REVISE
.wales

3.17 — Trigonometric function graphs

Mark schemes for the 3.17 question pack

Spec 3.7.8 — Unit 3

SOLUTIONS · 2025 SPECIFICATION

Mark schemes for the 12 questions in the corresponding revise.wales question pack (46 marks total). Sources: legacy WJEC GCSE papers, WJEC SAM, and custom-authored mark schemes. Pack layout © revise.wales.

15.(a) Concave down curve with *y*-coordinate of maximum = 7 *x*-coordinate of maximum = 5 Points (2,0) AND (8, 0) shown.		 B1 B1 B1	*Allow appropriate marking of axes if coordinates not given.*
15.(b) Cosine curve Correct cosine curve with 2 shown on the y-axis and 180° and 360° shown or implied.		M1 A1	Intention to sketch a portion of a cosine curve with minimum period of 360°.

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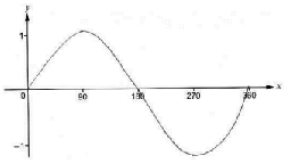
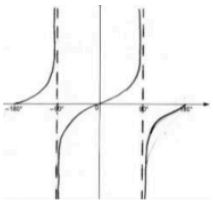
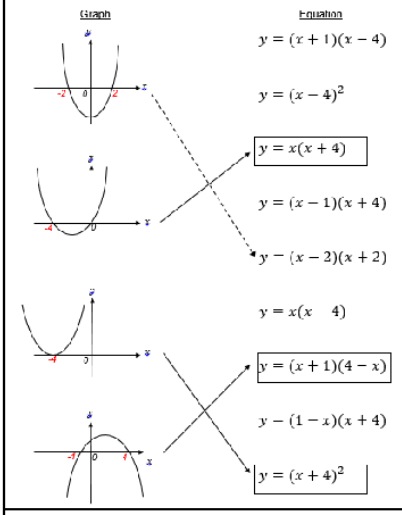
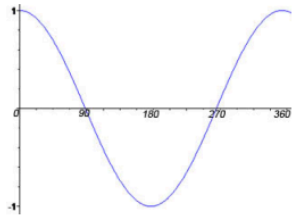
15.(a) Correct sine curve with 1 and −1 shown on the y-axis and 180° and 360° shown on the x-axis.		B2	Multiple cycles gain both marks only if both axes fully correctly labelled for x between 0 and 360. If B2 not awarded, B1 for a sine curve (single cycle) with missing values on axes OR B1 for multiple cycles with (only) x axis correctly labelled.
15.(b) sin 340°		B1	

		calculating with replacement'.
14.(a) 	C1	Clear Intention to draw a curve. Curve must pass through (0,0), (180,0) and (360,0) AND intention to have maximum at (90,1) and minimum at (270,-1). Ignore curve shown for values $x < 0°$ or $x > 360°$.
14.(b)(i) 17 AND 163 OR 17.5 AND 162.5 OR 17.4(576…) AND 162.5(423…)	B2	If more than two answers offered award B1 for sight of one correct angle. Allow embedded answers. Rounded angles must add up to 180°. B1 for sight of one correct angle OR, B1 for two angles which total 180°. Allow different degrees of accuracy in rounding.
14.(b)(ii) 270(°)	B1	Allow an embedded answer.

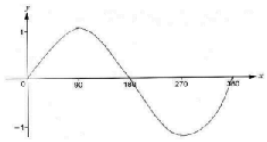
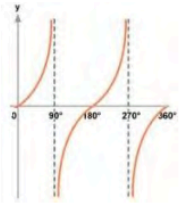
18. (a) 159° and 201° with no other values	B2	B1 for either angle. Check diagram. Penalise -1 for each extra value (beyond 2 attempts). Ignore extra (correct) values outside the required range.
18. (b) (i) Vertical enlargement upwards and downwards	B1	Mark clear intention. Must be the correct shape, i.e. a single cycle of a cosine curve, with x-intercepts at x = 90°and x = 270°, minimum at x = 180°, maxima at x = 0 and x = 360°.
Scale factor of 2	B1	Accept any clear indication. Must have correct x and y-intercepts, correct minimum and correct point for x = 360°.
18. (b) (ii) Vertical translation	B1	Mark clear intention. Must be the correct shape, i.e. a single cycle of a cosine curve, with x-intercepts at x = 0°and x = 360°, minimum at x = 180°, maxima at x = 0 and x = 360°.
Vertical –1	B1	Accept any clear indication. Must have correct x and y-intercepts, correct minimum and correct point for x = 360°. Award SC1 for a fully labelled sketch of y = cos x + 1.

11. Correct sketch, with inflection points at (-180,0), (0,0) and (180,0) AND graph tending towards the vertical asymptotes at $x = -90$ and $x = 90$. 	B2	If vertical asymptotes are not seen, they may be implied by a break in the curve of 'their sketch' at $x = -90$ and $x = 90$ provided there is asymptotic behaviour. Graph must be attempted from $x = -180$ to $x = 180$. *Ignore continuation of sketch for x<-180 and x>180.* B1 for a sketch with inflection points at (-180,0), (0,0) and (180,0) only OR vertical asymptotes seen at $x = -90$ and $x = 90$ only.

15.  	B2	B1 for any 1 or 2 correct.
16.(a) General sine curve with appropriate orientation and position. -1 and 1 indicated on the y-axis, curve passes through (-180°,0), (0°,0) and (180°,0) and approximately (-90°,-1) and (90°,1).	M1 A1	Ignore curve shown for values x< -180° or x> 180°.
16(b). -30(°) AND -150(°)	B2	Accept embedded answers. Penalise further incorrect answer(s) -1. Ignore further answer(s) outside of the range. Award B1 for sight of an answer -30(°) or -150(°) (but not for sight of -30 as part of working).
17.(a) $\frac{3}{100} \times \frac{1}{99}$ $= \frac{3}{9900}\left(= \frac{1}{3300}\right)$ ISW	M1 A1	Allow $3(.03\ldots)\times10^{-4}$ OR $0.0003(03\ldots)$ or equivalent. A0 for $0.0003(03\ldots)\%$. An unsupported $0.000303(\ldots)$ gains M1A1. An unsupported 3/10000 OR 0.0003 gains no marks.
17(b) $2 \times \frac{3}{100} \times \frac{1}{99}\left(= \frac{6}{9900} = \frac{1}{1650}\right)$ $+ \frac{3}{100} \times \frac{2}{99}\left(= \frac{6}{9900} = \frac{1}{1650}\right)$ OR $\frac{4}{100} \times \frac{3}{99}$ $= \frac{12}{9900}\left(= \frac{1}{825}\right)$ ISW	M2 A1	M1 for sight of $\left(\frac{3}{100} \times \frac{1}{99}\right) + \left(\frac{3}{100} \times \frac{1}{99}\right)$ OR $\left(\frac{3}{100} \times \frac{1}{99}\right) + \left(\frac{1}{100} \times \frac{3}{99}\right)$ OR $2 \times \frac{3}{100} \times \frac{1}{99}$ OR $\left(\frac{3}{100} \times \frac{1}{99}\right) + \left(\frac{3}{100} \times \frac{2}{99}\right)$ Allow $1(.21\ldots)\times10^{-3}$ OR $0.001(21\ldots)$ or equivalent. An unsupported answer of $0.00121(2\ldots)$ gains M2A1. A0 for $0.001(21\ldots)\%$. SC1 for working with replacement leading to an answer of 12/10000 (3/2500) OR 0.001(2) [may be unsupported].

16. Use of 7175 AND (1)·2345 or (1)23·45(÷100) $7175 \times 1{\cdot}2345$ = (£)8858	B1 M1 A1	Or equivalent complete method. FT for 'their 7175' provided $7170 \leq x < 7180$ and 'their 1·2345' provided $1{\cdot}234 \leq y < 1{\cdot}235$ Sight of (£)8857·53(75) or (£)8857·54 implies B1M1. CAO.
17.(a) General cosine curve with appropriate orientation and position. Correct sketch with curve passing through (0°,1), (90°,0) and (270°,0) and approximately (180°,-1) and (360°,1) AND 90(°), 180(°), 270(°), 360(°) indicated on the x-axis AND -1 and 1 indicated on the y-axis.  	M1 A1	Ignore curve shown for values x< 0° or x> 360°. Accept 180° as mid-way between 0° and 360° if unlabelled. Accept 360° as unlabelled provided the sketch does not exceed 360°.
17.(b) 46(°) AND 314(°) OR 45·6(°) AND 314·4(°) OR 45·57(29…°) AND 314·4(27…°).	B2	B1 for sight of one correct angle. Allow embedded answers. If more than two answers offered award B1 for sight of one correct angle. If no marks, awarded SC1 for truncated answers 45(°) AND 315(°) OR 45·5(°) AND 314·5(°).
18. $0{\cdot}7 \times 0{\cdot}2 \times 0{\cdot}1 \times 6$ = 0·084 or equivalent	M2 A1	M1 for sight of $0{\cdot}7 \times 0{\cdot}2 \times 0{\cdot}1$ OR 0·014 OR 7/500 or equivalent. Fractional answer: 21/250 or equivalent. (ISW)
19. Sight of $25x^2 + 15x - 15x - 9$ $25x^2 - 19x - 9 = 0$ $x = \dfrac{-(-19) \pm \sqrt{(-19)^2 - 4 \times 25 \times (-9)}}{2 \times 25}$ $x = \dfrac{19 \pm \sqrt{1261}}{50}$ x = 1·09 with x = –0· 33 (answers to 2dp)	B1 B1 M1 A1 A1	Or equivalent. '= 0' required, but may be implied by an attempt to use the quadratic formula or if $a = 25, b = -19,$ $c = -9$ used in the quadratic formula. **This substitution into the formula must be seen for M1, otherwise award M0A0A0.** FT 'their derived quadratic equation' of equivalent difficulty (a, b and c must be non-zero). Allow one slip in substitution **for M1 only**, but must be correct formula. Can be implied from at least one correct value of x evaluated, provided M1 awarded. CAO for their quadratic equation.

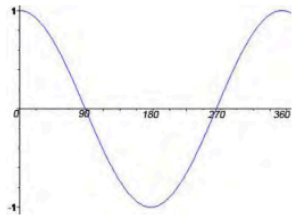
17. 218° and 322° with no other values	B2	B1 for either angle. Check diagram. Ignore extra (correct or incorrect) values outside the required range. Penalise -1 for each extra value within range (beyond 2 attempts). If no marks, SC1 for accurate evaluations from consistent use of 180+n AND 360-n (with n acute). Method must be seen for this mark.
18. *(a)* $\frac{1}{7} \times \frac{3}{6} \times \frac{2}{5}$ or equivalent 8/210 (= 4/105)	M1 A1	Penalise once only throughout for a repeated error in calculating the denominator (of 210) ISW
18. *(b)* 1 – P (3, 3, 3) $1 - \frac{1}{7} \times \frac{3}{6} \times \frac{2}{5}$ $\frac{186}{210} \left(= \frac{93}{105} = \frac{62}{70} = \frac{31}{35}\right)$	M1 M1 A1	 ISW If no other marks, award SC1 for an answer of $\frac{279}{343}$ (from working 'with replacement') OR SC1 for sight of $\frac{1}{7} \times \frac{3}{6} \times \frac{2}{5}$
Alternative method *(P(total10)+P(total11)+P(total12)+P(total13)+P(total14)=)* *P(3,3,4) × 3 + P(3,3,5) × 3 + P(3,4,5) × 6 + P(3,5,5) × 3 + P(4,5,5) × 3* $= \frac{1}{7} \times \frac{3}{6} \times \frac{1}{5} \times 3 + \frac{1}{7} \times \frac{3}{6} \times \frac{2}{5} \times 3 + \frac{1}{7} \times \frac{1}{6} \times \frac{2}{5} \times 6 + \frac{1}{7} \times \frac{2}{6} \times \frac{1}{5} \times 3 + \frac{1}{7} \times \frac{2}{6} \times \frac{1}{5} \times 3$ $\frac{186}{210} \left(= \frac{93}{105} = \frac{62}{70} = \frac{31}{35}\right)$	*M1* *M1* *A1*	*M0 if orderings are not considered* *ISW* If no marks awarded, award SC1 for the correct method for calculating any individual total, e.g. P(total 10) = $\frac{1}{7} \times \frac{3}{6} \times \frac{1}{5} \times 3$ or equivalent For information only: *P(10)*= $\frac{36}{210} \left(= \frac{6}{35}\right)$ *P(11)*= $\frac{72}{210} \left(= \frac{12}{35}\right)$ *P(12)*= $\frac{48}{210} \left(= \frac{8}{35}\right)$ *P(13)*= $\frac{24}{210} \left(= \frac{4}{35}\right)$ *P(14)*= $\frac{6}{210} \left(= \frac{1}{35}\right)$ OR award SC1 for a calculation leading to an answer of $\frac{54}{210}$ (from adding probabilities without accounting for different ordering) OR award SC1 for an answer of $\frac{279}{343}$ (from working 'with replacement').

9.(a) 	C1	Clear intention to draw a curve. Curve must pass through (0,0), (180,0) and (360,0). AND intention to have maximum at (90,1) and minimum at (270,-1). Ignore curve shown for values $x < 0°$ or $x > 360°$.
9.(b) 	C1	Clear intention to draw a curve with positive gradient. Curve must pass through (0,0), (180,0) and (360,0). AND have inflection point at (180,0). There must be an intention not to cross the asymptotes at $x = 90^o$, $x = 270^o$. Ignore curve shown for values $x < 0°$ or $x > 360°$.

20. 155° and 205° with no other values	B2	B1 for either angle. Check diagram. Ignore extra (correct or incorrect) values outside the required range Penalise -1 for each extra value within range (beyond 2 attempts).
21. $x(4x - 5) = 2(x + 1)$ or equivalent $4x^2 - 7x - 2$ [= 0] $(4x + 1)(x - 2)$ [= 0] $x = -\frac{1}{4}$ AND $x = 2$	M1 A1 B2 B1	M1 for sight of $x(4x - 5)$ AND $2(x + 1)$ or equivalent Ignore presence of denominator (provided correct). B1 for $(4x \ldots 1)(x \ldots 2)$ OR for $(2x \pm 1)(2x \mp 2)$ FT their quadratic equation, provided of equivalent difficulty. Both answers required. Strict FT 'their derived brackets'. *Allow use of quadratic formula FT their quadratic equation, provided of equivalent difficulty.* $(x =) \quad \frac{7 \pm \sqrt{[(-7)^2 - 4(4)(-2)]}}{2(4)}$ *M1* *For M1, allow one error, in sign or substitution, but not in formula.* $x = \frac{7 \pm \sqrt{81}}{8}$ *A1* $x = -\frac{1}{4}$ *AND* $x = 2$ *(both answers required) A1* *No marks for a trial and improvement method.*

16. (a) 242° and 298° with no other values	B2	B1 for either angle. Check diagram. Penalise –1 for each extra value within range (beyond 2 attempts). Ignore extra (correct or incorrect) values outside the required range. If only two angles offered and no marks gained, award SC1 for sight of both 180° + 62° and 360° – 62°.

with maximum at (270°, +1), minimum at (90°, –1)		Must be the correct shape, i.e. a single cycle of a negative sine curve, with x-intercepts at $x = 0$, $x = 180°$ and $x = 360°$, minimum at $x = 90°$, maximum at $x = 270°$. Accept any clear indication of y-coordinates. If not B2, award B1 for one of the following: • Fully correct shape and position (both for $0 \le x \le 180°$ and for $180° \le x \le 360°$) without correct coordinates indicated OR • Correct shape and position either for $0 \le x \le 180°$ or for $180° \le x \le 360°$ (a sine curve entirely between $y = -1$ and $y = 1$) AND indication of $y = -1$ and $y = 1$. SC1 for a graph which is fully correct (including labelling) other than having pointed minimum and maximum (formed from straight lines).
16.(b)(ii) Vertical translation +1 with maximum at (90°, +2), minimum at (270°, 0), with y-intercept at +1.	B2	Mark clear intention. Must be the correct shape, i.e. a single cycle of a sine curve, with consistent y values at $x = 0$, $x = 180°$ and $x = 360°$, maximum at $x = 90°$, minimum at $x = 270°$. Accept any clear indication of y-coordinates. Must have correct points for $x = 180°$ and $x = 360°$. 1 and 2 indicated on the y-axis. If not B2, award B1 for one of the following: • Fully correct shape and position (both for $0 \le x \le 180°$ and for $180° \le x \le 360°$) without correct coordinates indicated OR • Correct shape and position either for $0 \le x \le 180°$ or for $180° \le x \le 360°$ (a sine curve entirely between $y = 0$ and $y = 2$) AND indication of $y = 1$ and $y = 2$. SC1 for a graph which is fully correct (including labelling) other than having pointed minimum and maximum (formed from straight lines).

		answer of 0·8827(16…).
16.(a) Cosine curve with appropriate orientation and position AND passing through (0°,1), (90°,0) and (270°,0) and approximately (180°,-1) and (360°,1) AND 90(°), 180(°), 270(°), 360(°) indicated on the x-axis AND -1 and 1 indicated on the y-axis.  	B2	Ignore curve shown for values x< 0° or x> 360°. Accept 180° as mid-way between 0° and 360° if unlabelled. Accept 360° as unlabelled provided the sketch does not exceed 360°. B1 for: • General cosine curve with appropriate orientation and appropriate position (ignore missing or incorrect labelling) **OR** • A continuous graph passing through (0°,1), (90°,0) and (270°,0) and approximately (180°,-1) and (360°,1) AND 90(°),-270(°), indicated on the x-axis AND -1 and 1 indicated on the y-axis. Accept 180° as mid-way between 0° and 360° if unlabelled. Accept 360° as unlabelled provided the sketch does not exceed 360°.
16.(b) 60(°) AND 300(°)	B2	Ignore any angle outside of the range 0° < x < 360°. Note B2 for 60(°) AND 300(°) and no other angle within the range 0° < x < 360°. Allow embedded answers. If not B2, award B1 for either of the following: • 60(°) **AND** 300(°) and one incorrect angle within the range 0° < x < 360° • 60(°) **OR** 300(°) and up to one incorrect angle within the range 0° < x < 360° If B2 or B1 awarded, penalise -1 for each further incorrect answer. | | Radians | Gradians | | 60° | π/3 or 1·047… | 66·666… | | 300° | 358·952… | 293·333… |

End of solutions