1.) (a) (i) 100 (metres) A1 N1

(ii) 50 (metres) A1 N12

(b) (i) identifying symmetry with $h(2) = 9.5$ (M1)

subtraction A1

e.g. $100 - h(2)$, $100 - 9.5$

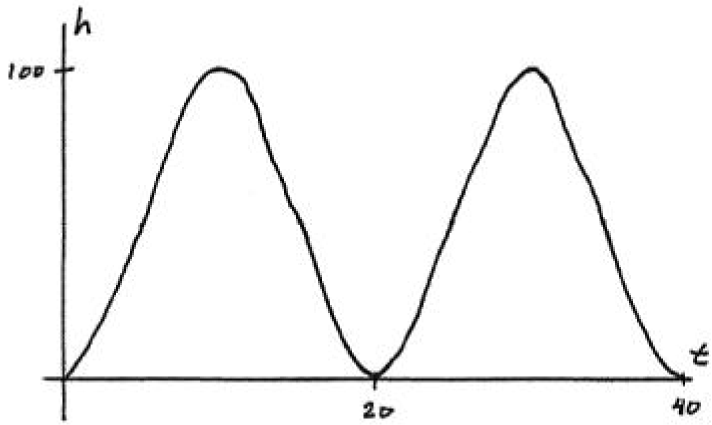
$h(8) = 90.5$ AG N0

(ii) recognizing period (M1)

e.g. $h(21) = h(1)$

$h(21) = 2.4$ A1 N24

(c)



A1A1A1 N3 3

Note: *Award A1 for end points (0, 0)* ***and*** *(40, 0), A1 for range $0 \le h \le 100$, A1 for approximately correct sinusoidal shape, with two cycles*

(d) evidence of a quotient involving 20, 2π or 360° to find b (M1)

e.g. $\frac{2\pi}{b} = 20, b = \frac{360}{20}$

$b = \frac{2\pi}{20}\left(= \frac{\pi}{10}\right)$

(accept b =18 if working in degrees) A1 N2

$a = -50$, $c = 50$ A2A1 N35

[14]

2.) (a) (i) $\sin x = 0$ A1

$x = 0, x = \pi$ A1A1 N2

(ii) $\sin x = -1$ A1

$x = \frac{3\pi}{2}$ A1N1

(b) $\frac{3\pi}{2}$ A1N1

(c) evidence of using anti-differentiation (M1)

e.g. $\int_0^{\frac{3\pi}{2}} (6 + 6\sin x)\mathrm{d}x$

correct integral $6x - 6\cos x$ (seen anywhere) A1A1

correct substitution (A1)

e.g. $6\left(\frac{3\pi}{2}\right) - 6\cos\left(\frac{3\pi}{2}\right) - (-6\cos 0)$, $9\pi - 0 + 6$

$k = 9\pi + 6$ A1A1N3

(d) translation of $\begin{pmatrix} \frac{\pi}{2} \\ 0 \end{pmatrix}$ A1A1N2

(e) recognizing that the area under g is the same as the shaded region in f (M1)

$p = \frac{\pi}{2}$, $p = 0$ A1A1N3

[17]

3.) (a) (i) evidence of finding the amplitude (M1)

e.g. $\frac{7+3}{2}$, amplitude = 5

$p = -5$ A1 N2

(ii) period = 8 (A1)

$q = 0.785 \left(= \frac{2\pi}{8} = \frac{\pi}{4}\right)$ A1N2

(iii) $r = \frac{7-3}{2}$ (A1)

$r = 2$ A1N2

(b) $k = -3$ (accept $y = -3$) A1N1

[7]

4.) (a) attempt to form any composition (even if order is reversed) (M1)

correct composition $h(x) = g\left(\frac{3x}{2} + 1\right)$ (A1)

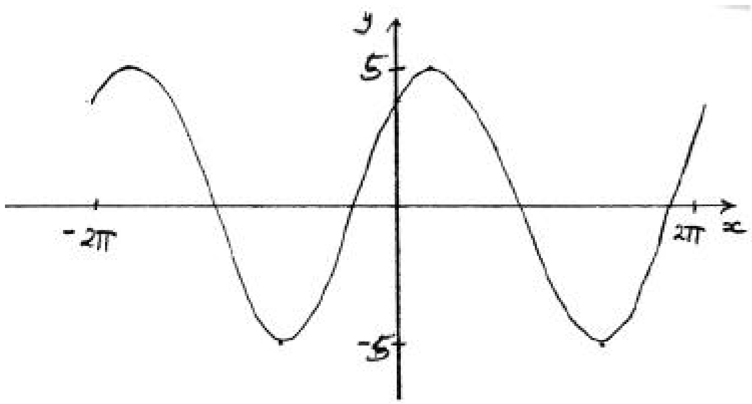
$h(x) = 4\cos\left(\frac{\frac{3x}{2}+1}{3}\right) - 1 \quad \left(4\cos\left(\frac{1}{2}x + \frac{1}{3}\right) - 1, 4\cos\left(\frac{3x+2}{6}\right) - 1\right)$ A1 N3

(b) period is $4\pi(12.6)$ A1N1

(c) range is $-5 \le h(x) \le 3$ ($[-5, 3]$) A1A1N2

[6]

5.) (a)



A1A1A1 N3

Note: *Award A1 for approximately sinusoidal shape, A1 for end points approximately correct, (–2π, 4), (2π, 4) A1 for approximately correct position of graph, (y-intercept (0, 4) maximum to right of y-axis).*

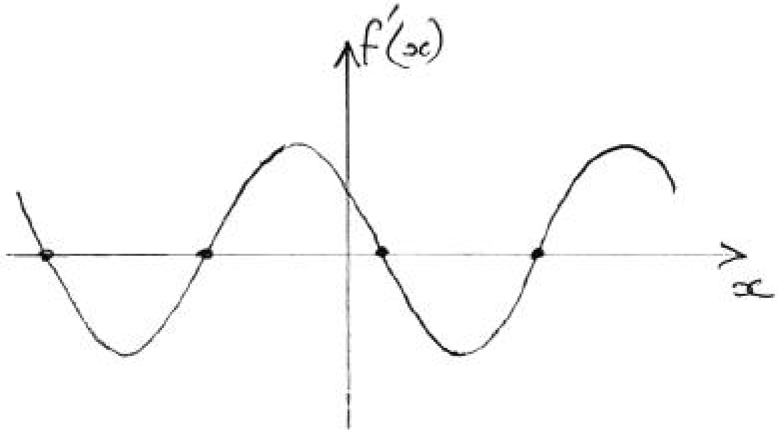
(b) (i) 5 A1 N1

(ii) 2π (6.28) A1N1

(iii) –0.927 A1N1

(c) $f(x) = 5 \sin (x + 0.927)$ (accept $p = 5$, $q = 1$, $r = 0.927$) A1A1A1N3

(d) evidence of correct approach (M1)
e.g. max/min, sketch of $f'(x)$ indicating roots

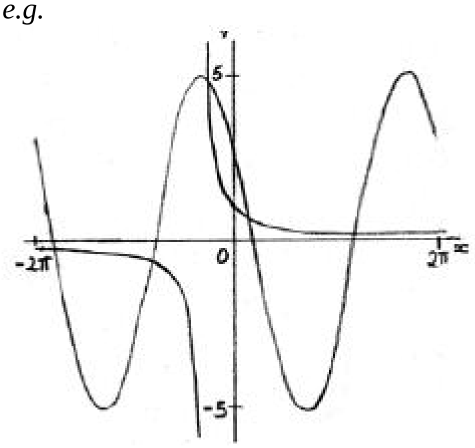


one 3 s.f. value which rounds to one of –5.6, –2.5, 0.64, 3.8 A1N2

(e) $k = –5$, $k = 5$ A1A1N2

(f) **METHOD 1**

graphical approach (but must involve derivative functions) M1
e.g.



each curve A1A1

$x = 0.511$ A2N2

METHOD 2

$g'(x) = \dfrac{1}{x+1}$ A1

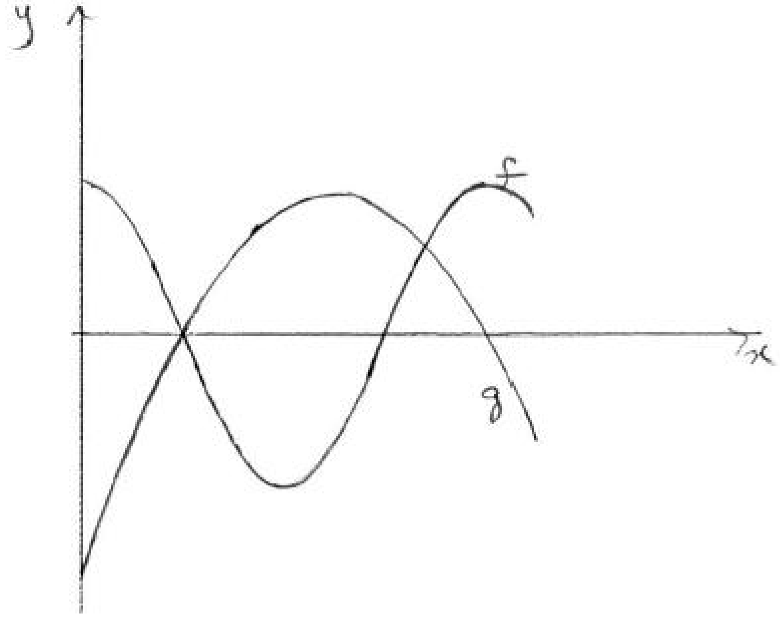
$f'(x) = 3\cos x - 4\sin x \quad (5\cos(x + 0.927))$ A1

evidence of attempt to solve $g'(x) = f'(x)$ M1

$x = 0.511$ A2N2

[18]

6.) (a)



A1A1A1 N3

Note: *Award A1 for f being of sinusoidal shape, with 2 maxima and one minimum,*
A1 for g being a parabola opening down,
A1 for ***two*** *intersection points in approximately correct position.*

(b) (i) (2,0) (accept $x = 2$) A1 N1

(ii) period = 8 A2N2

(iii) amplitude = 5 A1N1

(c) (i) (2, 0), (8, 0) (accept $x = 2$, $x = 8$) A1A1 N1N1

(ii) $x = 5$ (must be an equation) A1N1

(d) **METHOD 1**

intersect when $x = 2$ and $x = 6.79$ (may be seen as limits of integration) A1A1

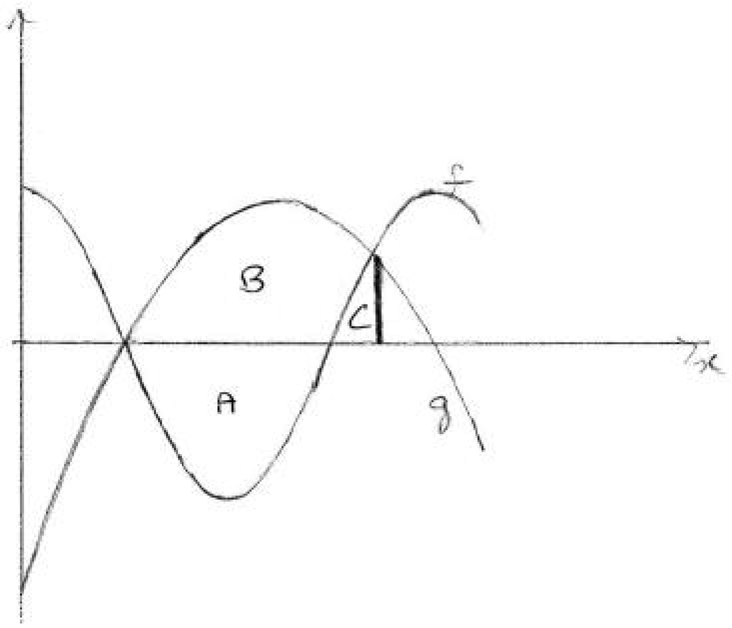
evidence of approach (M1)

e.g. $\int g - f, \int f(x)\mathrm{d}x - \int g(x)\mathrm{d}x, \int_2^{6.79}\left((-0.5x^2 + 5x - 8 - \left(5\cos\frac{\pi}{4}x\right)\right)$

area = 27.6 A2N3

METHOD 2

intersect when $x = 2$ and $x = 6.79$ (seen anywhere) A1A1 evidence of approach using a sketch of g and f, or $g - f$. (M1)

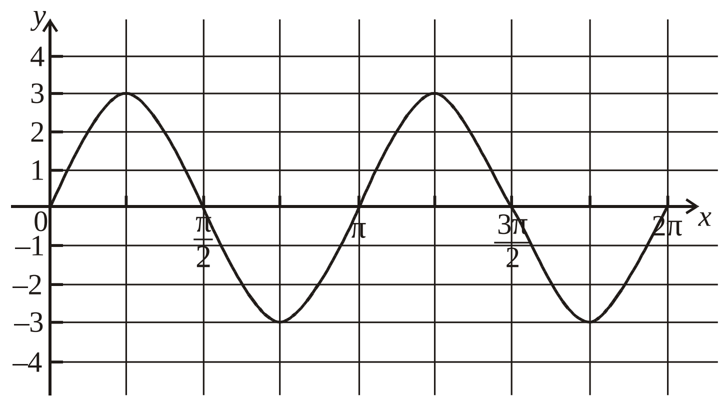


e.g. area $A + B - C$, 12.7324 + 16.0938 – 1.18129...
area = 27.6 A2N3

[15]

7.) (a) period = π A1 N1

(b)



A1A1A1 N3

Note: *Award A1 for amplitude of 3, A1 for **their** period, A1 for a sine curve passing through (0, 0) and (0, 2p).*

(c) evidence of appropriate approach (M1)

e.g. line $y = 2$ on graph, discussion of number of solutions in the domain

4 (solutions) A1 N2

[6]

8.) (a) (i) range of f is $[-1, 1]$, $(-1 \le f(x) \le 1)$ A2 N2

(ii) $\sin^3 x = 1 \Rightarrow \sin x = 1$ A1 justification for one solution on [0, 2π] R1

e.g. $x=\frac{\pi}{2}$, unit circle, sketch of sin x

1 solution (seen anywhere) A1 N1

(b) $f'(x) = 3\sin^2 x\cos x$ A2 N2

(c) using $V=\int_a^b \pi y^2 \mathrm{d}x$ (M1)

$$V=\int_0^{\frac{\pi}{2}} \pi\left(\sqrt{3}\sin x\cos^{\frac{1}{2}} x\right)^2 \mathrm{d}x$$ (A1)

$$=\pi\int_0^{\frac{\pi}{2}} 3\sin^2 x\cos x\,\mathrm{d}x$$ A1

$$V=\pi\left[\sin^3 x\right]_0^{\frac{\pi}{2}} \quad \left(=\pi\left(\sin^3\left(\frac{\pi}{2}\right)-\sin^3 0\right)\right)$$ A2

evidence of using sin $\frac{\pi}{2}=1$ and sin 0 = 0 (A1)

e.g. π(1 – 0)

$V = \pi$ A1 N1

[14]

9.) (a) (i) 7 A1 N1

(ii) 1 A1 N1

(iii) 10 A1 N1

(b) (i) evidence of appropriate approach M1

e.g. $A=\frac{18-2}{2}$

$A = 8$ AG N0

(ii) $C = 10$ A2 N2

(iii) **METHOD 1**

period = 12 (A1)

evidence of using $B \times$ period = 2π (accept 360°) (M1)

e.g. $12 = \frac{2\pi}{B}$

$B=\frac{\pi}{6}$ (accept 0.524 or 30) A1 N3

METHOD 2

evidence of substituting (M1)

e.g. $10 = 8\cos 3B + 10$

simplifying (A1)

e.g. $\cos 3B = 0$ $\left(3B = \frac{\pi}{2}\right)$

$B = \frac{\pi}{6}$ (accept 0.524 or 30) A1 N3

(c) correct answers A1A1

e.g. $t = 3.52$, $t = 10.5$, between 03:31 and 10:29 (accept 10:30) N2

[11]

10.) (a) (i) attempt to substitute (M1)

e.g. $a = \frac{29-15}{2}$

$a = 7$ (accept $a = -7$) A1 N2

(ii) period = 12 (A1)

$b = \frac{2\pi}{12}$ A1

$b = \frac{\pi}{6}$ AG N0

(iii) attempt to substitute (M1)

e.g. $d = \frac{29+15}{2}$

$d = 22$ A1 N2

(iv) $c = 3$ (accept $c = 9$ from $a = -7$) A1 N1

Note: *Other correct values for c can be found,* $c = 3 \pm 12k,\ k \in \mathbb{Z}$.

(b) stretch takes 3 to 1.5 (A1)

translation maps (1.5, 29) to (4.5, 19) (so M′ is (4.5, 19)) A1 N2

(c) $g(t) = 7\cos\frac{\pi}{3}(t - 4.5) + 12$ A1A2A1 N4

Note: *Award A1 for* $\frac{\pi}{3}$, ***A2*** *for 4.5, A1 for 12.*

Other correct values for c can be found $c = 4.5 \pm 6k,\ k \in \mathbb{Z}$.

(d) translation $\begin{pmatrix} -3 \\ 10 \end{pmatrix}$ (A1)

horizontal stretch of a scale factor of 2 (A1)

completely correct description, in correct order A1 N3

e.g. translation $\begin{pmatrix} -3 \\ 10 \end{pmatrix}$ then horizontal stretch of a scale factor of 2

[16]

11.) (a) $p = 30$ A2 N2

(b) **METHOD 1**

Period = $\frac{2\pi}{q}$ (M2)

$= \dfrac{\pi}{2}$ (A1)

$\Rightarrow q = 4$ A1N4

METHOD 2

Horizontal stretch of scale factor = $\dfrac{1}{q}$ (M2)

scale factor = $\dfrac{1}{4}$ (A1)

$\Rightarrow q = 4$ A1N4

[6]

12.) (a) When $t = 1$, $l = 33 + 5 \cos 720$ (M1)
$l = 33 + 5 = 38$ A1 N2

(b) Minimum when cos = –1 (M1)
$l_{\min} = 33 - 5$ (M1)
$= 28$ A1N3

(c) $33 = 33 + 5\cos 720t$ $(0 = 5 \cos 720t)$ M1
$720t = 90$ A1
$t = \dfrac{90}{720}\left(= \dfrac{1}{8}\right)$ A1N1

(d) Evidence of dividing into 360 (M1)
period = $\dfrac{360}{720}\left(= \dfrac{1}{2}\right)$ A1N2

[10]

13.) (a) period = $\dfrac{2\pi}{2} = \pi$ M1A1 N2

(b) $m = \dfrac{\pi}{2}$ A2N2

(c) Using $A = \int_0^{\frac{\pi}{2}} \sin 2x \mathrm{d}x$ (M1)

Integrating correctly, $A = \left[-\dfrac{1}{2}\cos 2x\right]_0^{\frac{\pi}{2}}$ A1

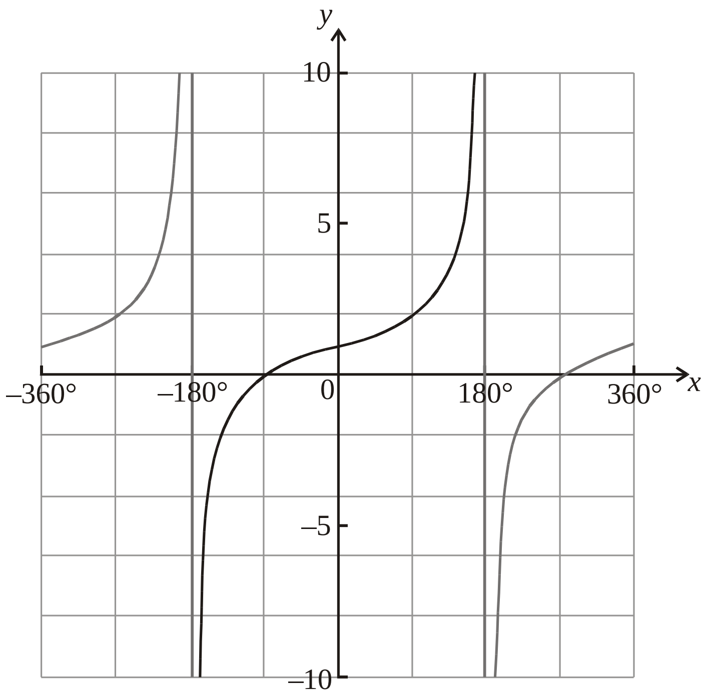
Substituting, $A = -\dfrac{1}{2}\cos\pi - (-\dfrac{1}{2}\cos 0)$ (M1)

Correct values, $A = -\dfrac{1}{2}(-1) - (-\dfrac{1}{2}(1))$ $\left(= \dfrac{1}{2} + \dfrac{1}{2}\right)$ A1A1

$A = 1$ A1N2

[10]

14.) (a)



Correct asymptotes A1A1 N2

(b) (i) Period = 360° (accept 2π) A1 N1

(ii) $f(90°) = 2$ A1 N1

(c) 270°, –90° A1A1 N1N1

***Notes**: Penalize **1 mark** for any additional values.*
*Penalize **1 mark** for correct answers given in radians* $\left(\frac{3\pi}{2}, -\frac{\pi}{2}, \text{or } 4.71, -1.57\right)$.

[6]

15.) (a) **METHOD 1**

Using the discriminant $\Delta = 0$ (M1)

$k^2 = 4 \times 4 \times 1$

$k = 4$, $k = -4$ A1A1 N3

METHOD 2

Factorizing (M1)

$(2x \pm 1)^2$

$k = 4$, $k = -4$ A1A1 N3

(b) Evidence of using $\cos 2q = 2\cos^2 q - 1$ M1

eg $2(2\cos^2 q - 1) + 4\cos q + 3$

$f(q) = 4\cos^2 q + 4\cos q + 1$ AG N0

(c) (i) 1 A1 N1

(ii) **METHOD 1**

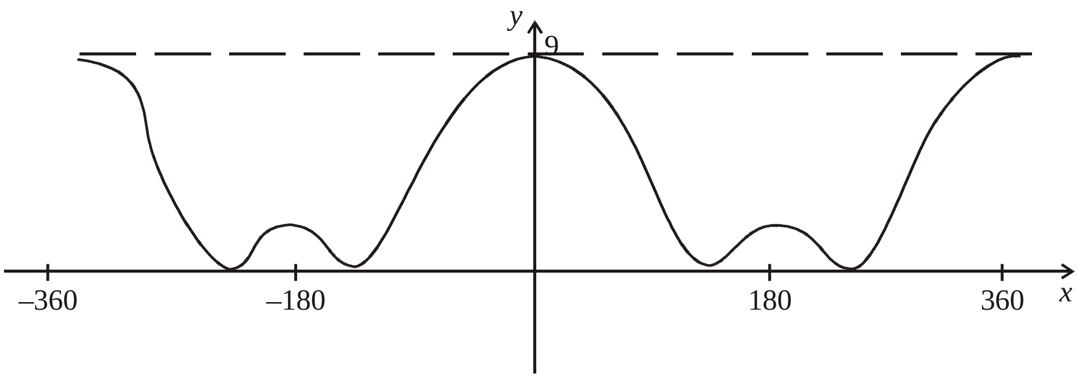
Attempting to solve for $\cos q$ M1

$\cos q = -\frac{1}{2}$ (A1)

q = 240, 120, – 240, –120 (correct four values only) A2 N3

METHOD 2

Sketch of $y = 4\cos^2 q + 4\cos q + 1$ M1



Indicating 4 zeros (A1)

q = 240, 120, –240, –120 (correct four values only) A2 N3

(d) Using sketch (M1)

$c = 9$ A1 N2

[11]

16.) $a = 4$, $b = 2$, $c = \frac{\pi}{2}\left(\text{or } \frac{3\pi}{2}\, etc\right)$ A2A2A2 N6

[6]

17.) (a) $p = 30$ A2 2

(b) **METHOD 1**

Period = $\frac{2®}{q}$ (M2)

$= \frac{®}{2}$ (A1)

$\Rightarrow q = 4$ A1 4

METHOD 2

Horizontal stretch of scale factor = $\frac{1}{q}$ (M2)

scale factor = $\frac{1}{4}$ (A1)

$\Rightarrow q = 4$ A1 4

[6]

18.) (a) when $y = 0$ (may be implied by a sketch) (A1)

$x = \frac{8\pi}{9}$ or 2.79 (A1) (C2)

(b) **METHOD 1**

Sketch of appropriate graph(s) (M1)
Indicating **correct** points (A1)
$x = 3.32$ or $x = 5.41$ (A1)(A1)(C2)(C2)

METHOD 2

$\sin\left(x + \frac{\pi}{9}\right) = -\frac{1}{2}$

$x + \frac{\pi}{9} = \frac{7\pi}{6}$, $x + \frac{\pi}{9} = \frac{11\pi}{6}$ (A1)(A1)

$x = \frac{7\pi}{6} - \frac{\pi}{9}$, $x = \frac{11\pi}{6} - \frac{\pi}{9}$

$x = \frac{19\pi}{18}$, $x = \frac{31\pi}{18}$ $(x = 3.32,\ x = 5.41)$ (A1)(A1)(C2)(C2)

[6]

19.) (a) (i) $f'(x) = \frac{1}{2} \times 2\cos 2x - \sin x$

$= \cos 2x - \sin x$ (A1)(A1) (N2)

Note: *Award (A1)(A1) for* $-2\sin^2 x - \sin x + 1$ *only if work shown, using product rule on* $\sin x \cos x + \cos x$.

(ii) $2\sin^2 x + \sin x - 1 = (2\sin x - 1)(\sin x + 1)$ or
$2(\sin x - 0.5)(\sin x + 1)$ (A1) (N1)

(iii) $2\sin x = 1$ or $\sin x = -1$

$\sin x = \frac{1}{2}$

$x = \frac{\pi}{6} = (0.524)$ $x = \frac{5\pi}{6} = (2.62)$ $x = \frac{3\pi}{2} = (4.71)$ (A1)(A1)(A1)(N1)

(N1)(N1) 6

(b) $x = \frac{\pi}{6}(= 0.524)$ (A1) (N1)1

(c) (i) **EITHER**

curve crosses axis when $x = \frac{\pi}{2}$ (may be implied) (A1)

Area $= \int_{\frac{\pi}{6}}^{\frac{\pi}{2}} f(x)\,\mathrm{d}x + \left| \int_{\frac{\pi}{2}}^{\frac{5\pi}{6}} f(x)\,\mathrm{d}x \right|$ (M1)(A1) (N3)

OR

Area $= \int_{\frac{\pi}{6}}^{\frac{5\pi}{6}} |f(x)|\,\mathrm{d}x$ (M1)(A2) (N3)

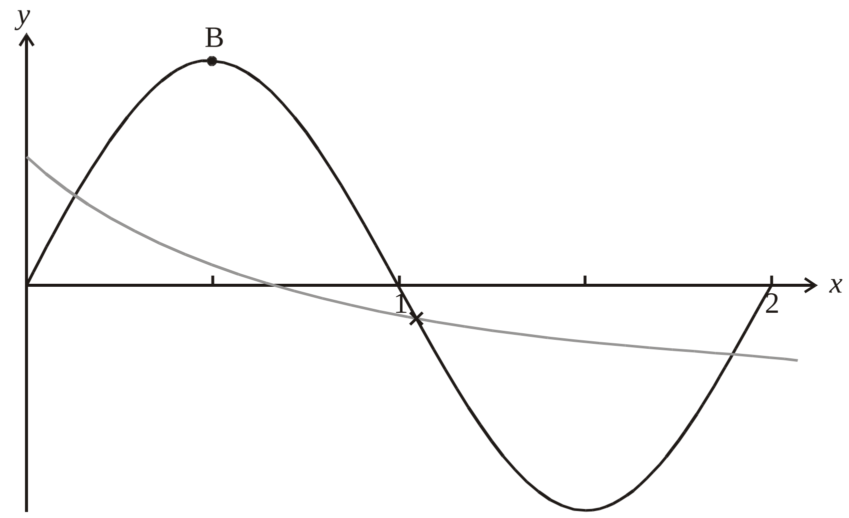
(ii) Area $= 0.875 + 0.875$ (M1)

$= 1.75$ (A1) (N2)5

[12]

20.) (a) $b = 6$ (A1) (C1)

(b)

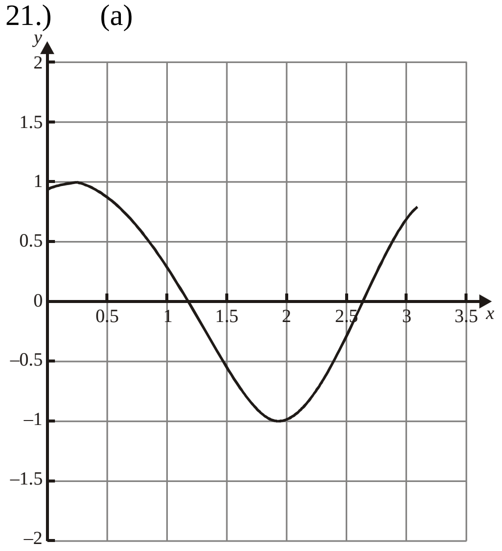


(A3) (C3)

(c) $x = 1.05$ (accept (1.05, −0.896)) (correct answer only, no additional solutions) (A2) (C2)

[6]

21.) (a)



(A1)(A1) (C2)

Note: *Award (A1) for the graph crossing the y-axis between 0.5 and 1, and (A1) for an approximate sine curve crossing the x-axis twice. Do* ***not*** *penalize for x >3.14.*

(b) (Maximum) $x = 0.285\ldots\left(\frac{\pi}{4} - \frac{1}{2}\right)$ (A1)

$x = 0.3$ (1 dp) (A1) (C2)

(Minimum) $x = 1.856\ldots\left(\frac{3\pi}{4} - \frac{1}{2}\right)$ (A1)

$x = 1.9$ (1 dp) (A1) (C2)

[6]

22.) $3 = p + q \cos 0$ (M1)
$3 = p + q$ (A1)
$-1 = p + q \cos \pi$ (M1)
$-1 = p - q$ (A1)

(a) $p = 1$ (A1) (C3)

(b) $q = 2$ (A1) (C3)

[6]

23.) (a) (i) $\cos\left(-\frac{\pi}{4}\right) = \frac{1}{\sqrt{2}}$, $\sin\left(-\frac{\pi}{4}\right) = -\frac{1}{\sqrt{2}}$ (A1)

therefore $\cos\left(-\frac{\pi}{4}\right) + \sin\left(-\frac{\pi}{4}\right) = 0$ (AG)

(ii) $\cos x + \sin x = 0 \Rightarrow 1 + \tan x = 0$
$\Rightarrow \tan x = -1$ (M1)
$x = \frac{3\pi}{4}$ (A1)

Note: *Award (A0) for 2.36.*

OR

$x = \frac{3\pi}{4}$ (G2) 3

(b) $y = e^x(\cos x + \sin x)$

$\frac{dy}{dx} = e^x(\cos x + \sin x) + e^x(-\sin x + \cos x)$ (M1)(A1)(A1) 3

$= 2e^x \cos x$

(c) $\frac{dy}{dx} = 0$ for a turning point $\Rightarrow 2e^x \cos x = 0$ (M1)

$\Rightarrow \cos x = 0$ (A1)

$\Rightarrow x = \frac{\pi}{2} \Rightarrow a = \frac{\pi}{2}$ (A1)

$y = e^{\frac{\pi}{2}}(\cos \frac{\pi}{2} + \sin \frac{\pi}{2}) = e^{\frac{\pi}{2}}$

$b = e^{\frac{\pi}{2}}$ (A1) 4

Note: *Award (M1)(A1)(A0)(A0) for $a = 1.57$, $b = 4.81$.*

(d) At D, $\frac{d^2y}{dx^2} = 0$ (M1)

$2e^x \cos x - 2e^x \sin x = 0$ (A1)
$2e^x (\cos x - \sin x) = 0$
$\Rightarrow \cos x - \sin x = 0$ (A1)

$\Rightarrow x = \dfrac{\pi}{4}$ (A1)

$\Rightarrow y = e^{\frac{\pi}{4}}(\cos\dfrac{\pi}{4} + \sin\dfrac{\pi}{4})$ (A1)

$= \sqrt{2}\, e^{\frac{\pi}{4}}$ (AG) 5

(e) Required area = $\int_0^{\frac{3}{4}} e^x (\cos x + \sin x)dx$ (M1)

= 7.46 sq units (G1)

OR

Area = 7.46 sq units (G2) 2

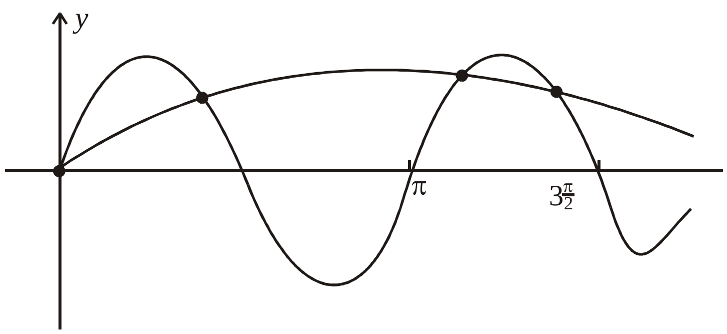
***Note**: Award (M1)(G0) for the answer 9.81 obtained if the calculator is in degree mode.*

[17]

24.) (a) (i) –1 (A1) (C1)

(ii) 4π (accept 720°) (A2) (C2)

(b)



(G1)

number of solutions: 4 (A2) (C3)

[6]

25.) **METHOD 1**

The value of cosine varies between –1 and +1. Therefore:

$t = 0 \Rightarrow a + b = 14.3$

$t = 6 \Rightarrow a - b = 10.3$

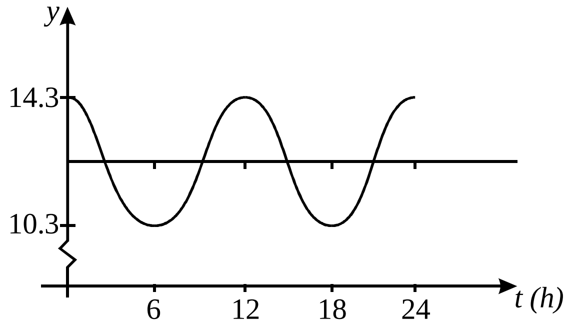
$\Rightarrow 2a = 24.6 \Rightarrow a = 12.3$ (A1) (C1)

$\Rightarrow 2b = 4.0 \Rightarrow b = 2$ (A1) (C1)

Period = 12 hours $\Rightarrow \dfrac{2\pi(12)}{k} = 2\pi$ (M1)

$\Rightarrow k = 12$ (A1) (C2)

METHOD 2



From consideration of graph: Midpoint = a = 12.3 (A1) (C1)

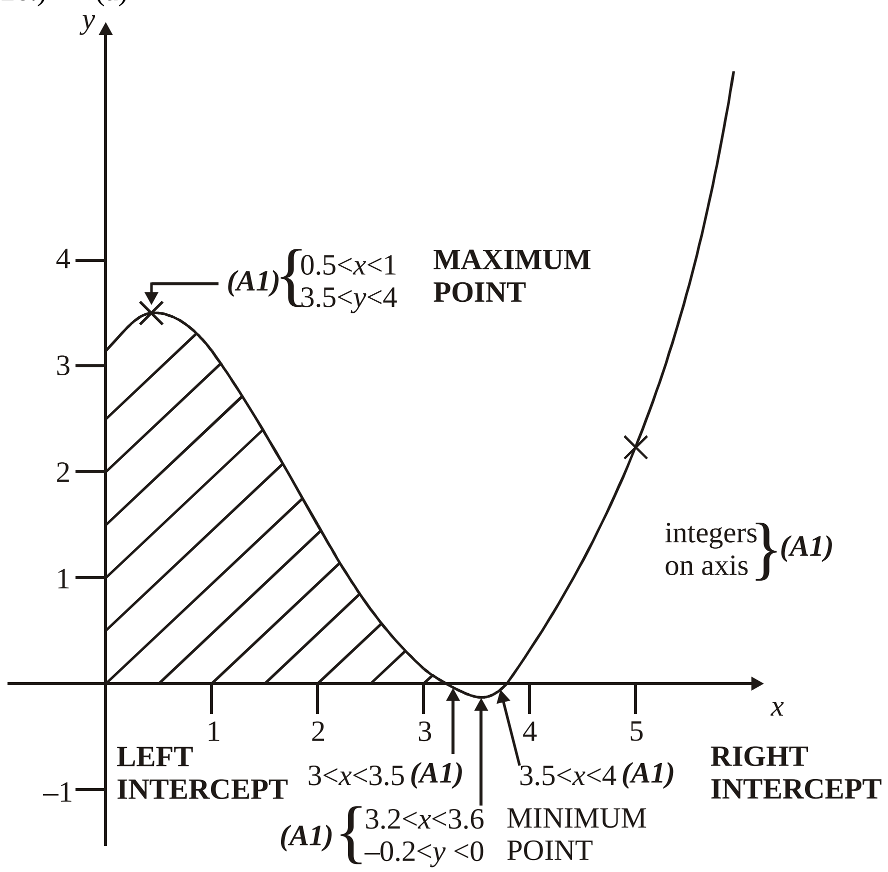
Amplitude = b = 2 (A1) (C1)

Period = $\dfrac{2\pi}{\frac{2\pi}{k}} = 12$ (M1)

$\Rightarrow k = 12$ (A1) (C2)

[4]

26.) (a)



5

(b) π is a solution if and only if $\pi + \pi \cos \pi = 0$. (M1)

Now $\pi + \pi \cos \pi = \pi + \pi(-1)$ (A1)

$= 0$ (A1) 3

(c) By using appropriate calculator functions x = 3.696 722 9... (M1)

$\Rightarrow x$ = 3.69672 (6sf) (A1) 2

(d) See graph: (A1)

$\int_0^{\pi}(\pi + x\cos x)\mathrm{d}x$ (A1) 2

(e) **EITHER** $\int_0^{\pi}(\pi + x\cos x)\mathrm{d}x$ = 7.86960 (6 sf) (A3) 3

Note: *This answer assumes appropriate use of a calculator eg*

'fnInt': $\begin{cases} fnInt(Y_1, X, 0, \pi) = 7.869604401 \\ with\, Y_1 = \pi + x\cos x \end{cases}$

OR $\int_0^{\pi}(\pi + x\cos x)\mathrm{d}x = [\pi x + x\sin x + \cos x]_0^{\pi}$

= π(π – 0) + (π sin π – 0 × sin 0) + (cos π – cos 0) (A1)

= π^2 + 0 + –2 = 7.86960 (6 sf) (A1) 3

[15]

27.) (a) (i) $Q = \frac{1}{2}(14.6 - 8.2)$ (M1)

= 3.2 (A1)

(ii) $P = \frac{1}{2}(14.6 + 8.2)$ (M0)

= 11.4 (A1) 3

(b) $10 = 11.4 + 3.2\cos\left(\frac{\pi}{6}t\right)$ (M1)

so $\frac{-7}{16} = \cos\left(\frac{\pi}{6}t\right)$

therefore $\arccos\left(\frac{-7}{16}\right) = \frac{\pi}{6}t$ (A1)

which gives $2.0236... = \frac{\pi}{6}t$ or t = 3.8648. t = 3.86(3 sf) (A1) 3

(c) (i)By symmetry, next time is 12 – 3.86... = 8.135... t = 8.14 (3 sf) (A1)

(ii) From above, first interval is 3.86 < t < 8.14 (A1)

This will happen again, 12 hours later, so (M1)

15.9 < t < 20.1 (A1) 4

[10]

28.) (a) $f(1) = 3$ $f(5) = 3$ (A1)(A1) 2

(b) **EITHER** distance between successive maxima = period (M1)

= 5 – 1 (A1)

= 4 (AG)

OR Period of sin $kx = \frac{2\pi}{k}$; (M1)

so period = $\frac{2\pi}{\frac{\pi}{2}}$ (A1)

= 4 (AG) 2

(c) **EITHER** $A\sin\left(\frac{\pi}{2}\right) + B = 3$ and $A\sin\left(\frac{3\pi}{2}\right) + B = -1$ (M1) (M1)

$\Leftrightarrow A + B = 3, -A + B = -1$ (A1)(A1)

$\Leftrightarrow A = 2, B = 1$ (AG)(A1)

OR Amplitude = A (M1)

$$A = \frac{3-(-1)}{2} = \frac{4}{2}$$ (M1)

$A = 2$ (AG)

Midpoint value = B (M1)

$$B = \frac{3+(-1)}{2} = \frac{2}{2}$$ (M1)

$B = 1$ (A1) 5

***Note:** As the values of A = 2 and B = 1 are likely to be quite obvious to a bright student, do not insist on too detailed a proof.*

(d) $f(x) = 2\sin\left(\frac{\pi}{2}x\right) + 1$

$f'(x) = \left(\frac{\pi}{2}\right)2\cos\left(\frac{\pi}{2}x\right) + 0$ (M1)(A2)

***Note:** Award (M1) for the chain rule, (A1) for* $\left(\frac{\pi}{2}\right)$*, (A1) for*

2 cos$\left(\frac{\pi}{2}x\right)$.

$= \pi\cos\left(\frac{\pi}{2}x\right)$ (A1) 4

***Notes:** Since the result is given, make sure that reasoning is valid. In particular, the final (A1) is for simplifying the result of the chain rule calculation. If the preceding steps are not valid, this final mark should not be given. Beware of "fudged" results.*

(e) (i) $y = k - \pi x$ is a tangent $\Rightarrow -\pi = \pi\cos\left(\frac{\pi}{2}x\right)$ (M1)

$\Rightarrow -1 = \cos\left(\frac{\pi}{2}x\right)$ (A1)

$\Rightarrow \frac{\pi}{2}x = \pi$ or 3π or ...

$\Rightarrow x = 2$ or 6 ... (A1)

Since $0 \le x \le 5$, we take $x = 2$, so the point is (2, 1) (A1)

(ii) Tangent line is: $y = -\pi(x-2) + 1$ (M1)

$y = (2\pi + 1) - \pi x$

$k = 2\pi + 1$ (A1) 6

(f) $f(x) = 2 \Rightarrow 2\sin\left(\frac{\pi}{2}x\right) + 1 = 2$ (A1)

$\Rightarrow \sin\left(\frac{\pi}{2}x\right) = \frac{1}{2}$ (A1)

$\Rightarrow \frac{\pi}{2}x = \frac{\pi}{6}$ or $\frac{5\pi}{6}$ or $\frac{13\pi}{6}$

$x = \frac{1}{3}$ or $\frac{5}{3}$ or $\frac{13}{3}$ (A1)(A1)(A1) 5

[24]