1. (a) $\sqrt{24.5} - \sqrt{12.5} = \sqrt{\frac{49}{2}} - \sqrt{\frac{25}{2}} = \frac{\sqrt{49}}{\sqrt{2}} - \frac{\sqrt{25}}{\sqrt{2}} = \frac{7}{\sqrt{2}} - \frac{5}{\sqrt{2}}$

$= \frac{2}{\sqrt{2}} = \frac{2\sqrt{2}}{\sqrt{2}\sqrt{2}} = \frac{2\sqrt{2}}{2} = \sqrt{2}$

(b) $\frac{\sqrt{2}}{1+\sqrt{2}} = \frac{\sqrt{2}(1-\sqrt{2})}{(1+\sqrt{2})(1-\sqrt{2})} = \frac{\sqrt{2}-2}{1-\cancel{\sqrt{2}}+\cancel{\sqrt{2}}-2} = \frac{\sqrt{2}-2}{-1} = 2-\sqrt{2}$

2. (a) $8+3x > 4(x-3)+2$

$\Rightarrow 8+3x > 4x-12+2$

$\Rightarrow 8+3x > 4x-10$

$\Rightarrow -x > -18$

$\Rightarrow x < 18$

(b) $(x-10)(x-4) \geqslant 5(x-1)-3$

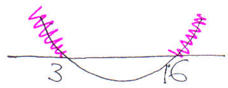
$\Rightarrow x^2-4x-10x+40 \geqslant 5x-5-3$

$\Rightarrow x^2-14x+40 \geqslant 5x-8$

$\Rightarrow x^2-19x+48 \geqslant 0$

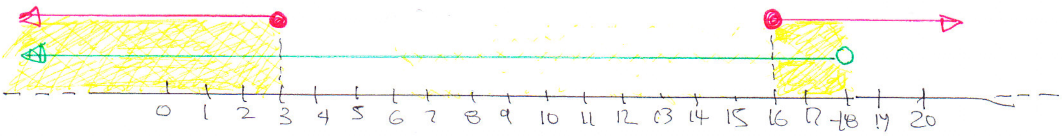
$\Rightarrow (x-16)(x-3) \geqslant 0$

$\Rightarrow$ C.V. $= \begin{cases} 16 \\ 3 \end{cases}$



$\therefore x \leqslant 3$ OR $x \geqslant 16$

(c)



$\therefore x \leqslant 3$ OR $16 \leqslant x < 18$

3. EQUAL ROOTS $\Rightarrow b^2-4ac=0$

$\Rightarrow (2m)^2 - 4\times1\times(3m+4) = 0$

$\Rightarrow 4m^2 - 4(3m+4) = 0$

$\Rightarrow 4m^2 - 12m - 16 = 0$

$\Rightarrow m^2 - 3m - 4 = 0$

$\Rightarrow (m-4)(m+1) = 0$

$m = \begin{cases} 4 \\ -1 \end{cases}$

4. $x+y=9$
$x^2-3xy+2y^2=0$ $\Big\} \Rightarrow \boxed{x=9-y}$

SUBSTITUTE INTO THE QUADRATIC

$\Rightarrow (9-y)^2-3(9-y)y+2y^2=0$

$\Rightarrow 81-18y+y^2-3y(9-y)+2y^2=0$

$\Rightarrow 81-18y+y^2-27y+3y^2+2y^2=0$

$\Rightarrow 6y^2-45y+81=0$

$\Rightarrow 2y^2-15y+27=0$

$\Rightarrow (2y-9)(y-3)=0$

$y = \begin{cases} 3 \\ \frac{9}{2} \end{cases}$

$x = \begin{cases} 9-3=6 \\ 9-\frac{9}{2}=\frac{9}{2} \end{cases}$

$\therefore (6,3)$ & $\left(\frac{9}{2},\frac{9}{2}\right)$

5. (a) $f(x)=0$

$9x^2+18x-7=0$

$(3x-1)(3x+7)=0$

$x = \begin{cases} \frac{1}{3} \\ -\frac{7}{3} \end{cases}$

(b) $f(x)=9x^2+18x-7$

$=9\left[x^2+2x-\frac{7}{9}\right]$

$=9\left[(x+1)^2-1-\frac{7}{9}\right]$

$=9(x+1)^2-9-7$

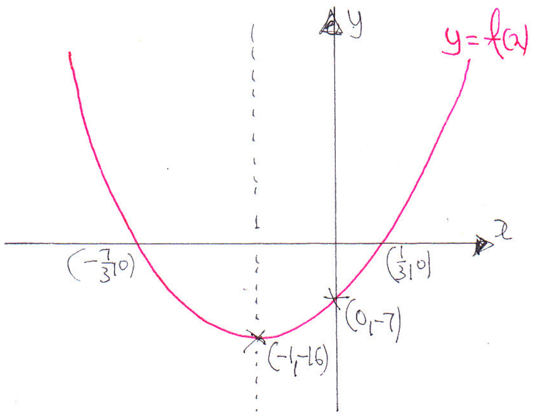
$=9(x+1)^2-16$

$A=1$
$B=-16$

(c) MINIMUM VALUE IS -16

(IT OCCURS WHEN $x=-1$)

(d)



- $+9x^2$ $\cup$
- $x=0,\ y=-7$ $(0,-7)$
- $y=0,\ x= \begin{cases} \frac{1}{3} \\ -\frac{7}{3} \end{cases}$ $\left(\frac{1}{3},0\right)$ $\left(-\frac{7}{3},0\right)$
- MIN AT $(-1,-16)$

C1, IYGB, PAPER C

8. (a) $\boxed{S_n = \frac{n}{2}\left[2a+(n-1)d\right]}$

$\Rightarrow 15360 = \frac{12}{2}\left[2\times1500 + 11d\right]$

$\Rightarrow 15360 = 6\left[3000 + 11d\right]$

$\Rightarrow \frac{15360}{6} = 3000 + 11d$

$\Rightarrow \frac{15000+360}{6} = 3000 + 11d$

$\Rightarrow 2500 + 60 = 3000 + 11d$

$\Rightarrow 2560 - 3000 = 11d$

$\Rightarrow 11d = -440$

$\Rightarrow \boxed{d = -40}$

$\therefore \alpha = 40$

(b) $\boxed{\begin{array}{l} a = 1500 \\ d = -40 \end{array}}$

$T_n = \frac{n}{2}\left[2\times1500 + (n-1)(-40)\right]$

$T_n = \frac{n}{2}\left[3000 + 40 - 40n\right]$

$T_n = n\left[1500 + 20 - 20n\right]$

$T_n = n\left[1520 - 20n\right]$

$T_n = 20n\left[76 - n\right]$ // AS REQUIRED

(c) $T_n = 26000$

$\Rightarrow 20n(76-n) = 26000$

$\Rightarrow n(76-n) = 1300$

BY INSPECTION

$n=10$	$10\times66 = 660$
$n=20$	$20\times56 = 1120$
$n=30$	$30\times46 = 1380$
$n=26$	$26\times50 = 1300$

THUS

$\Rightarrow 76n - n^2 = 1300$

$\Rightarrow 0 = n^2 - 76n + 1300$

$\Rightarrow 0 = (n-26)(n-50)$

$\therefore n = 26 \text{ or } 50$

(d) $\boxed{u_n = a + (n-1)d}$

- IF $n=26$

$u_{26} = 1500 + 25(-40)$

$u_{26} = 1500 - 1000$

$u_{26} = 500$

- IF $n=50$

$u_{50} = 1500 + 49(-40)$

$u_{50} = 1500 - 1960$

$u_{50} = -460$

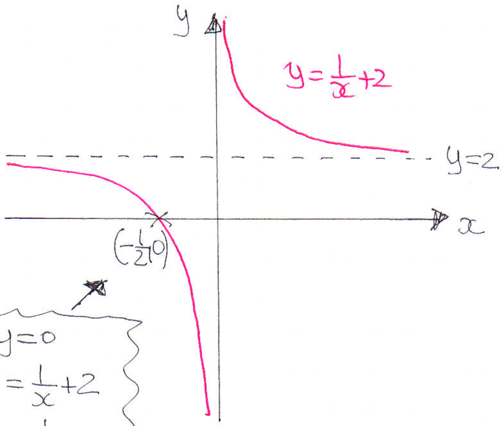
IMPOSSIBLE

$\therefore n = 26$

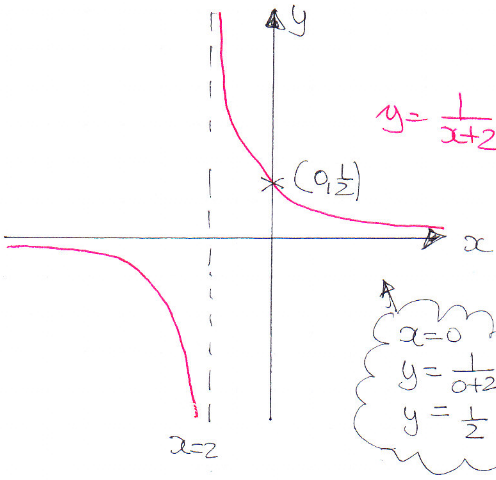
C1, IYGB, PAPER C

6. • $y = \frac{1}{x} + 2$ IS A TRANSLATION OF $y = \frac{1}{x}$, UPWARDS BY 2 UNITS

• $y = \frac{1}{x+2}$ IS A TRANSLATION OF $y = \frac{1}{x}$, 2 UNITS TO THE LEFT



$y = 0$
$0 = \frac{1}{x} + 2$
$-2 = \frac{1}{x}$
$-2x = 1$
$x = -\frac{1}{2}$



$x = 0$
$y = \frac{1}{0+2}$
$y = \frac{1}{2}$

7. (a) AB: $5x + 4y = 7$

$4y = -5x + 7$

$y = -\frac{5}{4}x + \frac{7}{4}$

GRAD OF AB

"CD" IS PARALLEL & PASSES THROUGH (4,7)

$y - y_0 = m(x - x_0)$

$y - 7 = -\frac{5}{4}(x - 4)$

$4y - 28 = -5x + 20$

$4y + 5x = 48$ // AS REQUIRED

(b) GRADIENT AD IS $\frac{4}{5}$ (PERPENDICULAR)

$y - 7 = \frac{4}{5}(x - 4)$

$5y - 35 = 4x - 16$

$5y = 4x + 19$

(c) [CD]: $5x + 4y = 48$

[BC]: $x + 9y + 15 = 0$

$\boxed{x = -9y - 15}$

BY SUBSTITUTION

$5(-9y - 15) + 4y = 48$

$-45y - 75 + 4y = 48$

$-123 = 41y$

$\boxed{y = -3}$

$\therefore x = -9y - 15$

$x = -9(-3) - 15$

$x = 27 - 15$

$\boxed{x = 12}$

$\therefore C(12, -3)$ // AS REQUIRED

9. (a)

$y = x^3 - 10x + 2$

$\frac{dy}{dx} = 3x^2 - 10$

$\left.\frac{dy}{dx}\right|_{x=2} = 3\times2^2 - 10 = 12 - 10 = 2$

- TANGENT l_1

$y - y_0 = m(x - x_0)$

$y + 10 = 2(x - 2)$

$y + 10 = 2x - 4$

$y = 2x - 14$

- NORMAL l_2

$y - y_0 = m(x - x_0)$

$y + 10 = -\frac{1}{2}(x - 2)$

$2y + 20 = -x + 2$

$x + 2y + 18 = 0$

(b)

- WHEN $y = 0$

$l_1: \; 0 = 2x - 14$

$14 = 2x$

$x = 7$

$\therefore \boxed{A(7,0)}$

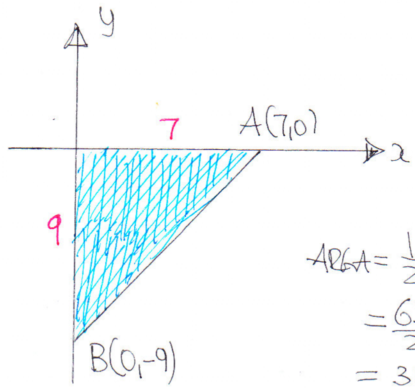
- WHEN $x = 0$

$l_2: \; 0 + 2y + 18 = 0$

$2y = -18$

$y = -9$

$\therefore \boxed{B(0,-9)}$



$\text{AREA} = \frac{1}{2}\times7\times9$

$= \frac{63}{2}$

$= 31.5$

10. (a)

$f'(x) = \frac{12x - 1}{\sqrt{x}} = \frac{12x - 1}{x^{\frac{1}{2}}} = \frac{12x}{x^{\frac{1}{2}}} - \frac{1}{x^{\frac{1}{2}}} = 12x^{\frac{1}{2}} - x^{-\frac{1}{2}}$

$\therefore f(x) = \int 12x^{\frac{1}{2}} - x^{-\frac{1}{2}} \, dx$

$f(x) = \left(\frac{12}{\frac{3}{2}}\right)x^{\frac{3}{2}} - \left(\frac{1}{\frac{1}{2}}\right)x^{\frac{1}{2}} + C$

$f(x) = 8x^{\frac{3}{2}} - 2x^{\frac{1}{2}} + C$

WHEN $x = 0$ $y = 0$ (PASSES THROUGH O)

$0 = 8\times0^{\frac{3}{2}} - 2\times0^{\frac{1}{2}} + C$

$0 = C$

$\therefore f(x) = 8x^{\frac{3}{2}} - 2x^{\frac{1}{2}}$

(b) $f(x) = 8x^{\frac{3}{2}} - 2x^{\frac{1}{2}}$

$0 = 8x^{\frac{3}{2}} - 2x^{\frac{1}{2}}$

$0 = 2x^{\frac{1}{2}}(4x-1)$

- $x^{\frac{1}{2}} = 0$
  $x = 0$
  $\uparrow$
  ORIGIN

- $4x-1$
  $x = \frac{1}{4}$
  $\therefore P(\frac{1}{4}, 0)$