HSoG N5 Model Papers

Paper E:1

(1) $2\frac{1}{3} + \frac{5}{6}$ of $1\frac{2}{5}$ (X first: "of" means X)

$\frac{5}{6} \times \frac{7}{5} = \frac{35}{30} (\div 5) = \frac{7}{6}$

$= 1\frac{1}{6}$.

Then $2\frac{1}{3} + 1\frac{1}{6}$

$= 3\left(\frac{1}{3} + \frac{1}{6}\right)$ (LCM = 6)

$= 3\left(\frac{2}{6}^{(\times 2)} + \frac{1}{6}\right) = 3\frac{3}{6} = \underline{\underline{3\frac{1}{2}}}$

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(2) $(4x+2)(x-5) + 3x$ (FOIL): $4x \times x = 4x^2$

$4x \times (-5) = -20x$

$2 \times x = 2x$

$2 \times (-5) = -10$

$= 4x^2 - 20x + 2x - 10 + 3x$

$= \underline{\underline{4x^2 - 15x - 10}}$ (Collect "x" terms together)

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(3) (Choose any 2 points) $(\underset{x_1}{1}, \underset{y_1}{4})$ and $(\underset{x_2}{3}, \underset{y_2}{0})$

(Gradient) $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{0-4}{3-1} = \frac{-4}{2} = -2$

$y = mx + c$

$\Rightarrow y = (-2)x + c$ (Use x, y from any point e.g. $(\underset{x}{1}, \underset{y}{4})$)

$\Rightarrow 4 = (-2) \times 1 + c \Rightarrow 4 = -2 + c$ $(+2)$

$\Rightarrow 6 = c$ or $c = 6$

Eqn. of line is: $\underline{\underline{y = -2x + 6}}$

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(4) $\frac{2}{x} + 9 = 16$ $(\times x)$ ← Remove fractions

$\Rightarrow \frac{2\cancel{x}}{\cancel{x}} + 9x = 16x$ $\Rightarrow 2 + 9x = 16x$

(4) cont.

$$2 + 9x = 16x \quad (-9x)$$
$$\Rightarrow 2 = 7x$$
$$\text{or} \quad 7x = 2 \quad (\div 7)$$
$$\Rightarrow \underline{\underline{x = \frac{2}{7}}}$$

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(5) $2x^2 - 2x - 1 = 0$ $\quad a = 2,\ b = -2,\ c = -1$ (Use Quadratic Formula)

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$= \frac{2 \pm \sqrt{(-2)^2 - 4 \times 2 \times (-1)}}{2 \times 2} = \frac{2 \pm \sqrt{4 - (-8)}}{4}$$

$$= \frac{2 \pm \sqrt{12}}{4} \qquad \text{Now } \sqrt{12} = \sqrt{4} \times \sqrt{3} = 2\sqrt{3}$$

$$x = \frac{2 \pm 2\sqrt{3}}{4} = \frac{\cancel{2}(1 \pm \sqrt{3})}{\cancel{2} \times 2} = \frac{1 \pm \sqrt{3}}{2}$$

$$\text{So } \underline{\underline{x = \frac{1 \pm \sqrt{3}}{2} \quad \text{Proved}}}$$

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(6) $y = 36 - (x-2)^2$ $\quad$ a) Max. at $\underline{(2, 36)}$

(i.e. when $(x-2) = 0$ so $(x-2)^2$ is as <u>small</u> as possible. Then $y = 36 - 0 = 36$)

b) Eqn. is $\underline{\underline{x = 2}}$ (parallel to y-axis $x = 0$; passes through turning point - so $x = 2$).

c) $S = (6, 20)$ $\quad 6 - 2 = 4$ so S is 4 units right of axis of symmetry $x = 2$

$\Rightarrow$ R is 4 units left of $x = 2$

(6) cont. $2-4=-2$ (x-coord. of R)

So $\underline{\underline{R = (-2, 20)}}$ (y-coord. is same as for S)

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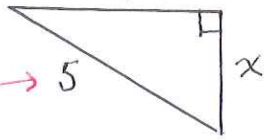
(7) (Top part of circle)



4 ← ($\frac{1}{2}$ of 8)

radius → 5

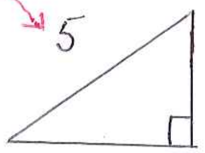
$x^2 + 4^2 = 5^2$ (Pythagoras)

$x^2 + 16 = 25$

$\Rightarrow x^2 = 25 - 16 \; (=9)$ So $x = \sqrt{9} = 3$ (cm)

(Bottom)

radius → 5



4 (7 − 3 ← from above)

($\frac{1}{2}$ of base) → y

$y^2 + 4^2 = 5^2$ (Pythagoras)

$y^2 + 16 = 25$

$\Rightarrow y^2 = 9$ So $y = \sqrt{9} = 3$ (cm)

$\underline{\underline{\text{Width of base} = 6\text{cm}}}$ (2×3)

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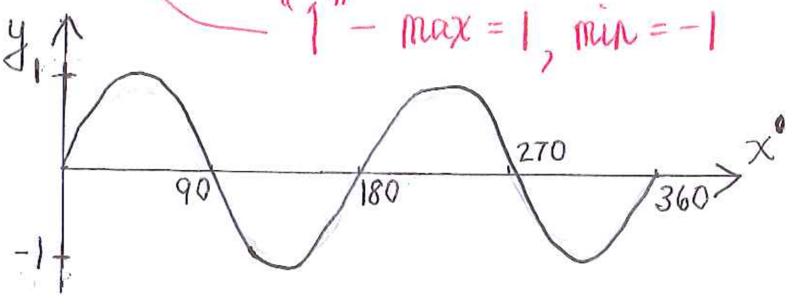
(8) $y = \sin 2x°$ → 2 complete periods ($0 \rightarrow 360°$)

"1" − max = 1, min = −1



(Mark points where graph meets x-axis)

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(9) a) $f(72) = 4\sqrt{72} + \sqrt{2}$ (Clue: we already have $\sqrt{2}$).

$= 4\sqrt{36}\sqrt{2} + \sqrt{2}$

$= 4 \times 6 \times \sqrt{2} + \sqrt{2} = 24\sqrt{2} + \underset{(1 \times \sqrt{2})}{\sqrt{2}} = \underline{\underline{25\sqrt{2}}}$

b) $f(t) = 3\sqrt{2}$

$\Rightarrow 4\sqrt{t} + \sqrt{2} = 3\sqrt{2}$ $(-\sqrt{2})$

$\Rightarrow 4\sqrt{t} = 2\sqrt{2}$ $(\div 4)$ $\Rightarrow \sqrt{t} = \frac{\sqrt{2}}{2}$

(9) cont. $\sqrt{t} = \frac{\sqrt{2}}{2}$ (square both sides)

$\Rightarrow t = \frac{2}{4} \Rightarrow \underline{\underline{t = \frac{1}{2}}}$

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(10) Area (Δ) $= \frac{1}{2} \times \text{base} \times \text{height}$

$\Rightarrow \frac{1}{2} \times 2x(2x-5) = 7$

$\Rightarrow x(2x-5) = 7 \Rightarrow 2x^2 - 5x = 7$ (-7)

$\Rightarrow 2x^2 - 5x - 7 = 0$

$\Rightarrow (2x-7)(x+1) = 0$

$2x \quad -7$
$x \quad +1$
$2x - 7x = -5x$ ✓

(Non-calculator paper: unlikely to need Quadratic Formula!)

$2x - 7 = 0$ or $x + 1 = 0$

$\Rightarrow 2x = 7$ $\quad \Rightarrow x = -1$ (Ignore -ve lengths)

$\Rightarrow x = 3\frac{1}{2}$

$\underline{\underline{\text{So } x = 3\frac{1}{2}}}$

Paper E:2 (1) $E = mc^2$

$= 3{\cdot}6 \times 10^{-2} \times (3 \times 10^8)^2$

$= \underline{\underline{3{\cdot}24 \times 10^{15}}}$ (by scientific calc.)

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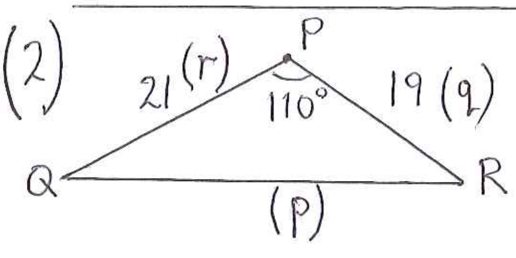
(2)



$A = \frac{1}{2} rq \sin P$

$= 0{\cdot}5 \times 21 \times 19 \times \sin 110°$

$= \underline{\underline{185{\cdot}7 \text{ cm}^2}}$

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(3) (At 11 pm) : $28 \times (0{\cdot}896)^3$

$= \underline{\underline{20{\cdot}1\,°C}}$

(8pm $\rightarrow$ 11pm = 3h)

($10{\cdot}4\% = 0{\cdot}104$ and $1{\cdot}00 - 0{\cdot}104 = 0{\cdot}896$)

(4) a) $C = \underline{\underline{(4,3,4)}}$ $D = \underline{\underline{(6,2,2)}}$ ((x,y,z) coords. Count the blocks)

b) $B = \underline{\underline{(6,4,2)}}$ (2 further along y-axis from D)

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(5) Scale factor (Volume) $= \dfrac{1600}{200} = 8$
(Sf)

and Sf (Volume) $= \left(\text{Sf (length)}\right)^3 = 8$

$\Rightarrow$ Sf (length) $= \sqrt[3]{8} = 2 \Rightarrow$ Height of salon size

travel size $\longrightarrow$ $= 2 \times 12 = \underline{\underline{24\text{ cm}}}$

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(6) b = length of 1 bead $\Rightarrow$ $2b + 5p = 5{\cdot}2$ $(\times(-2))$
p = " " 1 pearl $3b + 2p = 5{\cdot}6$ $(\times 5)$

(Other ways possible too) (to eliminate p)

$$\begin{array}{rl} -4b - 10p &= -10{\cdot}4 \\ + \quad 15b + 10p &= 28{\cdot}0 \\ \hline 11b \ (+0p) &= 17{\cdot}6 \end{array}$$

$\longrightarrow 11b = 17{\cdot}6 \ (\div 11)$
$\Rightarrow b = 1{\cdot}6$

Now replace $b = 1{\cdot}6$: $2b + 5p = 5{\cdot}2 \Rightarrow (2 \times 1{\cdot}6) + 5p = 5{\cdot}2$

$\Rightarrow 3{\cdot}2 + 5p = 5{\cdot}2$ $(-3{\cdot}2)$

$\Rightarrow 5p = 2{\cdot}0$ $(\div 5)$

$\Rightarrow p = 0{\cdot}4$

So $b = 1{\cdot}6$, $p = 0{\cdot}4 \longrightarrow$ <u>bead is 1·6cm long, pearl 0·4cm</u>

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(7) a) Sphere: $V = \frac{4}{3}\pi r^3 = 4 \div 3 \times \pi \times (0{\cdot}5)^3$

$= 0{\cdot}5235.... = \underline{\underline{0{\cdot}524\text{cm}^3 \text{ (3sf)}}}$

(0·523 if 3·14 used for π)

(7) b) (Cylinder) $V = \pi r^2 h$ $\left(r = 1{\cdot}4 \div 2 = 0{\cdot}7\text{cm}\right)$

$\Rightarrow 0{\cdot}524 = \pi \times 0{\cdot}7^2 \times h$

$\Rightarrow 0{\cdot}524 = 1{\cdot}539 \times h$

$\Rightarrow h = \dfrac{0{\cdot}524}{1{\cdot}539} = 0{\cdot}34$ <u>Height = 0·34cm</u>

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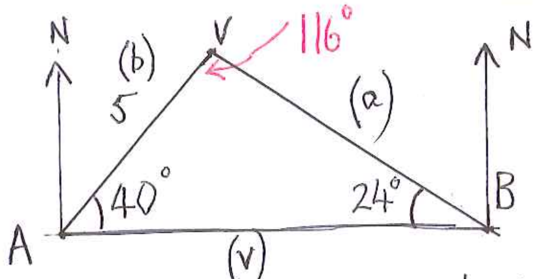
(8)



$\left(\angle A = 90 - 50 = 40^\circ\right.$
$\angle B = 294 - 270 = 24^\circ$
$\left.\angle V = 180 - 40 - 24 = 116^\circ\right)$

(Sine Rule): $\left(\dfrac{a}{\sin A}\right) = \dfrac{b}{\sin B} = \dfrac{V}{\sin V} \rightarrow ?$ $\Rightarrow \dfrac{5}{\sin 24^\circ} = \dfrac{V}{\sin 116^\circ}$ $(\times \sin 116^\circ)$

$\Rightarrow V = \dfrac{5 \times \sin 116^\circ}{\sin 24^\circ} = 11{\cdot}05 \Rightarrow$ <u>Hostels are 11·05 km apart</u>

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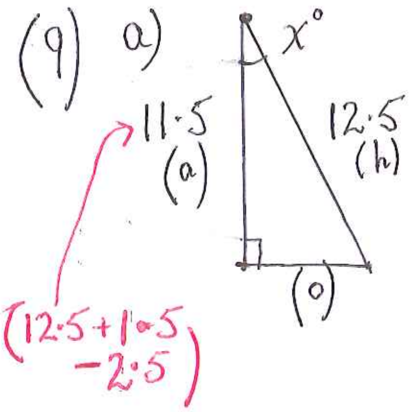
(9) a)



$\cos x^\circ = \dfrac{\text{adj}}{\text{hyp}} = \dfrac{11{\cdot}5}{12{\cdot}5}$ (SOH<u>C</u>AHTOA)

$\Rightarrow x^\circ = \cos^{-1}\left(\dfrac{11{\cdot}5}{12{\cdot}5}\right) = \cos^{-1} 0{\cdot}92$

$= 23{\cdot}07^\circ$ <u>(approx 23°, as required)</u>

b) Chain swings through $2 \times 23 = 46^\circ$

Arc length $= \dfrac{46}{360} \times \pi \times 25$ $\left(D = 2 \times 12{\cdot}5 = 25 \text{ since } r = 12{\cdot}5\right)$

$= 10{\cdot}04$ = <u>10·0 m (to 3 sf)</u>

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(10) $kx^2 - 4x + 2 = 0$

$a = k$
$b = -4$
$c = 2$

($\sqrt{b^2 - 4ac} \geqslant 0$ for real roots)

Discriminant is $\sqrt{b^2 - 4ac}$

$= \sqrt{(-4)^2 - 4 \times k \times 2}$ ($\geqslant 0$ for real roots)

$\Rightarrow 16 - 8k \geqslant 0$ (-16)

$\Rightarrow -8k \geqslant -16$ $(\div(-8))$

$\Rightarrow k \leqslant \frac{-16}{-8}$

(Remember to reverse inequality sign when $\div$ (-ve))

$\Rightarrow \underline{\underline{k \leqslant 2}}$

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(11) a) $\sqrt{3}\sin x^\circ - 1 = 0$ $(+1)$

$\Rightarrow \sqrt{3}\sin x^\circ = 1$ $(\div\sqrt{3})$

$\Rightarrow \sin x^\circ = \frac{1}{\sqrt{3}}$ $(= 0.577)$

S ✓	A ✓
T	C

$\longrightarrow$ x° is in Quadrants 1 or 2 (since $\sin x^\circ$ is +ve)

Q1: $x = 35.3^\circ$ (from calculator)

Q2: $x = 180 - 35.3 = 144.7$

So $\underline{\underline{x = 35.3 \text{ or } 144.7}}$

b) $\tan x^\circ \cos x^\circ$

$= \frac{\sin x^\circ}{\cancel{\cos x^\circ}} \times \frac{\cancel{\cos x^\circ}}{1}$

(since $\tan x^\circ = \frac{\sin x^\circ}{\cos x^\circ}$)

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