

Tilg Graphs + Equations - Solutions

(1) 2010 Paper 2 Q.13

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

(a) $h = 5$, $D = 3 + 1.75 \times \sin(30 \times 5)$ ✓
 $D = 3 + 1.75 \times \sin 150$ (2ku)
 $D = 3.875 \text{ m}$ ✓

(b) max depth = $3 + 1.75 = 4.75$ ✓
min depth = $3 - 1.75 = 1.25$ ✓
Difference = $4.75 - 1.25$ ✓
= 3.5 m ✓ (2RE)

(2) 2008 Paper 2 Q.12

(a) $\tan x = 5$ ✓ $\frac{s}{t} = \frac{5}{1} \Rightarrow \tan^{-1} 5 = 78.7^\circ$

$x = 78.7^\circ$, $x = 180 + 78.7^\circ$
 $x = 258.7^\circ$

$P \rightarrow 78.7^\circ$ ✓ , $Q \rightarrow 258.7^\circ$ ✓ (3RE)

(b) The tan graph repeats every 180° so


$R \Rightarrow 258.7 + 180 = \underline{438.7^\circ}$ ✓ (1RE)

(3) 2007 Paper 1 Q.13

• $y = \cos bx + c$
 ↑
 no of waves in 360°

$b = 2$ ✓

$c = 3$ ✓

• The graph usually looks like: 

so has moved up 3 units

(2ku)

④ 2006 Paper 2 Q.10

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

(a) $t=20$, $h = -31 \times \cos 20 + 33$ ✓

$h = 3.87 \text{ m}$ ✓ (2ku)

(b) $h=60$, $60 = -31 \cos t + 33$ ✓

$$31 \cos t = -27$$

$$\cos t = \frac{-27}{31}$$
 ✓

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

$t = 150.6 \text{ seconds}$ ✓

note: no need to do $\frac{s}{t} = \frac{A}{c}$ as the question says 'first reach'.

(c) $\frac{s}{t} = \frac{A}{c}$ $\cos^{-1}\left(\frac{27}{31}\right) = 29.4^\circ$

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

⑤ 2005 Paper 2 Q.11

(a) $\sqrt{3} \sin x - 1 = 0$ $\sin^{-1}(1/\sqrt{3})$
 $\sin x = 1/\sqrt{3}$ ✓ $\frac{s}{t} = \frac{A}{c}$

$x = 35.3^\circ$ ✓ $x = 180 - 35.3$ ✓ (3ku)
 $x = 144.7^\circ$ ✓

(b) $\sqrt{3} \sin 2x - 1 = 0$ $0 \leq x < 90$
 ↑

$2x = 35.3^\circ$

$x = 17.65$

answer must be less than 90
 or $2x = 144.7$

$x = 72.35$

(1RE)

(only answer required)

(10) 2000 Paper 2 Q.9

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

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

$$\underline{H = 15.5m}$$
 ✓ (2kw)

(b) $H=12.5$,

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

$$14 + 3\cos(30n) = 12.5$$
 ✓

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

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

$$30n = \cos^{-1}(-1.5/3)$$
 ✓

$$30n = 120$$

$$n = 40$$

so $H=12.5$ at 4am ✓ (3kw)

(11) 1999 Paper 2 Q5

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

$$\sin x = -2/3$$
 ✓

S	A
✓	✓
T	C

 $\sin^{-1}(2/3) = 41.8^\circ$

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

$$\underline{x = 221.8^\circ}$$
 ✓

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

$$\underline{x = 318.2^\circ}$$
 ✓ (3kw)

(12) 1998 Paper 2 Q.7

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

$$\cos x = 2/7$$
 ✓

S	A
✓	✓
T	C

 $\cos^{-1}(2/7) = 73.4^\circ$

$$\underline{x = 73.4^\circ}$$
 ✓

$$x = 360 - 73.4$$

$$\underline{x = 286.6^\circ}$$
 ✓

(3kw)

(13) 1997 Q.13

$$y = k \sin ax$$

↑ ↑
max no. of waves in 360°

$k = 3$ ✓ $a = 2$ ✓ (2kU)

(14) 1996 Q.13

$$5 \tan x - 9 = 0$$
$$\tan x = 9/5 \checkmark$$

S	A
✓	✓
T	C

 $\tan^{-1}(9/5) = 60.9^\circ$

$x = 60.9^\circ$ ✓, $x = 180 + 60.9^\circ$
 $x = 240.9^\circ$ ✓ (3kU)

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

$H = 1.75 \text{ m}$ ✓ (3RE)

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

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

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

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

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

$$30t = 60$$

$$t = 2 \quad \checkmark$$

Answer: After 2 seconds.

⑩ 1995 Q.17
 $a=3, b=2$ ✓✓ (2kw)

⑪ 1994 Q.17

$$5 \sin x + 2 = 0 \quad \begin{array}{c|c} s & A \\ \hline \checkmark & \checkmark \\ r & c \end{array} \quad \sin^{-1}(2/5) = 23.6^\circ$$

$$\sin x = -2/5 \quad \checkmark$$

$$x = 180 + 23.6^\circ \quad x = 360 - 23.6^\circ$$

$$\underline{x = 203.6^\circ} \quad \checkmark \quad \underline{x = 336.4^\circ} \quad \checkmark \quad (3kw)$$

⑫ 1992 Paper 1 Q.13
 $a=3, b=2$ ✓✓ (2kw)

⑬ 1991 Paper 2 Q.7
 $D = 6 + 4 \cos(32t + 108)$

(a) $\max = 6 + 4 = \underline{10 \text{ m}}$ ✓
 $\min = 6 - 4 = \underline{2 \text{ m}}$ ✓ (2kw)

(b) low tide $D = 2 \rightarrow 6 + 4 \cos(32t + 108) = 2$ ✓
 $\cos(32t + 108) = -1$
 $32t + 108 = \cos^{-1}(-1)$ ✓
 $32t + 108 = 180$
 $t = 2.25$ (3RE)
time = 02:15 ✓

(c) 3pm $\Rightarrow t = 15$, $D = 6 + 4 \cos(32 \times 15 + 108)$ ✓
 $D = 3.32$ ✓
No as $3.32 \text{ m} < 4 \text{ m}$. ✓ (3RE)