosperm; D scutellum / cotyledon; E plumule / coleoptile; F radicle / coleorhiza All six correct = 3 marks Four or five correct = 2 marks Two or three correct = 1 mark	3			3											
	(b)			Its outer layer is the pericarp, which develops from the ovary wall (1) A fruit is a fertilised ovary containing the seed; in maize the testa is fused to the pericarp and the ovary contains one seed (1)		2		2											
	(c)			Main food store: endosperm (maize); cotyledons (broad bean) (1) Number of cotyledons: one (maize); two (broad bean) (1) Example of a full-mark answer<table><tr><td>Feature</td><td>Maize grain</td><td>Broad bean seed</td></tr><tr><td>Main food store</td><td>endosperm</td><td>cotyledons</td></tr><tr><td>Number of cotyledons</td><td>one</td><td>two</td></tr></table>	Feature	Maize grain	Broad bean seed	Main food store	endosperm	cotyledons	Number of cotyledons	one	two	2			2		
Feature	Maize grain	Broad bean seed																	
Main food store	endosperm	cotyledons																	
Number of cotyledons	one	two																	
	(d)			Each kernel develops from a separate ovule, fertilised by a different pollen grain (1) Pollen grains are genetically different as they are formed by meiosis / may come from different plants (1) The endosperm contains a male nucleus, so its genotype / colour depends on the allele carried by that pollen grain (as well as the two polar nuclei) (1)			3	3											
				Question 10 total	5	2	3	10	0	0									

Question				Marking details	Marks available																																
					AO1	AO2	AO3	Total	Maths	Prac																											
11	(a)			Axes correct way round, labelled with units: x = time / days; y = dry mass / g (1) Suitable linear scales using more than half of the grid (1) All points plotted correctly $\pm$ half a small square (1) Points joined with ruled straight lines and the two lines identified / key (1) Example of a full-mark answer <table><caption>Data points for Example of a full-mark answer</caption><thead><tr><th>Time / days</th><th>Cotyledons Dry mass / g</th><th>Embryo axis Dry mass / g</th></tr></thead><tbody><tr><td>0</td><td>1.4</td><td>0.0</td></tr><tr><td>2</td><td>1.35</td><td>0.02</td></tr><tr><td>4</td><td>1.3</td><td>0.05</td></tr><tr><td>6</td><td>1.15</td><td>0.1</td></tr><tr><td>8</td><td>0.95</td><td>0.2</td></tr><tr><td>10</td><td>0.8</td><td>0.3</td></tr><tr><td>12</td><td>0.65</td><td>0.4</td></tr><tr><td>14</td><td>0.5</td><td>0.5</td></tr></tbody></table>	Time / days	Cotyledons Dry mass / g	Embryo axis Dry mass / g	0	1.4	0.0	2	1.35	0.02	4	1.3	0.05	6	1.15	0.1	8	0.95	0.2	10	0.8	0.3	12	0.65	0.4	14	0.5	0.5		2	2	4	4	4
Time / days	Cotyledons Dry mass / g	Embryo axis Dry mass / g																																			
0	1.4	0.0																																			
2	1.35	0.02																																			
4	1.3	0.05																																			
6	1.15	0.1																																			
8	0.95	0.2																																			
10	0.8	0.3																																			
12	0.65	0.4																																			
14	0.5	0.5																																			
	(b)			To remove all the water, as the water content changes during germination and would hide changes in organic matter (1)			1	1		1																											

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)			Stored starch / protein in the cotyledons is hydrolysed (by amylase / protease) to maltose / sugars / amino acids (1) These are transported to the embryo axis / growing regions (plumule and radicle) (1) Where they are used to make new cells / cell walls / proteins for growth, so the axis gains dry mass (1)		3		3		
	(d)			0.38 (g) (1) Used in (aerobic) respiration / released as carbon dioxide, as the seedling cannot photosynthesise in the dark (1)		1	1	2		
				Question 11 total	0	6	4	10	4	5

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
12	(a)			Boiling removes dissolved oxygen (1) The oil stops oxygen from the air dissolving in the water again (1)			2	2		1
	(b)			Oxygen is needed for aerobic respiration, releasing ATP / energy for growth / cell division (1) Group E shows 0 % without oxygen (1) A low temperature (group D, 6 %) slows / stops enzyme activity / the hydrolysis of food stores, as molecules have less kinetic energy (1)	1	2		3		
	(c)			The difference between A (92 %) and C (90 %) is only 2 % / one seed, so it is probably due to chance / not significant (1) Light is not needed for germination; the experiment would need to be repeated / a statistical test used before a conclusion is made (1)			2	2		1
	(d)			Anchors the seedling in the soil (1) Absorbs water (and mineral ions) needed for further growth before the shoot emerges (1)	2			2		
				Question 12 total	3	2	4	9	0	2

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
13	(a)			Amylase is secreted by the grain and diffuses into the agar (1) It hydrolyses starch to maltose, so no blue-black colour forms with iodine (1)		2		2		
	(b)	(i)		25 (mm) / grain 3 on day 3 (1) 14.5 (1) Reject 18.0 (anomaly included)		1	1	2	1	1
		(ii)		380 (mm ²) (2) Award 1 mark for $r = 11 \text{ mm} / \pi \times 11^2 = 380.1$ Must be to 3 significant figures for 2 marks		2		2	2	
	(c)			Half-grains that have been boiled (and cooled) / starch agar with no grains / grains killed by heat (1) To show that the clear zones are caused by (active) enzymes from the living grains, not by the grain itself / handling (1)			2	2		2
	(d)			Water taken up activates the embryo, which secretes gibberellin (1) Gibberellin diffuses to the aleurone layer (1) It switches on / induces the synthesis of amylase, so more amylase is made the longer the grain germinates (1)		3		3		
	(e)			Clear zones may not be circular / edges are not sharp, so diameters are hard to measure / zones may overlap / half-grains differ in size (1)			1	1		1
				Question 13 total	0	8	4	12	3	4

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
14	(a)			283 (%) (2) Award 1 mark for $(46 - 12) \div 12 \times 100$ Accept 283.3 / 280		2		2	2	
	(b)			Stem length increases as the concentration increases, from 12 cm to 47 cm, levelling off above 1 mg dm^{-3} (1) Gibberellin causes elongation of the internodes / stem by stimulating cell elongation / cell division (1) The sprayed gibberellic acid replaces the gibberellin the dwarf plants cannot make (1)		2	1	3		
	(c)			The tall variety already makes enough / normal amounts of gibberellin, so the response is already at its maximum (1)			1	1		
	(d)			The effective concentration was not known, so a wide range was needed (1) A ten-fold series covers a large range with few groups / shows the concentration at which the response levels off (1)			2	2		2
	(e)			Stimulates the aleurone layer to synthesise / secrete amylase (and protease) (1)	1			1		
				Question 14 total	1	4	4	9	2	2

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
15				Indicative content	3	3	3	9		
				A Wind pollination and producing hybrid seed A1 Tassels (anthers) held high at the top of the plant, exposed to the wind A2 Anthers hang on long filaments and release large amounts of small, light, smooth pollen A3 Long, feathery / silky stigmas and styles hang outside the cob to trap pollen from the air A4 No large, coloured petals, scent or nectar A5 Removing the tassels means these plants produce no pollen, so they cannot self-pollinate A6 Their silks can only receive pollen from the other line, so every grain is from cross-pollination / hybrid						
				B Double fertilisation B1 Pollen grain lands on the silk / stigma and grows a pollen tube down the style B2 Tube nucleus controls growth; hydrolytic enzymes digest a path B3 Tube enters the ovule through the micropyle and releases two male nuclei into the embryo sac B4 One male nucleus fuses with the egg cell to form a diploid zygote B5 The other fuses with the two polar nuclei to form a triploid endosperm nucleus						

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				C Grain development (Graph 15.1) and germination C1 Little change in the first 10 days, then endosperm dry mass rises rapidly from about 5 mg to 215 mg between days 10 and 40 C2 Endosperm levels off at about 250 mg by day 50 to 60; the embryo increases slowly to about 30 mg C3 The endosperm is much larger than the embryo: it is the food store (starch, protein) made from sugars transported from the leaves C4 Ovary wall becomes the pericarp, fused with the testa, so the grain is a fruit C5 On germination, water is absorbed and the embryo secretes gibberellin C6 Gibberellin acts on the aleurone layer, which secretes amylase and protease C7 Starch is hydrolysed to maltose / sugars, absorbed through the scutellum and used for respiration and growth of the plumule and radicle						
				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.						

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				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.						
				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 4.2
SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	5	2	2	9	0	3
2	6	4	0	10	0	0
3	5	5	0	10	1	1
4	0	6	3	9	5	6
5	7	3	0	10	1	1
6	2	3	5	10	2	2
7	2	3	4	9	3	2
8	6	4	0	10	0	0
9	4	5	0	9	2	0
10	5	2	3	10	0	0
11	0	6	4	10	4	5
12	3	2	4	9	0	2
13	0	8	4	12	3	4
14	1	4	4	9	2	2
15	3	3	3	9	0	0
TOTAL	49	60	36	145	23	28



A Tutor Meets Tutee project

BioWelsh mark scheme BW-A2-4.2-W1 (MS). Not an official WJEC mark scheme.

