Paper F:1

(1) $1\frac{3}{5} + 2\frac{4}{7}$

$= 3\left(\frac{3}{5} + \frac{4}{7}\right)$ LCM of 5 and 7 = 35

$\times 7$ $\times 5$

$= 3\left(\frac{21}{35} + \frac{20}{35}\right) = 3\left(\frac{41}{35}\right) = 3\left(\underbrace{\frac{35}{35}}_{=1} + \frac{6}{35}\right)$

$= 3 + 1\frac{6}{35} = \underline{4\frac{6}{35}}$

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(2) a) $4x^2 - y^2 = (2x)^2 - (y)^2$ (Difference of 2 squares)

$= \underline{\underline{(2x+y)(2x-y)}}$

b) $\dfrac{4x^2 - y^2}{6x + 3y} = \dfrac{\cancel{(2x+y)}(2x-y)}{3\cancel{(2x+y)}} = \underline{\underline{\dfrac{2x-y}{3}}}$

common factor = 3

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(3)
- Number of cigarettes smoked is less.
- Less consistent (greater variety of) number of cigarettes smoked.

(<u>Note</u>: Does <u>NOT</u> show that some people have <u>stopped smoking</u>).

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(4) a) 2 points are: $(\underset{x_1}{9}, \underset{y_1}{21})$ and $(\underset{x_2}{15}, \underset{y_2}{33})$

$m = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{33 - 21}{15 - 9} = \dfrac{12}{6} = 2$

Then $(y-b) = m(x-a)$ → Choose $(a, b) = (9, 21)$ (or $(15, 33)$)

$\Rightarrow y - 21 = 2(x - 9)$

$\Rightarrow y - 21 = 2x - 18$ $(+21)$ $\Rightarrow \underline{\underline{y = 2x + 3}}$ is equation

b) Film score = 20 $\Rightarrow x = 20$

$y = 2x + 3$
$= 2 \times 20 + 3 = 40 + 3 = 43$

<u>Sport score should be 43</u>

HSoG N5 Model Papers

(5) $\overrightarrow{AB} = \begin{pmatrix} 3 \\ 0 \\ -3 \end{pmatrix}$ so $|\overrightarrow{AB}| = \sqrt{3^2 + 0^2 + (-3)^2}$

$= \sqrt{9 + 0 + 9}$

$= \sqrt{18} = \sqrt{9} \times \sqrt{2} = \underline{\underline{3\sqrt{2}}}$

($|\overrightarrow{AB}|$ = length of $\overrightarrow{AB}$ "magnitude")

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(6) $13 + 4x < 18 - 7(2 - x)$

$\Rightarrow 13 + 4x < 18 - 14 - (-7x)$

$\Rightarrow 13 + 4x < 4 + 7x$ $(-7x)$

$\Rightarrow 13 - 3x < 4$ (-13)

$\Rightarrow -3x < -9$ $(\div(-3))$

$\Rightarrow x > \frac{-9}{-3}$

$\Rightarrow \underline{\underline{x > 3}}$

(Remove brackets - watch out for (-ve) sign)

(Divide by (-ve) → reverse inequality sign)

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(7) $\underline{\underline{y = (x-1)^2 - 4}}$

(Graph moved 1 unit to right → so $(x-1)$; also moved <u>down</u> 4 units → so "-4")

Yes, it is!!

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(8) a) $2y + x = 6$ $(-x)$

$\Rightarrow 2y = -x + 6$ $(\div 2)$

$\Rightarrow y = -\frac{1}{2}x + 3$

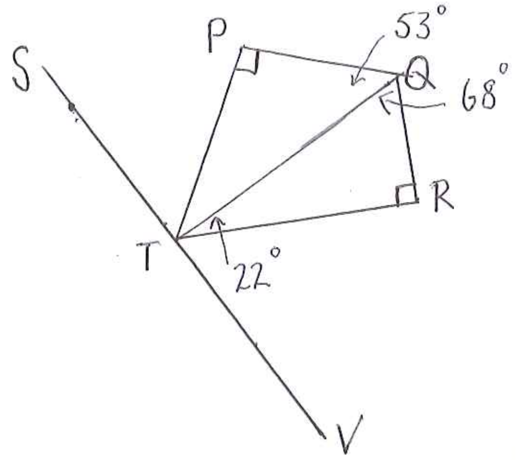
$\underline{\underline{\text{Hence gradient} = -\frac{1}{2}}}$

(Re-arrange into form $y = mx + c$ → make "y" the subject)

(multiplier of x)

b) $\underline{\underline{c = 3}}$ ($y = mx + \underline{\underline{c}}$)

(9)



$\angle QTR = 22°$ (90 − 68 ← QT meets tangent at 90°)

So $\angle TQR$

$= 180 - 90 - 22$

$= 68°$ ($\angle QRT = 90°$ − angle in a semi-circle)

Likewise $\angle PQT$

$= 180 - 90 - 37 = 53°$

So $\angle PQR = 68 + 53 = \underline{\underline{121°}}$

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(10) $\underline{\underline{a = 30}}$ (Maxima of graph are at 30°, 390° instead of 0°, 360° → graph moved 30° to right compared to $y = \cos x°$).

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(11) Standard size = 100%

so Special offer = 120% (= 900g)

(DO NOT calculate 20% of 900 and subtract)

$1\% = \frac{900}{120}$ so $100\% = \frac{\cancel{900}^{30}}{\cancel{120}_{4}} \times \frac{100}{1}$

$= \frac{3000}{4} = \underline{\underline{750g \text{ in the Standard box}}}$

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(12) a) $x^2 - 3x + 5 = 0$ $a = 1$, $b = -3$, $c = 5$

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

$= \sqrt{(-3)^2 - 4 \times 1 \times 5} = \sqrt{9 - 20} = \sqrt{-11}$ (No $\sqrt{\ }$ of a (-ve) number)

$\underline{\underline{\text{As discriminant} < 0, \text{there are no real roots}}}$

b) $y = x^2 - 3x + 5 = \left(x - \frac{3}{2}\right)^2 - \left(\frac{3}{2}\right)^2 + 5$

($\frac{1}{2}$ of 3) (Unwanted "extra" from brackets)

(12) (b) cont. $y = \left(x - \frac{3}{2}\right)^2 - \frac{9}{4} + \frac{20}{4}$ (= 5)

$$y = \left(x - \frac{3}{2}\right)^2 + \frac{11}{4}$$

c) $y = \left(x - \frac{3}{2}\right)^2 + \frac{11}{4} \rightarrow$ Min. turning pt. when $\left(x - \frac{3}{2}\right)^2 = 0$

$\Rightarrow x - \frac{3}{2} = 0 \Rightarrow x = \frac{3}{2}$

At turning pt, $y = 0^2 + \frac{11}{4} = \frac{11}{4}$ i.e. $\left(\frac{3}{2}, \frac{11}{4}\right)$

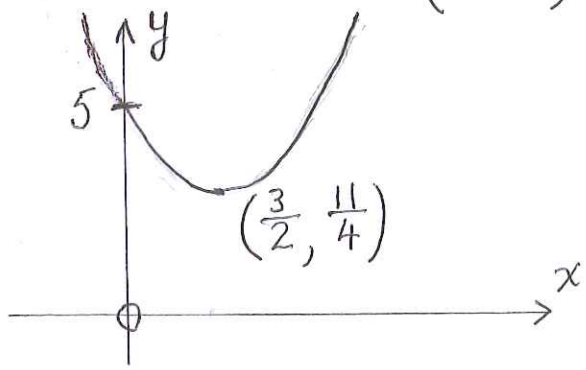
When $x = 0$, $y = x^2 - 3x + 5$

(Intersect y-axis)

$= 0^2 - 3 \times 0 + 5$

$= 5$ $(0, 5)$

(Note misprint on Question Paper: $x^2 - 3x + \cancel{1}$ $\underline{+5}$)



(13) a) Δ Area $= \frac{1}{2} \times b \times h$

$= \frac{1}{2} \times 20 \times 15$

$= 10 \times 15 = \underline{150\,m^2}$

(Base, height at 90° to each other: treat AB and BC as base and height)

b) Area $= \frac{1}{2} \times b \times h$

$150 = \frac{1}{2} \times 25 \times BD$ $(\times 2)$

$\Rightarrow 300 = 25 \times BD$ $(\div 25)$

$\Rightarrow BD = \frac{300}{25}$ $\underline{BD = 12\,m^2}$

Paper F:2

(1) $r = 4{\cdot}96 \times 10^7$ (49 600 000 km)
$D = 2 \times 4{\cdot}96 \times 10^7$ ($9{\cdot}92 \times 10^7$ or 99200 000)

$C = \pi D$
$= \pi \times 2 \times 4{\cdot}96 \times 10^7 = 311645991$ km
$= \underline{\underline{3{\cdot}12 \times 10^8 \text{ km (to 3sf)}}}$

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(2) $35\,000 \times (0{\cdot}92)^4$ (4 years)
$= 25073{\cdot}75$ ($8\% = 0{\cdot}08$ and $1{\cdot}0 - 0{\cdot}08 = 0{\cdot}92$)

<u>The boat is worth £25073·75</u>

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(3) $\frac{x}{c} + a = b$ $(-a)$
$\Rightarrow \frac{x}{c} = b - a$ $(\times c)$
$\Rightarrow \frac{x}{\cancel{c}} \times \frac{\cancel{c}}{1} = c(b-a)$ $\Rightarrow \underline{\underline{x = bc - ac}}$

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(4) $4x + 2y = 13$ $(\times 3)$
$5x + 3y = 17$ $(\times(-2))$ (We want $+6y$ and $(-6y)$ to eliminate y)

So $12x + 6y = 39$
$\oplus$ $(-10x) - 6y = -34$
$2x = 5$ $\Rightarrow x = \frac{5}{2}$ $\rightarrow$ Replace $x = \frac{5}{2}$:

$4x + 2y = 13$
$\Rightarrow \frac{4}{1} \times \frac{5}{2} + 2y = 13$ $\left(\frac{20}{2} = 10\right)$
$\Rightarrow 10 + 2y = 13$ (-10)
$\Rightarrow 2y = 3$ $(\div 2)$ $\Rightarrow y = \frac{3}{2}$ $\underline{\underline{x = \frac{5}{2},\ y = \frac{3}{2}}}$

(Other methods possible e.g. eliminate x instead of y)

(5) $V(\text{cone}) = \frac{1}{3}\pi r^2 h$ $r = 5$, $h = 11$ $(16 - 5)$

$= \dfrac{\pi \times 5^2 \times 11}{3}$

$= 287{\cdot}98\ (\text{cm}^3)$

$V(\text{hemisphere}) = \frac{1}{2} \times \left(\frac{4}{3}\pi r^3\right)$ $(r = 5)$

$= \frac{2}{3} \times \pi \times 5^3 = 261{\cdot}80\ (\text{cm}^3)$

Total Volume $= 287{\cdot}98 + 261{\cdot}80 = 549{\cdot}78$

$= \underline{\underline{550\ \text{cm}^3}}$ (to 2sf)

(same final answer if $\pi = 3{\cdot}14$ used)

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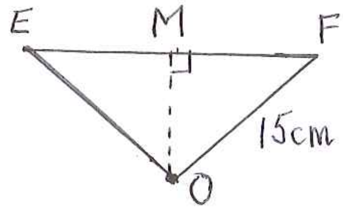
(6)



(M is midpoint of EF ; $\angle OMF = 90°$ - calculate OM)

$OM^2 + MF^2 = OF^2$ (Pythagoras)

$\Rightarrow OM^2 + 9^2 = 15^2$ $(MF = 18 \div 2 = 9\text{cm})$

$\Rightarrow OM^2 + 81 = 225$ (-81)

$\Rightarrow OM^2 = 225 - 81 = 144 \Rightarrow OM = \sqrt{144} = 12\text{cm}$

(radius + OM) $\longrightarrow$ So width of stand $= 15 + 12 = \underline{\underline{27\text{cm}}}$

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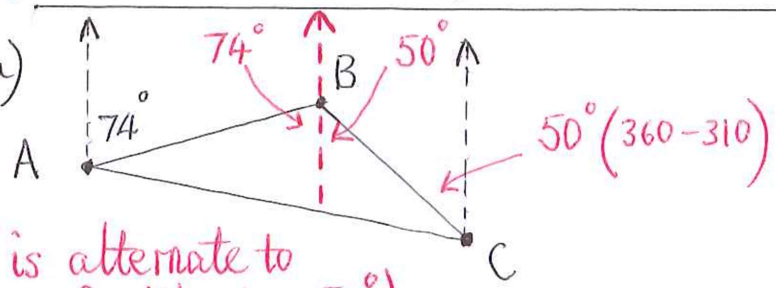
(7) a)



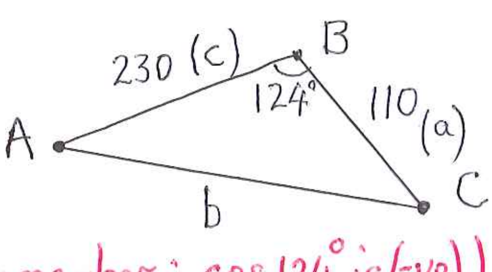
(74° is alternate to given 74°; likewise 50°)

a) Angle ABC ($\angle ABC$)

$= 74° + 50°$

$= \underline{\underline{124°}}$

b)



(Remember: cos 124° is (−ve))

$b^2 = a^2 + c^2 - 2ac\cos\hat{B}$ (Cosine Rule)

$= 110^2 + 230^2 - 2 \times 110 \times 230 \times \cos 124°$

$= 12100 + 52900 - (-28295)$

$(= 12100 + 52900 + 28295)$

7b) (cont) $b^2 = 93295$

$\Rightarrow b = \sqrt{93295} = 305\cdot4 \Rightarrow \underline{\underline{AC = 305\,m \text{ (to 3sf)}}}$

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(8) $\left(\dfrac{3}{(x+1)} - \dfrac{1}{(x-2)}\right)$ (LCM $= (x+1)(x-2)$)

$\left(\times (x-2)\right)$ $\left(\times (x+1)\right)$

$= \dfrac{3(x-2) - 1(x+1)}{(x+1)(x-2)} = \dfrac{3x - 6 - x - 1}{(x+1)(x-2)}$

$= \underline{\underline{\dfrac{2x-7}{(x+1)(x-2)}}}$

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(9) Pointer 9cm long $\longrightarrow r = 9$ (cm) so $D = 18$ cm

Arc length (284° angle) $= \dfrac{284}{360} \times \pi \times 18 = 44\cdot6$ cm

100g moves pointer 2cm : $\dfrac{44\cdot6}{2} \times 100 = 2230$(g)

(number of "100g")

$\Rightarrow$ $\underline{\underline{\text{Parcel weighs 2230g (2·23kg)}}}$

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(10) a) $d = \frac{1}{2}n(n-3)$ (Replace "n" by 7)

$= \frac{1}{2} \times 7 \times (7-3) = \frac{1}{2} \times 7 \times 4 = \frac{1}{2} \times 28$ $(=14)$

$\Rightarrow$ $\underline{\underline{\text{14 diagonals}}}$

b) $d = 65 \Rightarrow \frac{1}{2}n(n-3) = 65$ $(\times 2)$

$\Rightarrow \frac{\cancel{2}}{1} \times \frac{1}{\cancel{2}} n(n-3) = 130$

$\Rightarrow n(n-3) = 130 \Rightarrow n^2 - 3n = 130$ (-130)

$\Rightarrow \underline{\underline{n^2 - 3n - 130 = 0}}$ (As required)

(10) cont. c) $n^2 - 3n - 130 = 0$

$\Rightarrow (n+10)(n-13) = 0$

$\Rightarrow n + 10 = 0$ or $n - 13 = 0$

$\Rightarrow \cancel{n = -10}$ $\quad \Rightarrow n = 13$ ✓

(Ignore: can't have (-ve) number)

$\begin{array}{r} 10 \\ +(-13) \\ \hline -3 \end{array}$ ✓ (Factors of (-130))

(Or solve using Quadratic Formula)

So the polygon has 13 sides

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(11) a) $h = -31 \cos t^\circ + 33$ (replace "t" by 20)

$= -31 \cos 20^\circ + 33$ ($\cos 20^\circ = 0{\cdot}9397$)

$= 3{\cdot}87$ $\Rightarrow$ She is 3·87m above ground

b) $-31 \cos t^\circ + 33 = 60$ (-33)

$\Rightarrow -31 \cos t^\circ = 27$ $(\div(-31))$

$\Rightarrow \cos t^\circ = \frac{27}{(-31)} = -0{\cdot}871$

For $\cos x^\circ = +0{\cdot}871$

$\Rightarrow x^\circ = 29{\cdot}4^\circ$

(Related acute angle).

✓S	A
✓T	C

(since $\cos t^\circ$ is (-ve))

t° is in Q2:

$t = 180 - 29{\cdot}4$

$= 150{\cdot}6$

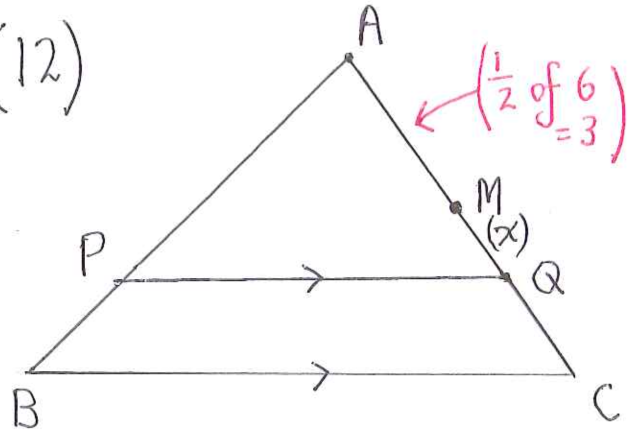
First time at 60m: 150·6s from start

c) t° in Q3: (see above) $\quad t = 180 + 29{\cdot}4$

$= 209{\cdot}4$

209·4s from start

(12)



a) $AQ = AM + MQ$ $\left(\frac{1}{2} \text{ of } 6 = 3\right)$

$= 3 + x$

$\underline{AQ = x + 3}$ (or $3 + x$)

b) (Similar Δs ABC and APQ – since they have equal angles)

$$\frac{PQ}{BC} = \frac{AQ}{AC}$$ (Corresponding sides are in same ratio)

$$\Rightarrow \frac{PQ}{8} = \frac{(x+3)}{6}$$ ← (from a)) $(\times 8)$

$$\Rightarrow PQ = \frac{\overset{4}{\cancel{8}}(x+3)}{\underset{3}{\cancel{6}}} = \frac{4(x+3)}{3} = \frac{4x+12}{3}$$

$$= \frac{4x}{3} + \frac{12}{3} = \frac{4}{3}x + 4, \text{ or}$$

$$\underline{PQ = \left(4 + \frac{4}{3}x\right)}$$ Proved