REVISE
.wales

3.05 — Direct & inverse proportion equations

Mark schemes for the 3.05 question pack

Spec 2.2.10 — Unit 3

SOLUTIONS · 2025 SPECIFICATION

Mark schemes for the 15 questions in the corresponding revise.wales question pack (60 marks total). Sources: legacy WJEC GCSE papers, WJEC SAM, and custom-authored mark schemes. Pack layout © revise.wales.

11.(a) $y \propto 1/x$ OR $y = k/x$ $4 = k/3$ OR $k = 12$ $y = 12/x$		B1 M1 A1	Allow $y \propto k/x$ Must be in correct form, not a F.T. M1 implies B1. May be seen in part (b). Allow equivalent e.g. $x = 12/y$
11.(b) x 3 0·25 **60** y 4 **48** 1/5		B2	F.T. non-linear only. B1 for each value.

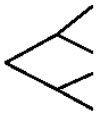
13. *(a)* $y \propto 1/x^3$ OR $y = k/x^3$ $120 = k/2^3$ OR $k = 960$ $y = 960/x^3$	B1 M1 A1	Allow $y \propto k/x^3$ F.T. from $y \propto x^3$ or $y \propto 1/x^n$ with $n > 0$ and $n \neq 1$ M1 implies B1 (excluding F.T. case) May be seen in part *(b)*. Allow equivalent e.g. $x^3 = 960/y$
13. *(b)* x | 2 | 10 | **4** y | 120 | **0·96** | 15	B2	Accept equivalent e.g. 960/1000 B1 for one correct value. F.T. provided $y \propto 1/x^n$ with $n > 0$ and $n \neq 1$ used in part *(a)*. SC1 for following through from $y = k/x$, provided both answers are correct OR SC1 for following through from $y = kx^3$, provided both answers are correct

11.(a) $y = k\sqrt{x}$ OR $y^2 = cx$ $30 = k \times 6$ OR $30 = k \times \sqrt{36}$ OR $k = 5$ OR $c = 25$ $(y =)\ 5\sqrt{x}$	B1 M1 A1	Allow $y \propto k\sqrt{x}$. $(y \propto \sqrt{x}$ is insufficient.) FT from expressions of the form $k \times x^n\ (n \neq 1)$ (equivalent difficulty only) M1 implies B1 May be seen (explicitly) in part *(b)*. Do not allow equivalent e.g. $y^2 = 25x$ unless $(y =)\ 5\sqrt{x}$ seen in part (b)
(b) x: 36, 49, **64** y: 30, **35**, 40	B2	B1 for one correct value. FT from any non-linear

11(a) 0·625 mg	B1	
11(b) $m = 160 \times 0{\cdot}25^t$ or $m = \frac{160}{4^t}$ or $m = 160 \times (\frac{1}{4})^t$ or equivalent	B3	B2 for $160 \times 0{\cdot}25^t$ or $\frac{160}{4^t}$ or $160 \times (\frac{1}{4})^t$ or or $m = (160 \times 0{\cdot}25)^t$ or $m = 160 \times \frac{1^t}{4}$ B1 for sight of $0{\cdot}25^t$ or 4^t or $(\frac{1}{4})^t$ or $160 \times \frac{1^t}{4}$ or $(160 \times 0{\cdot}25)^t$ B0 for $\frac{1^t}{4}$ only If no marks awarded: SC2 for $m = 160 \times 0{\cdot}75^t$ or $m = 160 \times (\frac{3}{4})^t$ SC1 for $160 \times 0{\cdot}75^t$ or $160 \times (\frac{3}{4})^t$ or $m = 160 \times \frac{3^t}{4}$

12. $F \propto 1 / d^2$ OR $F = k / d^2$	B1	Allow $F \propto k / d^2$
$4 = k / 10^2$ OR $k = 400$	M1	M1 implies B1. F.T. for use of $F \propto d^2$ or $F \propto 1 / d^n$ with $n > 0$ and $n \neq 2$.
$F = 400 / d^2$	A1	May be implied by further work.
$100 = 400 / d^2$ or equivalent	M1	F.T. (for M1 only) from consistent $F \propto d^2$ or $F \propto 1 / d^n$ with $n > 0$ and $n \neq 2$

11. $I \propto 1/d^2$ OR $I = k/d^2$ or equivalent $5 = k/2^2$ OR $k = 20$ $I = 20/d^2$ OR $I = 20/0{\cdot}5^2$ or equivalent $I = 80$ (lux)	B1 M1 M1 A1	Allow $I \propto k/d^2$ M1 implies B1. F.T. (for possible B0 M2 A0) for use of $I \propto d^2$ or $I \propto 1/d^n$ with $n > 0$ and $n \neq 2$. CAO. Use of $I \propto 1/d$, leading to $I = 10/d$ (or an answer of $I = 20$ (lux)) is awarded B0 FT M2 A0. Use of $I \propto d^2$, leading to $I = 1{\cdot}25\,d^2$ (or an answer of $I = 0{\cdot}3125$ (lux)) is awarded B0 FT M2 A0. Use of $I \propto 1/\sqrt{d}$, leading to $I = 5\sqrt{2}/\sqrt{d}$, (or an answer of $I = 10$ (lux)) is awarded B0 FT M2 A0.
12. $CAD = 2x$ (Reason =) Alternate segment (theorem) $BCD = 180 - 3x$ OR $BCD = 3(60 - x)$ (Reason =) Opposite angles in a cyclic quadrilateral (add up to 180°)	B1 E1 B1 E1	Check diagram. (If this is the only B mark awarded, then $2x$ marked on diagram must be unambiguous. Otherwise, ignore spurious angles on diagram.) Dependent on B1. Allow 'opposite segments'. Do not accept 'alternate angles' or 'opposite angles'. F.T. $180 - (x$ + 'their CAD'). Must be in simplest form. Mark final answer e.g. do not accept $60 - x$ or $x = 60$ If B0, E mark may be awarded provided there is a clear attempt to apply the circle theorem.
13.(a) $48x^2 + 6x - 48x^2 + 12x - 12x + 3$ OR $48x^2 + 6x - 48x^2 + 3$. $6x + 3$	B2 B1	Accept $48x^2 + 6x - (48x^2 - 12x + 12x - 3)$ or $48x^2 + 6x - (48x^2 - 3)$ B1 for $16x^2$ [$- 4x + 4x$] $- 1$ or $48x^2$ [$- 12x + 12x$] $- 3$ or $- 48x^2$ [$+ 12x - 12x$] $+ 3$. OR B1 if one error or incorrect (or extra or missing) term within entire expression. (An incorrect term may be implied e.g. $- 24x$ implies $- 12x - 12x$). Must be convincing. For last B1, do not accept $48x^2 + 6x - (48x^2 - 12x + 12x - 3)$ or $48x^2 + 6x - (48x^2 - 3)$ without further correct work seen before final $6x + 3$. If no work seen in (a), allow marks in (a) for work shown in (b)
13.(b) $-\frac{1}{2}$ or $-\frac{3}{6}$ or -0.5 or equivalent	B1	Mark final answer.

7.(a) Correct framework 	B1	
Suitable labelling on both 1st pair of branches AND on both of at least one pair of 2nd set of branches. e.g. 'Car', 'No car', 'Before 8', 'After 8'. OR Titles of 'Car' and 'Before 8' with branch endings of 'Yes' and 'No'.	B1	Accept any unambiguous wording.
Correct probabilities on first pair of branches 0·7 AND 0·3 (for 'Car', 'No car') OR 0·4 AND 0·6 (for 'Before 8', 'After 8')	B1	Must be consistent with their labelling. Allow this B1 if no headings given, unless contradicted by, or inconsistent with, further labelling.
Correct probabilities on second two sets of branches 0·4 AND 0·6 correctly placed (following 0·7 and 0·3) OR 0·7 AND 0·3 correctly placed (following 0·4 and 0·6)	B1	Allow this B1 if no headings given, unless contradicted by, or inconsistent with, further labelling. Allow this B1 if only shown on one set of branches. Provided not contradicted on the other set of branches.
7.(b) 0·7 × 0·4 or equivalent. = 0·28 or equivalent.	M1 A1	No FT. M1A0 for a final answer of 0·28%. Mark final answer.
8.(a) PA = 12(cm) AND correct theorem given, e.g. 'tangents from an external point are equal in length'.	E1	Must use the words 'tangents' AND 'equal (identical/same)'. Do not accept e.g. 'PA = PB'. (E0) Accept alternative correct answers.
8.(b) PÂO = 90(°) AND correct theorem given, e.g. 'the tangent at any point on a circle is perpendicular to the radius at that point'.	E1	Must use the words 'tangent' AND 'radius (diameter)' Allow e.g. 'radius and tangent meet at 90'. (E1) Do not accept e.g. 'PA and OA meet at 90'. (E0)
8.(c) (Area PAOB =) $2 \times \frac{12 \times 4}{2}$ or equivalent. = 48 (cm^2)	M1 A1	OR FT 'their PA' × 4 + $\frac{12 \times 4}{2}$ M0 for 48 × 2 or 12 × 4 × 2 (= 96) An unsupported final answer of 48 gains both marks. If no marks gained allow SC1 for sight of 24(cm^2) OR a correct evaluation of ('their PA' × 4) / 2.
9.(a) y = 2·5x + 3	B1	
9.(b) y = 3x − 5	B1	
9.(c) Line D	B1	
10.(a) $t \propto 1/g$ OR $t = k/g$ 36 = k / 25 OR k = 900 t = 900 / g	B1 M1 A1	Allow $t \propto k/g$ FT from $y \propto 1/x^n$ with $n \neq 1$, n>0 No FT from direct proportion M1 implies B1. May be seen explicitly in part *(b)*. Do not allow $t \propto 900/g$ for the A mark
10.(b) (900/20 =) 45 (days)	B1	FT 'their formula' only if non-linear.
10.(c) Sight of 900/40 22 (goats)	M1 A1	FT 'their formula' only if non-linear and of equivalent difficulty M1 A0 for an answer of 22·5 or 23 For A1, FT for equivalent difficulty i.e. need to round down an answer with a decimal part of 0.5 or over. Allow use of trial and improvement for M1, provided 22 or 23 seen. A0 for incorrect working e.g. 90/4 given as 22.2, leading to 22.
11. (a) $(\sqrt[3]{m})^2$	B1	
11. (b) $p^{\frac{1}{4}}$	B1	

8. $(x - 6)(x + 2)$ $(x =) 6$ AND $(x =) -2$	B2 B1	B1 for $(x \ldots 6)(x \ldots 2)$. Strict F.T. from their brackets. Penalise change of letter −1. Allow the following. B2 for $x - 6 (=0)$ AND $x + 2 (=0)$ (B1) $(x =) 6$ AND $(x =) -2$ (B1) B1 for $x + 6 (=0)$ AND $x - 2 (=0)$ (B0) $(x =) -6$ AND $(x =) 2$ (B1) FT B1 if only $(x =) 6$ AND $(x =) -2$ seen. (B1) Use of quadratic formula would only lead to this B1. Mark final answer.
9. (Arc length =) $\frac{212}{360} \times 2 \times \pi \times 7{\cdot}3 =$	M1	
26·99 to 27·0143 (cm) or $\frac{3869\pi}{450}$	A1	Seen or implied.
(Perimeter = their arc length + 2 × 7·3) = 42 or 41·6 (cm)	B1	Accept 41·59 to 41·6143 (cm). FT 'their derived arc length' + 14.6, provided M1 awarded.
Alternative version $\frac{212}{360} \times 2 \times \pi \times 7{\cdot}3 + 2 \times 7{\cdot}3 =$	*M2*	
= 42 or 41·6 (cm)	*A1*	*Accept 41·59 to 41·6143 (cm).*
Organisation and Communication.	OC1	For OC1, candidates will be expected to: • present their response in a structured way • explain to the reader what they are doing at each step of their response • lay out their explanation and working in a way that is clear and logical • write a conclusion that draws together their results and explains what their answer means
Accuracy of writing.	W1	For W1, candidates will be expected to: • show all their working • make few, if any, errors in spelling, punctuation and grammar • use correct mathematical form in their working • use appropriate terminology, units, etc
10. *(a)(i)* $y \propto 1/\sqrt{x}$ OR $y = k/\sqrt{x}$	B1	Allow $y \propto k/\sqrt{x}$
$65 = k / \sqrt{51{\cdot}84}$ OR $65 = k / 7{\cdot}2$ OR $k = 65 \times \sqrt{51{\cdot}84}$ OR $k = 65 \times 7{\cdot}2$ OR $k = 468$	M1	M1 implies B1 F.T. for B0 M1 from $y \propto 1/x^n$ with $n > 0$ and $n \neq 1/2$ No F.T. from direct proportion
$(y =) 468 / \sqrt{x}$	A1	May be seen explicitly in part *(ii)*.
10. *(a)(ii)* x: 51·84, 15·21, **36** y: 65, **120**, 78	B2	Check working space (if table left blank). B1 for one correct value. F.T. for consistent use of 'their expression' for inverse proportion only, but not for $y = 1/x$
10. (b) *c* is multiplied by 4	B1	

11. $W \propto \frac{1}{f}$ OR $W = \frac{k}{f}$	B1	Allow $W \propto \frac{k}{f}$
$0.5 = \frac{k}{1200}$ OR $k = 600$	M1	M1 implies B1. F.T. for use of $W \propto \frac{1}{f^n}$ with $n > 0$.
$W = \frac{600}{f}$ or $10 = \frac{600}{f}$ or equivalent	A1	May be implied by further work.
$(f =)\ 60$ [The frequency is 60 (Hz)]	B1	FT for 'their k' provided M1 awarded.
Alternative method *1200 ÷ 2 ÷ 10 or 1200 ÷ 20 or equivalent*	*M3*	*A complete method (based on multiplying and dividing)* *M1 for* *W = 1 when f = 600 Hz OR W = 2 when f = 300 OR W = 5 when f = 120, i.e. where Wf = 600 provided W > 0.5 (i.e. f < 1200)*
(f =) 60 [The frequency is 60 (Hz)]	*A1*	*No marks for 1200 × 20 = 24000 Hz (using direct proportion)*

11.*(a)* (i) $y \propto x^3$ OR $y = kx^3$ $108 = k \times 3^3$ OR $k = 4$ $(y =) 4x^3$	B1 M1 A1	Allow $y \propto k x^3$ M1 implies B1. F.T. from $y \propto x^n$ with $n > 1$ or n = –3 Use of n = –3 leads to k = 2916 Use of n = 2 leads to k = 12 May be seen in part (ii)
11.*(a)* (ii) x: 3, 5, **10** y: 108, **500**, 4000	B2	B1 for each correct value. Check working space if table is empty. F.T. from 'their k', provided M1 awarded (accept answer left as a root) (No FT for $y = (1)x^3$) F.T. from $y \propto x^n$ with $n > 1$ or n = –3 Use of n = –3 leads to answers of 23.328 and 0.9 Use of n = 2 leads to answers of 300 and $\sqrt{(1000/3)}$
11.*(b)* Valid statement e.g. *e* is halved; *e* is divided by 2	E1	

11. (a) $y \propto \frac{1}{x}$ OR $y = \frac{k}{x}$ $0{\cdot}2 = \frac{k}{160}$ OR $k = 32$ $y = \frac{32}{x}$	B1 M1 A1	Allow $y \propto \frac{k}{x}$. M1 implies B1. FT from $y \propto \frac{1}{x^n}$ with $n > 1$ and n = integer. (Use of $n = 2$ leads to $k = 5120$.) May be seen in part (b).
11. (b) x: 160, 128, **40** y: 0·2, **0·25**, 0·8	 B1 B1	Check working space if table is empty. Table takes precedence over working space. For y-value, accept equivalents to 0·25 including $\frac{32}{128}$. Mark final answer. For x-value, do not accept $\frac{32}{0{\cdot}8}$ or $\frac{320}{8}$. Mark final answer. FT from 'their k' (using $y = \frac{k}{x}$) or FT from $y \propto \frac{1}{x^n}$, with $n > 1$ and n = integer. Use of $n = 2$ leads to answers of 0·3125 and 80. No FT from continued use of direct proportion from part (a). If no marks in part (a), allow B1 B1 for answers of $y = 0{\cdot}25$, $x = 40$ in part (b).

13. (a) $y \propto \frac{1}{x^2}$ OR $y = \frac{k}{x^2}$ or equivalent $16 = \frac{k}{5^2}$ OR $k = 16 \times 5^2$ (= 400) $(y =) \frac{400}{x^2}$	B1 M1 A1	Allow $y \propto \frac{k}{x^2}$. May be implied by completely correct further working. FT for B0 M1 from $y \propto \frac{1}{x^n}$ with $n > 0$ and $n \neq 2$ No FT from direct proportion. May be seen (explicitly) in part (b). Allow $y \propto \frac{400}{x^2}$.
13. (b) x | 5 | 0·1 | **(±)2** y | 16 | **40 000** | 100	B2	Check working space if table is empty. Table takes precedence over working space. B1 for one correct value. FT from 'their k' (using $y = \frac{k}{x^2}$) or FT for inverse proportion only, but <u>not</u> from $y = \frac{k}{x}$.

12. $x = k\sqrt{w}$ OR $24 = k\sqrt{36}$	M1	Allow $x \propto \sqrt{w}$ OR $x \propto k\sqrt{w}$. Allow $x \propto 4\sqrt{w}$.
k = 4 OR $x = 4\sqrt{w}$	A1	CAO
When w = 25, x = 20	A1	Allow $y \propto \frac{c}{x}$. Allow the use of k again.
$y \propto \frac{1}{x}$ OR $y = \frac{c}{x}$ OR $8 = \frac{c}{15}$	M1	Allow $y \propto \frac{120}{x}$. Allow M1 A1 for (y =) 8 x 15 ÷ 20 or 8 x ¾
c = 120 OR $y = \frac{120}{x}$	A1	FT 'their x', provided 2nd M1 awarded.
(When x = 20, y =) 6	A1	FT 'their k'. Accept an answer rounded, truncated or as an improper fraction (if not whole number). An unsupported answer of 6 is awarded no marks.
12. Alternative method: $x = k\sqrt{w}$ OR $24 = k\sqrt{36}$	*M1*	*Allow $x \propto \sqrt{w}$ OR $x \propto k\sqrt{w}$.*
k = 4 OR $x = 4\sqrt{w}$	*A1*	*Allow $x \propto 4\sqrt{w}$.*
$y \propto \frac{1}{x}$ OR $y = \frac{c}{x}$ OR $8 = \frac{c}{15}$	*M1*	*Allow $y \propto \frac{c}{x}$. Allow the use of k again.*
c = 120 OR $y = \frac{120}{x}$	*A1*	*Allow $y \propto \frac{120}{x}$.*
$y = \frac{120}{4\sqrt{w}}$ $(= \frac{30}{\sqrt{w}})$ *or equivalent*	*m1*	*If one previous M1 awarded:* *FT 'y = 120 / their x', with 'x' given in terms of 'w'* *OR* *FT substituting $x = 4\sqrt{w}$ in 'their y', with 'y' given in terms of 'x'.*
When w = 25, y = 6	*A1*	*Accept an answer rounded, truncated or as an improper fraction (if not whole number).*

11.(a) Showing that **two** pairs of data values lead to different values of k for 'their $y = kx$' OR a valid statement e.g. $4 \times 20 = 80$, $8 \times 20 \neq 320$. $4 \times 20 = 80$, $8 \times 20 = 160$. $8/4 \neq 320/80$ $4 \times 20 = 80$, $245/20 = 12.25 \neq 7$, $320/20 = 16 \neq 8$ $4 \times 2 = 8$, $80 \times 2 = 160 \neq 320$ (reading across)	B2	$k = 20$ (from (4, 80)) $k = 35$ (from (7, 245)) $k = 40$ (from (8, 320)) Or correctly finding a second (contradictory) value of k. Award B1 for using $y = kx$ *to* correctly calculate the value of k from a correct substitution.
11.(b) $y \propto x^2$ OR $y = kx^2$ $80 = k \times 4^2$ OR $245 = k \times 7^2$ OR $320 = k \times 8^2$ OR $k = 5$ $y = 5x^2$	B1 M1 A1	Allow $y \propto kx^2$ M1 implies B1. FT from $y \propto x^n$ with $n > 1$ or n = –2 Use of n = –2 leads to $k = 1280$ or $k = 12005$ or $k = 20480$

10. (a) $y \propto 1/x^2$ OR $y = k/x^2$	B1	
$5 = k/2^2$	M1	Must be in correct form, not a F.T.
$y = 20/x^2$	A1	
(b)		
x 2 0·5 **(±)10**	B2	F.T. non-linear only.
y 5 **80** 0·2		B1 for each value.
	5	

End of solutions