

Trig Graphs + Equations - Solutions

(1) 2010 Paper 2 Q.13

$$(1) D = 3 + 1.75 \sin 30h^\circ.$$

$$(a) h = 5, D = 3 + 1.75 \times \sin(30 \times 5) \quad \checkmark$$

$$D = 3 + 1.75 \times \sin 150 \quad (2\text{ku})$$

$$\underline{D = 3.875 \text{ m}} \quad \checkmark$$

(b)

$$\text{max depth} = 3 + 1.75 = 4.75 \quad \checkmark$$

$$\text{min depth} = 3 - 1.75 = 1.25$$

$$\begin{aligned} \text{Difference} &= 4.75 - 1.25 \\ &= \underline{3.5 \text{ m}} \quad \checkmark \end{aligned} \quad (2\text{RE})$$

(2) 2008 Paper 2 Q.12

$$(a) \tan x^\circ = 5 \quad \checkmark \quad \begin{array}{c} s \\ \diagup \\ \sqrt{5} \\ \diagdown \\ t \\ | \\ c \end{array} \quad \tan^{-1} 5 = 78.7^\circ$$

$$x^\circ = 78.7^\circ, x^\circ = 180 + 78.7^\circ$$

$$x^\circ = 258.7^\circ$$

$$\underline{P \rightarrow 78.7^\circ, Q \rightarrow 258.7^\circ} \quad (3\text{RE})$$

(b) The tan graph repeats every 180° so

$$R \rightarrow 258.7^\circ + 180^\circ = \underline{438.7^\circ} \quad \checkmark \quad (1\text{RE})$$

(3) 2007 Paper 1 Q.13

$$y = \cos bx + c$$

\uparrow
no of waves in 360°

$$\underline{b = 2} \quad \checkmark$$

$$\underline{c = 3} \quad \checkmark$$

The graph usually looks like: 
so has moved up 3 units

(2ku)

④ 2006 Paper 2 Q.10

$$h = -31 \cos t + 33$$

(a) $t=20^\circ$, $h = -31 \times \cos 20^\circ + 33 \quad \checkmark$

$$\underline{h = 3.87 \text{ m}} \quad \checkmark \quad (2 \text{ku})$$

(b) $h = 60$, $60 = -31 \cos t + 33 \quad \checkmark$

$$31 \cos t = -27$$

$$\cos t = -\frac{27}{31} \quad \checkmark$$

$$t = \cos^{-1}(-\frac{27}{31}) \quad (3 \text{RE})$$

$$\underline{t = 150.6 \text{ seconds}} \quad \checkmark$$

note: no need to do $\frac{s}{r/c}$ as the question says "first reach".

(c)

S	
✓	A
T	C

$$\cos^{-1}(\frac{-27}{31}) = 29.4^\circ$$

$$\text{Answer: } 180 + 29.4^\circ = \underline{209.4^\circ} \quad \checkmark \quad (1 \text{RE})$$

⑤ 2005 Paper 2 Q.11

(a) $\sqrt{3} \sin x - 1 = 0$

$$\sin x = 1/\sqrt{3} \quad \checkmark$$



$$\sin^{-1}(1/\sqrt{3})$$

$$\underline{x = 35.3^\circ} \quad \checkmark \quad x = 180 - 35.3^\circ \quad \checkmark \quad (3 \text{ku})$$

(b) $\sqrt{3} \sin 2x - 1 = 0 \quad 0^\circ < x < 90^\circ$

↑

answer must be less than 90°

$$2x = 35.3^\circ \quad \text{or} \quad 2x = 144.7^\circ$$

$$\underline{x = 17.65^\circ}$$

$$\underline{x = 72.35^\circ}$$

(1RE)

(only 1 answer required)

⑥ 2004 Paper 1 Q.9

$$y = a \cos b x$$

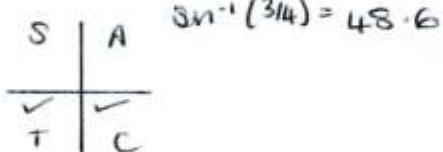
max ↑ ↑
no of waves in 360°

$$\underline{a = 2}, \underline{b = 4} \quad (1 \text{ wave in } 90^\circ)$$

(2ku)

⑦ 2004 Paper 2 Q.10

$$4 \sin x + 1 = -2$$



$$\sin^{-1}(3/4) = 48.6$$

$$4 \sin x = -3$$

$$\sin x = -3/4$$

$$x = 180 + 48.6^\circ$$

$$x = 360 - 48.6^\circ$$

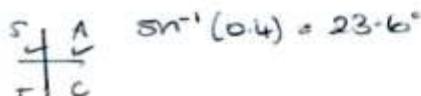
$$\underline{x = 225.6^\circ} \quad \checkmark$$

$$\underline{x = 311.4^\circ} \quad \checkmark$$

(3cu)

⑧ 2002 Paper 2 Q.8

$$\sin x = 0.4 \quad \checkmark$$



$$\sin^{-1}(0.4) = 23.6^\circ$$

$$\underline{x = 23.6^\circ} \quad \checkmark$$

$$x = 180 - 23.6^\circ$$

$$\underline{x = 156.4^\circ} \quad \checkmark$$

(3RE)

⑨ 2001 Paper 2 Q.7

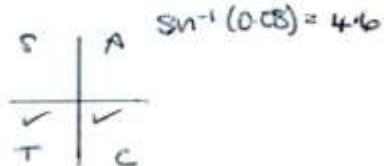
$$\tan 40^\circ = 2 \sin x + 1$$

$$2 \sin x + 1 = \tan 40$$

$$2 \sin x + 1 = 0.839$$

$$2 \sin x = 0.839 - 1$$

$$\sin x = \frac{0.839 - 1}{2} = -0.08$$



$$\sin^{-1}(-0.08) = 4.6$$

$$x = 4.6^\circ + 180^\circ$$

$$\underline{x = 184.6^\circ} \quad \checkmark$$

$$x = 360 - 4.6^\circ =$$

$$\underline{155.4^\circ} \quad \checkmark$$

(3ku)

(10) 2006 Paper 2 Q.9

$$H = 14 + 3\cos(30n)$$

(a) $n=2$, $H = 14 + 3\cos(30 \times 2)$ ✓

$$\underline{H = 15.5 \text{ m}} \quad \checkmark \quad (2 \text{ kU})$$

(b) $H=12.5$,

$$12.5 = 14 + 3\cos(30n)$$

$$14 + 3\cos(30n) = 12.5 \quad \checkmark$$

$$3\cos(30n) = -1.5$$

$$\cos(30n) = -\frac{1}{2}$$

$$30n = \cos^{-1}\left(-\frac{1}{2}\right) \checkmark$$

$$30n = 120$$

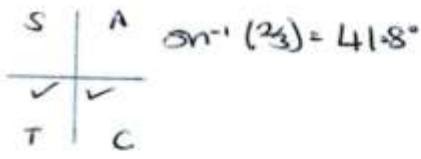
$$n = 40$$

so $H = 12.5$ at 4 am ✓ (3 kU)

(11) 1999 Paper 2 Q5

$$2 + 3\sin x = 0$$

$$\sin x = -\frac{2}{3}$$



$$x = 180 + 41.8^\circ$$

$$x = 360 - 41.8^\circ$$

$$\underline{x = 221.8^\circ} \quad \checkmark$$

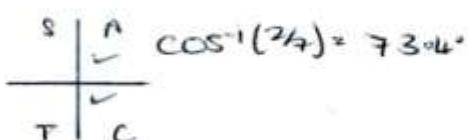
$$\underline{x = 318.2^\circ} \quad \checkmark$$

(3 kU)

(12) 1998 Paper 2 Q.7

$$7\cos x - 2 = 0$$

$$\cos x = \frac{2}{7}$$



$$\underline{x = 73.4^\circ} \quad \checkmark$$

$$x = 360 - 73.4$$

$$\underline{x = 286.6^\circ} \quad \checkmark$$

(3 kU)

(13) 1997 Q.13

$$y = k \sin \alpha x$$

max no. of waves in 360°

$$\underline{k = 3} . \quad \underline{\alpha = 2} \quad - \quad (2\text{ku})$$

(14) 1996 Q.13

$$5 \tan x - 9 = 0 \quad \begin{array}{c} S \\ \diagup \quad \diagdown \\ A \\ \hline C \end{array} \quad \tan^{-1}(9/5) = 60.9^\circ$$
$$\tan x = 9/5$$

$$\underline{x = 60.9^\circ}, \quad x = 180 + 60.9^\circ \quad (3\text{ku})$$
$$\underline{x = 240.9^\circ}$$

(15) 1997 Q.16

$$H = 1.9 + 0.3 \cos(30t)$$

(a) max value = $1.9 + 0.3 = \underline{2.2 \text{ m}}$ ✓ (1ku)

(b) $t=8$, $H = 1.9 + 0.3 \times \cos(30 \times 8)$ ✓✓

$$\underline{H = 1.75 \text{ m}} \quad \checkmark \quad (3\text{RE})$$

(c) $H = 2.05$, $2.05 = 1.9 + 0.3 \cos(30t)$

$$1.9 + 0.3 \cos(30t) = 2.05 \quad \checkmark$$

$$0.3 \cos(30t) = 0.15$$

$$\cos(30t) = 0.5 \quad \checkmark$$

$$30t = \cos^{-1}(0.5) \quad (3\text{RE})$$

$$30t = 60 \\ t = 2 \quad \checkmark$$

Answer: After 2 seconds.

(16) 1995 Q.17

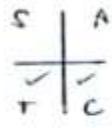
$$a = 3, b = 2 \quad \checkmark \checkmark$$

(2kW)

(17) 1994 Q.17

$$5 \sin x + 2 = 0$$

$$\sin x = -\frac{2}{5}$$



$$\sin^{-1}(-\frac{2}{5}) = 23.6^\circ$$

$$x = 180 + 23.6^\circ$$

$$x = 203.6^\circ \quad \checkmark$$

$$x = 360 - 23.6^\circ$$

$$x = 336.4^\circ \quad \checkmark$$

(3kW)

(18) 1992 Paper 1 Q.13

$$a = 3, b = 2 \quad \checkmark \checkmark$$

(2kW)

(19) 1991 Paper 2 Q.7

$$D = 6 + 4 \cos(32t + 108)$$

(a) max = $6+4 = 10 \text{ m}$ ✓

min = $6-4 = 2 \text{ m}$ ✓

(2kW)

(b) low tide $D=2 \rightarrow 6+4 \cos(32t + 108) = 2$ ✓

$$\cos(32t + 108) = -1$$

$$32t + 108 = \cos^{-1}(-1) \quad \checkmark$$

$$32t + 108 = 180$$

$$t = 2.25 \quad (3RE)$$

time = 02:15 ✓

(c) 3pm $\Rightarrow t = 15, D = 6 + 4 \cos(32 \times 15 + 108) \quad \checkmark$

$$D = 3.32 \quad \checkmark$$

No as $3.32 \text{ m} < 4 \text{ m}$. ✓

(3RE)