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Wave Function

Higher Maths Exam Questions

Source: 2019 P2 Q6a Higher Maths	
(1)	(a) Express $2\cos x° - 3\sin x°$ in the form $k\cos(x+a)°$ where $k>0$ and $0 \le a < 360$. (b) Hence solve $2\cos x° - 3\sin x° = 3$ for $0 \le x < 360$.
Answers: $(a)\ \sqrt{13}\cos(x+56.3)°$ $(b)\ x = 270°,\ 337.38\ldots°$	

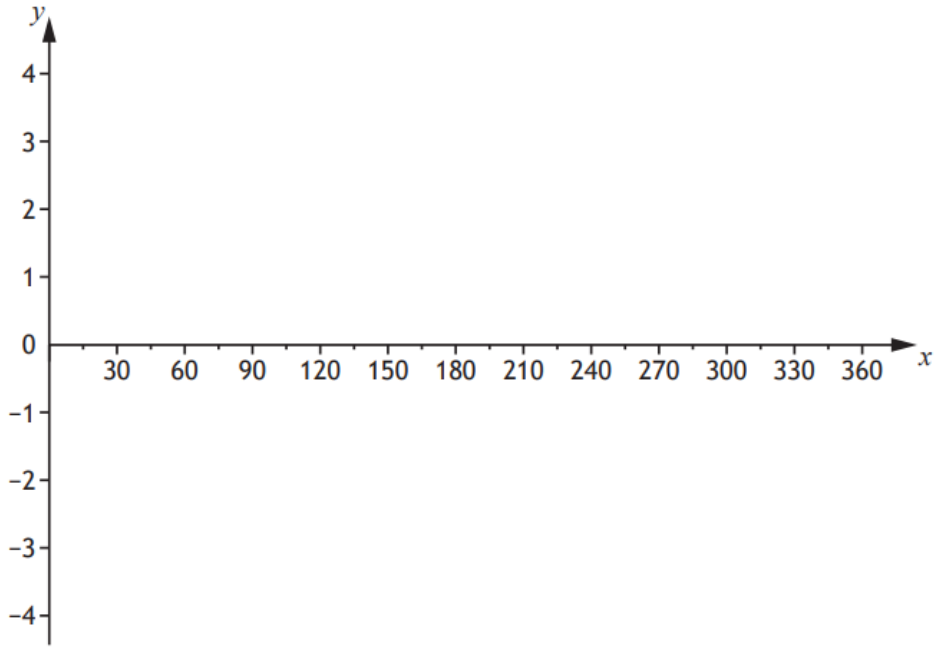
Source: 2018 P2 Q8 Higher Maths	
(2)	(a) Express $2\cos x° - \sin x°$ in the form $k\cos(x-a)°$, $k>0$, $0<a<360$. (b) Hence, or otherwise, find (i) the minimum value of $6\cos x° - 3\sin x°$ and (ii) the value of x for which it occurs where $0 \le x < 360$.
Answers: $(a)\ \sqrt{5}\cos(x-333.4\ldots)°$ $(b)\ (i) -3\sqrt{5}\ \ or\ \ -\sqrt{45}$ $(ii)\ x = 153.4\ldots°$	

Source: 2017 P1 Q14 Higher Maths

(3) (a) Express $\sqrt{3}\sin x° - \cos x°$ in the form $k\sin(x-a)°$, where $k > 0$ and $0 < a < 360$.

(b) Hence, or otherwise, sketch the graph with equation $y = \sqrt{3}\sin x° - \cos x°$, $0 \leq x \leq 360$.

Use the diagram provided in the answer booklet.



Answers: (a) $2\sin(x-30)°$

(b)	roots identifiable from graph	•[5] 30 and 210
	coordinates of both turning points identifiable from graph	•[6] $(120, 2)$ and $(300, -2)$
	y-intercept and value of y at $x = 360$ identifiable from graph	•[7] -1

Source: 2016 P2 Q8a Higher Maths

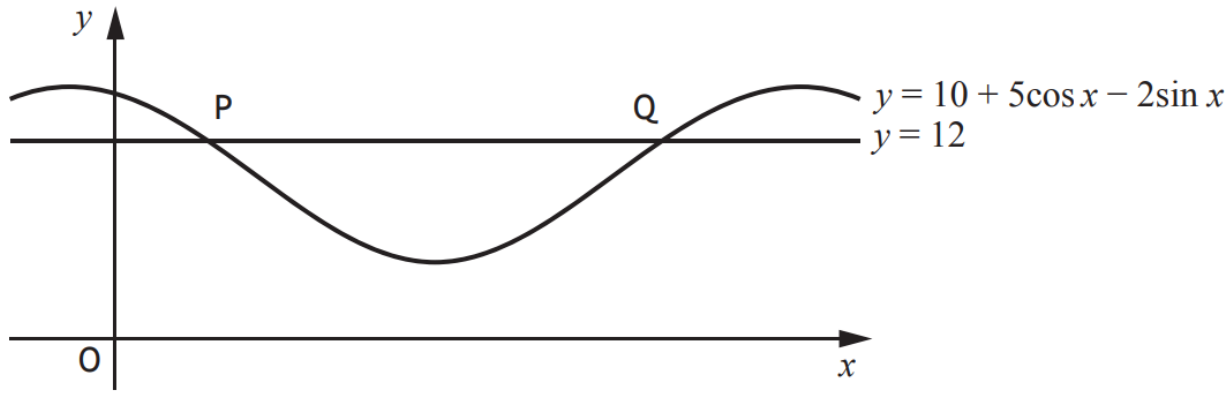
(4)

(a) Express $5\cos x - 2\sin x$ in the form $k\cos(x + a)$,

where $k > 0$ and $0 < a < 2\pi$.

(b) The diagram shows a sketch of part of the graph of $y = 10 + 5\cos x - 2\sin x$ and the line with equation $y = 12$.

The line cuts the curve at the points P and Q.



Find the x-coordinates of P and Q.

Answers: $(a)\ \sqrt{29}\cos(x + 0.38)$ $(b)\ x = 0.8097,\ 4.712$

Source: 2015 P2 Q9 Higher Maths

(5)

The blades of a wind turbine are turning at a steady rate.

The height, h metres, of the tip of one of the blades above the ground at time, t seconds, is given by the formula

$$h = 36\sin(1{\cdot}5t) - 15\cos(1{\cdot}5t) + 65.$$

Express $36\sin(1{\cdot}5t) - 15\cos(1{\cdot}5t)$ in the form

$k\sin(1{\cdot}5t - a)$, where $k > 0$ and $0 < a < \frac{\pi}{2}$,

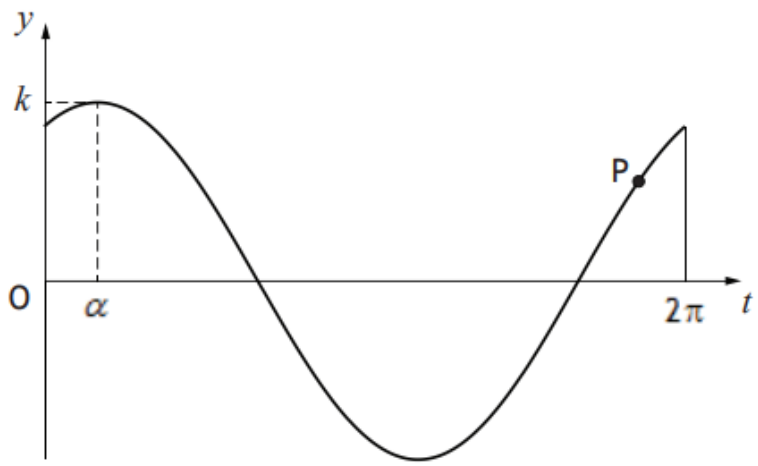
and hence find the **two** values of t for which the tip of this blade is at a height of 100 metres above the ground during the first turn.

Answers: $39\sin(1.5t - 0.395) + 65$ $t = 1.006$ *and* 1.615

Source: Specimen P2 Q10 Higher Maths

(6) Two sound sources produce the waves $y = \sin t$ and $y = \sqrt{3}\cos t$.

An investigation into the addition of these two waves produces the graph shown, with equation $y = k\cos(t - \alpha)$ for $0 \le t \le 2\pi$.



(a) Calculate the values of k and α.

The point P has a y-coordinate of 1·2.

(c) Hence calculate the value of the t-coordinate of point P.

Answers: $(a)\ k = 2,\ a = \frac{\pi}{6}$ $(c)\ 5.9$

Source: Exemplar P1 Q9 Higher Maths

(7) The expression $\cos 4x - \sqrt{3}\sin 4x$ can be written in the form $k\cos(4x + a)$ where $k > 0$ and $0 \le a \le 2\pi$.

(a) Calculate the values of k and a.

(b) Find the points of intersection of the graph of $y = \cos 4x - \sqrt{3}\sin 4x$ with the x axis, in the interval $0 \le x \le \frac{\pi}{2}$.

Answers: $(a)\ k = 2\ \ a = \frac{\pi}{3}$ $(b)\left(\frac{\pi}{24},\ 0\right)\ \ \left(\frac{7\pi}{24},\ 0\right)$