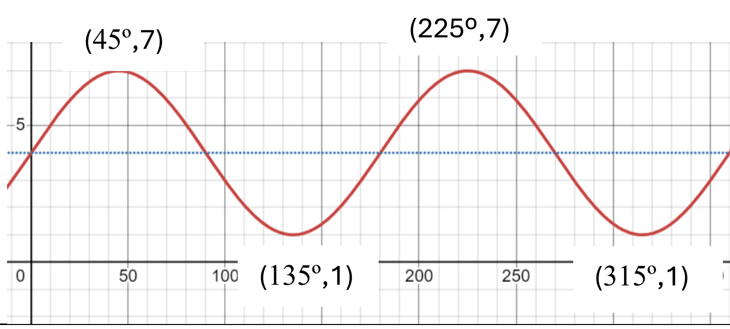
FMS(S) SEC 4 EXPRESS PRELIMINARY EXAMINATION 2024
ADDITIONAL MATHEMATICS PAPER 1 ANSWERS

1(i)	$4(x+1)^2-9$	(ii)	$(-1,-9)$	2	$a=4$ and $b=2$

3(i)	$\angle CAE = \angle ABC$ (alt segment theorem/tangent chord thm) $\angle ACB = \angle CAE$ (alternate $\angle$s, $BC//AE$) $\angle ABC = \angle ACB$ (base $\angle$s of isos Δ) $\therefore AB = AC$ (*shown*)

3(ii)	$\angle BAC = 180^\circ - 2\angle ABC$ ($\angle$ sum of Δ) $\angle BDC = \angle BAC$ ($\angle$s in same segment) $\angle CDE = 180^\circ - \angle BDC$ (adj $\angle$s on a straight line) $\angle CDE = 180^\circ - (180^\circ - 2\angle ABC)$ (adj $\angle$s on a straight line) $\angle CDE = 2\angle ABC$ (shown)

4(a)(i)	period $= 8\pi$ $8\pi = \dfrac{\pi}{b} \Rightarrow b = \dfrac{1}{8}$	4(a) (ii)	$y = 4\tan\left(\dfrac{x}{8}\right)+3$

4(b)	

5(i)	Length of rectangle $= \dfrac{20-3x}{2}$ Area $= \left(\dfrac{20-3x}{2}\right)x - \dfrac{1}{2}x^2 \sin 60^\circ \ = 10x - \dfrac{3}{2}x^2 - \dfrac{1}{2}x^2\dfrac{\sqrt{3}}{2} = 10x - \left(\dfrac{6+\sqrt{3}}{4}\right)x^2$ (shown)

5(ii)	$x = \dfrac{20}{\left(6+\sqrt{3}\right)}$ =2.5866 = 2.6 (2 s.f.) $A = 13$ cm^2 (2 s.f.)

6(a)	$\dfrac{8x+13}{(1+2x)(2+x)^2} = \dfrac{4}{(1+2x)} - \dfrac{2}{(2+x)} + \dfrac{1}{(2+x)^2}$	7(a)	$a=19, b=12$
6(b)	$2\ln\dfrac{5}{4}+\dfrac{1}{12}$ or $\ln\dfrac{25}{16}+\dfrac{1}{12}$ or 0.530 (3 s.f.)	7(b)	$x=0.270$ or $x=-4.94$ (3 s.f.)

8(a)	$2^{3x+4} \times 5^{2x-1} = 16^x \times 5^{3x}$ $2^{3x} \times 2^4 \times 5^{2x} \times 5^{-1} = 2^{4x} \times 5^{3x}$ $\frac{16}{5} = 2^{4x} \div 2^{3x} \times 5^{3x} \div 5^{2x}$ $\frac{16}{5} = 2^x \times 5^x$ $\frac{16}{5} = 10^x$ $\lg\frac{16}{5} = \lg 10^x$ $x \lg 10 = \lg\frac{16}{5}$ $x = \lg\frac{16}{5}$ (shown)	8(b)	$2\log_2 x - \log_2(x-4) = 3$ $\log_2 x^2 - \log_2(x-4) = 3$ $\log_2 \frac{x^2}{x-4} = 3$ $\frac{x^2}{x-4} = 2^3$ $x^2 - 8x + 32 = 0$ Either $b^2 - 4ac = (-8)^2 - 4(1)(32) = -64 < 0$ $\therefore$ no real solutions (shown) OR $x = \frac{-(-8) \pm \sqrt{(-8)^2 - 4(1)(32)}}{2(1)} = \frac{8 \pm \sqrt{-64}}{2}$ $\sqrt{-64}$ does exist, $\therefore$ no real solutions (shown)

9(a)	$k = 8$	9(b)(i)	24 g	9(b)(ii)	34.7 or 35 days	9(b)(iii)	mass is decreasing at 0.475 g/day

10(i)	LHS $= \frac{\tan^2 x + (1+\sec x)^2}{\tan x(1+\sec x)}$ $= \frac{\tan^2 x + 1 + 2\sec x + \sec^2 x}{\tan x(1+\sec x)}$ $= \frac{2\sec^2 x + 2\sec x}{\tan x(1+\sec x)}$ $= \frac{2\sec x(\sec x + 1)}{\tan x(1+\sec x)}$ $= \frac{2}{\cos x} \div \frac{\sin x}{\cos x}$ $= \frac{2}{\sin x}$ (shown)	10(ii)	$41.8^\circ, 138.2^\circ$ (1 d.p.)

11(i)	Sub $(k, k-3)$ into $y = (9-x)(x-3)$ $k - 3 = (9-k)(k-3)$ $k - 3 = 9k - 27 - k^2 + 3k$ $k^2 - 11k + 24 = 0$ $(k-3)(k-8) = 0$ $k = 3 (N.A.)$ or $k = 8$ (shown)	11(ii)	$12\frac{2}{3}$ units^2

12(i)	$(2,6)$	12(ii)	Since $OT = RT = 5$ units, ΔORT is isosceles.	12(iii)	$(-8,1)$	12(iv)	25 units^2