Pearson Edexcel AS Further Mathematics 8FM0

Further Pure 1 – 1 Further Trigonometry

Time allowed: 45 **minutes**

School: www.CasperYC.club

Name:

Teacher:

Question	Points	Score
1	7	
2	9	
3	11	
4	10	
Total:	37	

How I can achieve better:

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Last updated: February 3, 2026

1. (a) Use the substitution $t = \tan\frac{x}{2}$ to show that the equation [3]

$$5\sin x + 12\cos x = 2$$

can be written in the form

$$7t^2 - 5t - 5 = 0$$

(b) Hence solve, for $-180° < x < 180°$, the equation $5\sin x + 12\cos x = 2$, giving your answers to one decimal place. [4]

Total: 7

2. (a) Write down the t-formula for $\sin x$. [1]

(b) Using the answer to part (a), [4]

i. find the exact value of $\sin x$ when

$$\tan\left(\frac{x}{2}\right) = \sqrt{2}$$

ii. show that

$$\cos x = \frac{1 - t^2}{1 + t^2}$$

(c) Use the t-formulae to solve for $0 < \theta \leqslant 360°$ [4]

$$7\sin\theta + 9\cos\theta + 3 = 0$$

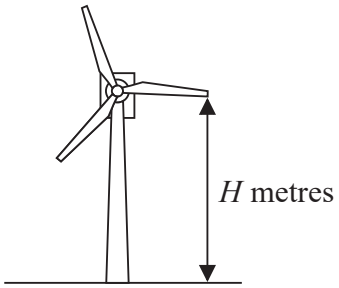
giving your answers to one decimal place.

Total: 9

3. (a) Use the substitution $t = \tan\left(\frac{x}{2}\right)$ to prove that [2]

$$\cot x + \tan\left(\frac{x}{2}\right) = \csc x, \qquad x \neq n\pi, \quad n \in \mathbb{Z}$$

(b) An engineer models the vertical height above the ground of the tip of one blade of a wind turbine, shown below.



The ground is assumed to be horizontal.

The vertical height of the tip of the blade above the ground, H metres, at time x seconds after the wind turbine has reached its constant operating speed, is modelled by the equation

$$H = 90 - 30\cos(120x)^\circ - 40\sin(120x)^\circ \qquad (\star)$$

i. Show that $H = 60$ when $x = 0$ [1]

ii. Using the substitution $t = \tan(60x)^\circ$ show that equation $(\star)$ can be rewritten as [3]

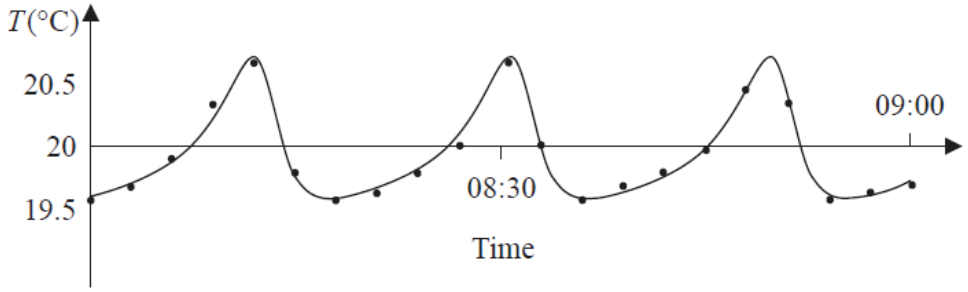
$$H = \frac{120t^2 - 80t + 60}{1 + t^2}$$

iii. Hence find, according to the model, the value of x when the tip of the blade is 100 m above the ground for the first time after the wind turbine has reached its constant operating speed. [5]

Total: 11

(Q3 continued . . .)

4. The temperature in a room of a house being regulated by a central heating system was recorded by an engineer every 3 minutes between 08:00 and 09:00 on a particular morning. The temperature outside at 08:00 was recorded as 15°C.



Using radians, the engineer modelled the temperature, T°C, in the room, x minutes after 08:00 by the equation

$$T = \frac{119 + 38\cos\left(\frac{x}{3}\right) + 79\sin\left(\frac{x}{3}\right)}{6 + 4\sin\left(\frac{x}{3}\right) + 2\cos\left(\frac{x}{3}\right)}$$

Figure above shows the recorded temperatures and the graph resulting from the engineer's model.

Using the t–substitution $t = \tan\frac{x}{6}$,

(a) show that equation can be re-written as [3]

$$T = \frac{81t^2 + 158t + 157}{4t^2 + 8t + 8}$$

The engineer assumes that while the heating system is switched on, the equation will continue to model the temperature beyond 09:00. Given that the heating system remains switched on,

(b) use the answer to part (a) to find the proportion of time that the temperature in the room will be above 20°C according to the model. [6]

(c) Give a reason why the equation may not be suitable to model the temperature in the room beyond 09:00. [1]

Total: 10

(Q4 continued . . .)