Modelling with Trigonometric Functions 2 - Edexcel Past Exam Questions MARK SCHEME

Question 1

Question Number	Scheme	Marks
(a)	$R = \sqrt{(7^2 + 24^2)} = 25$	B1
	$\tan\alpha = \frac{24}{7}, \quad \Rightarrow \quad \alpha = \text{awrt } 73.74°$	M1A1
		(3)
(b)	maximum value of $24\sin x + 7\cos x = 25$ so $V_{\min} = \frac{21}{25} = (0.84)$	M1A1
		(2)
(c)	Distance $AB = \frac{7}{\sin\theta}$, with $\theta = \alpha$	M1, B1
	So distance = 7.29m $= \frac{175}{24}$ m	A1
		(3)
(d)	$R\cos(\theta - \alpha) = \frac{21}{1.68} \Rightarrow \cos(\theta - \alpha) = 0.5$	M1, A1
	$\theta - \alpha = 60 \Rightarrow \theta = .., \theta - \alpha = -60 \Rightarrow \theta = ..$	dM1, dM1
	$\theta = \text{awrt } 133.7, 13.7$	A1, A1
		(6)
		(14 marks)

Notes for Question

(a)

B1 25. Accept 25.0 but not $\sqrt{625}$ or answers that are not exactly 25. Eg 25.0001

M1 For $\tan\alpha = \pm\frac{24}{7}, \tan\alpha = \pm\frac{7}{24}$.

If the value of R is used only accept $\sin\alpha = \pm\frac{24}{R}, \cos\alpha = \pm\frac{7}{R}$

A1 Accept answers which round to 73.74 – must be in degrees for this mark

(b)

M1 Calculates $V = \frac{21}{their\ 'R'}$ NOT - R

A1 Obtains correct answer. $V = \frac{21}{25}$ Accept 0.84

Do not accept if you see incorrect working- ie from $\cos(\theta - \alpha) = -1$ or the minus just disappearing from a previous line.

Questions involving differentiation are acceptable. To score M1 the candidate would have to differentiate V by the quotient rule (or similar) , set V'=0 to find θ and then sub this back into V to find its value.

Notes for Question Continued

(c)

M1 Uses the trig equation $\sin\theta = \frac{7}{AB}$ with a numerical θ to find $AB = ...$

B1 Uses θ = their value of α in a trig calculation involving sin. ($\sin\alpha = \frac{AB}{7}$ is condoned)

A1 Obtains answer $\frac{175}{24}$ or awrt 7.29

(d)

M1 Substitutes $V = 1.68$ and their answer to part (a) in $V = \frac{21}{24\sin\theta + 7\cos\theta}$ to get an equation of the form $R\cos(\theta \pm \alpha) = \frac{21}{1.68}$ or $1.68R\cos(\theta \pm \alpha) = 21$ or $\cos(\theta \pm \alpha) = \frac{21}{1.68R}$.
Follow through on their R and α

A1 Obtains $\cos(\theta \pm \alpha) = 0.5$ oe. Follow through on their α. It may be implied by later working.

dM1 Obtains one value of θ **in the range** $0 < \theta < 150$ from inverse cos +their α
It is dependent upon the first M being scored.

dM1 Obtains second angle of θ **in the range** $0 < \theta < 150$ from inverse cos +their α
It is dependent upon the first M being scored.

A1 one correct answer awrt $\theta = 133.7$ *or* 13.7 1dp

A1 both correct answers awrt $\theta = 133.7$ *and* 13.7 1dp.

Extra solutions in the range loses the last A1.

Answers in radians, lose the first time it occurs. Answers must be to 3dp

For your info $\alpha = 1.287, \theta_1 = 2.334, \theta_2 = 0.240$

Question 2

Question Number	Scheme	Marks
(a)	$R=\sqrt{\left(6^2+2.5^2\right)}=6.5$	B1
	$\tan\alpha=\frac{2.5}{6}, \Rightarrow \alpha=\text{awrt } 0.395$	M1A1
		(3)
(b)	$(0,6)$,	B1
	awrt $(1.97,0)$ $(5.11,0)$	M1A1
		(3)
(c)	$H_{\max}=18.5, H_{\min}=5.5$	M1A1A1
		(3)
(d)	Sub $H=16$ and proceed to $'6.5'\cos\left(\frac{2\pi t}{52}\pm'0.395'\right)=4$	M1
	$\left(\frac{2\pi t}{52}-'0.395'\right)=\text{awrt } 0.91$	A1
	$t=\left(awrt\,0.908\pm'0.395'\right)\times\frac{52}{2\pi}=11\ (10.78)$	dM1A1
	$\left(\frac{2\pi t}{52}\pm'0.395'\right)=awrt\,2\pi-0.908\Rightarrow t=48\ (47.75)$	ddM1A1
		(6) **(15 marks)**

(a)

B1 $R=6.50, \frac{13}{2}$. Accept $R=\text{awrt } 6.50$. Do not accept $R=\pm6.50$

M1 For reaching $\tan\alpha=\pm\frac{2.5}{6}$ *or* $\tan\alpha=\pm\frac{6}{2.5}$.

If R has been attempted first then only accept $\sin\alpha=\pm\frac{2.5}{'R'}$ *or* $\cos\alpha=\pm\frac{6}{'R'}$

A1 Correct value $\alpha=awrt\ 0.395$. The answer in degrees $22.6°$ is A0

(b)

B1 The correct y intercept. Accept $y=6$, $(0,6)$, awrt $y=6.00$, $f(0)=6$ or it marked on the curve.
Do not accept $(6,0)$

M1 Attempt to find either x intercept from $\frac{\pi}{2}+\text{their } 0.395$, or $\frac{3\pi}{2}+\text{their } 0.395$

If the candidate is working in degrees accept $90+\text{their } 22.6$ or $270+\text{their } 22.6$
One answer correct will imply this.

A1 Both answers correct. Accept awrt $(1.97,0)$ and $(5.11,0)$, Accept $x=1.97$ and $x=5.11$ or both being marked on the curve. Do not accept $(0,1.97)$ and $(0,5.11)$ for both marks
In degrees accept $(112.6,0)$ and $(292.6,0)$

ddM1 A full method to find a secondary value of t. It is dependent upon both previous M's.

$$\left(\frac{2\pi t}{52} \pm their\,'0.395'\right) = awrt\,2\pi - their\,0.91 \Rightarrow t = ..$$

Don't be overly concerned with the mechanics of this but the '0.395' the 2π and the 52 must have been used to find t.

A1 Accept 11 and 48 coming from awrt 10.8/10.7 and 47.7/47.8. Both values of t need to be correct and have been rounded from t values that were correct to 1 dp. The intermediate values can be implied by seeing the whole calculation as written out in the mark scheme

Answers obtained by graphical or numerical means are not acceptable.

Answers obtained from degrees are perfectly acceptable only if degrees were used throughout (d) with π, being replaced by $180°$ in the formula and the answers in degrees converted back to radians at the end.

Mixed units can only score the first M1A1

$$6.5\cos\left(\frac{2\pi t}{52} - '22.6'\right) = 4 \Rightarrow \left(\frac{2\pi t}{52} - '22.6'\right) = awrt\,52.0$$