Q1(a)

i)	ii)	iii)
$x^2 + 5x$ HCF $= \boxed{x(x+5)}$	$9x^2 - 25$ Diff of 2 Sqs $= (3x)^2 - (5)^2$ $= \boxed{(3x+5)(3x-5)}$	$x^2 - 3x - 18$ Quadratic $\boxed{(x-6)(x+3)}$
iv)	**v)**	**vi)**
$49p^2 - 1$ $= (7p)^2 - (1)^2$ $= \boxed{(7p+1)(7p-1)}$	Grouping $2pq + 3p + 2mq + 3m$ $= p(2q+3) + m(2q+3)$ $= \boxed{(2q+3)(p+m)}$	$3x^2 + 17x - 6$ $\boxed{(3x-1)(x+6)}$
vii)	**viii)**	**ix)**
$2ab - ac - 2bd + cd$ $= a(2b-c) - d(2b-c)$ $= \boxed{(a-d)(2b-c)}$	$4x^2 + 4x - 15$ $\boxed{(2x+5)(2x-3)}$	$3x^2 - x$ HCF $= \boxed{x(3x-1)}$

Q1(b)

i)	ii)	iii)
$x^2 - 7x + 12 = 0$ $(x-4)(x-3) = 0$ $x-4=0$ OR $x-3=0$ $\boxed{x=4}$ $\boxed{x=3}$	$x^2 - 6x = 0$ $x(x-6) = 0$ $\boxed{x=0}$ OR $x-6=0$ $\boxed{x=6}$	$x^2 - 25 = 0$ $(x)^2 - (5)^2 = 0$ $(x+5)(x-5) = 0$ $x+5=0$ OR $x-5=0$ $\boxed{x=-5}$ $\boxed{x=5}$
iv)	**v)**	**vi)**
$4x^2 - 12x + 5 = 0$ $(2x-1)(2x-5) = 0$ $2x-1=0$ OR $2x-5=0$ $\frac{2x}{2} = \frac{1}{2}$ $\frac{2x}{2} = \frac{5}{2}$ $\boxed{x = 1/2}$ $\boxed{x = 5/2}$	$5x^2 - 6x = 0$ $x(5x-6) = 0$ $\boxed{x=0}$ OR $5x-6=0$ $\frac{5x}{5} = \frac{6}{5}$ $\boxed{x = 6/5}$	$9x^2 - 16 = 0$ $(3x)^2 - (4)^2 = 0$ $(3x+4)(3x-4) = 0$ $3x+4=0$ OR $3x-4=0$ $\frac{3x}{3} = \frac{-4}{3}$ $\frac{3x}{3} = \frac{4}{3}$ $\boxed{x = -4/3}$ $\boxed{x = 4/3}$
vii)	**viii)**	**ix)**
$(x+3)^2 = (x+1)(2x+3)$ $(x+3)(x+3) = (x+1)(2x+3)$ $x(x+3)+3(x+3) = x(2x+3)+1(2x+3)$ $x^2+3x+3x+9 = 2x^2+3x+2x+3$ $x^2+6x+9 = 2x^2+5x+3$ $x^2-2x^2+6x-5x+9-3 = 0$ $-x^2+x+6 = 0$ ← Change all signs $x^2 - x - 6 = 0$ $(x+2)(x-3) = 0$ $x+2=0$ OR $x-3=0$ $\boxed{x=-2}$ $\boxed{x=3}$	$5x^2 - 13x = 6$ $5x^2 - 13x - 6 = 0$ $(5x+2)(x-3) = 0$ $5x+2=0$ OR $x-3=0$ $\frac{5x}{5} = \frac{-2}{5}$ $\boxed{x=3}$ $\boxed{x = -2/5}$	$4x^2 = 1$ $4x^2 - 1 = 0$ $(2x)^2 - (1)^2 = 0$ $(2x+1)(2x-1) = 0$ $2x+1=0$ OR $2x-1=0$ $\frac{2x}{2} = \frac{-1}{2}$ $\frac{2x}{2} = \frac{1}{2}$ $\boxed{x = -1/2}$ $\boxed{x = 1/2}$

Q1(c)

i)

$$x^2 + 2x - 5 = 0$$

$a=1 \quad b=2 \quad c=-5$

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

$$= \frac{-2 \pm \sqrt{(2)^2-4(1)(-5)}}{2(1)}$$

$$= \frac{-2 \pm \sqrt{4+20}}{2}$$

$$= \frac{-2 \pm \sqrt{24}}{2}$$

$$= \boxed{1.45, \ -3.45}$$

ii)

$$3x^2+7x-5=0$$

$a=3 \quad b=7 \quad c=-5$

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

$$= \frac{-7 \pm \sqrt{(7)^2-4(3)(-5)}}{2(3)}$$

$$= \frac{-7 \pm \sqrt{49+60}}{6}$$

$$= \frac{-7 \pm \sqrt{109}}{6}$$

$$= \boxed{0.57, \ -2.9}$$

iii)

$$2x^2 = 7x - 4$$

$$2x^2 - 7x + 4 = 0$$

$a=2 \quad b=-7 \quad c=4$

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

$$= \frac{-(-7) \pm \sqrt{(-7)^2-4(2)(4)}}{2(2)}$$

$$= \frac{7 \pm \sqrt{49-32}}{4}$$

$$= \frac{7 \pm \sqrt{17}}{4}$$

$$= \boxed{2.78, \ 0.72}$$

Q1(d)

i)

$$3x^2 - 6x + 2 = 0$$

$a=3 \quad b=-6 \quad c=2$

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

$$= \frac{-(-6) \pm \sqrt{(-6)^2-4(3)(2)}}{2(3)}$$

$$= \frac{6 \pm \sqrt{36-24}}{6}$$

$$= \frac{6 \pm \sqrt{12}}{6}$$

Type this into calculator and should get

$$= \frac{6 \pm \sqrt{4}\sqrt{3}}{6}$$

$$= \frac{\cancel{6}^{3} \pm \cancel{2}^{1}\sqrt{3}}{\cancel{6}_{3}}$$

$$= \boxed{\frac{3 \pm \sqrt{3}}{3}}$$

ii)

$$4x^2 + 3x = 5$$

$$4x^2 + 3x - 5 = 0$$

$a=4 \quad b=3 \quad c=-5$

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

$$= \frac{-3 \pm \sqrt{(3)^2-4(4)(-5)}}{2(4)}$$

$$= \frac{-3 \pm \sqrt{9+80}}{8}$$

$$= \boxed{\frac{-3 \pm \sqrt{89}}{8}}$$

Q1(e)

i) Method 1: Work in reverse

$x = -4$ OR $x = 3$

$x+4=0$ OR $x-3=0$

$\Rightarrow (x+4)(x-3) = 0$

$x(x-3)+4(x-3)=0$

$x^2-3x+4x-12=0$

$\boxed{x^2+x-12=0}$

Method 2: Formula

$x^2 - x\left(\begin{smallmatrix}\text{SUM OF}\\ \text{ROOTS}\end{smallmatrix}\right) + \left(\begin{smallmatrix}\text{PRODUCT OF}\\ \text{ROOTS}\end{smallmatrix}\right) = 0$

$x^2 - x(-4+3) + (-4)(3) = 0$

$x^2 - x(-1) - 12 = 0$

$\boxed{x^2 + x - 12 = 0}$

ii) Method 1: Work in reverse

$x = 2/3$ OR $x = 1/5$

$\Rightarrow 3x = 2$ OR $5x = 1$ ← Mult both sides by 5

$3x-2=0$ $\quad$ $5x-1=0$

$\Rightarrow (3x-2)(5x-1)=0$

$3x(5x-1)-2(5x-1)=0$

$15x^2-3x-10x+2=0$

$\boxed{15x^2-13x+2=0}$

Method 2: Formula

$x^2 - x\left(\begin{smallmatrix}\text{SUM OF}\\ \text{ROOTS}\end{smallmatrix}\right) + \left(\begin{smallmatrix}\text{PRODUCT OF}\\ \text{ROOTS}\end{smallmatrix}\right) = 0$

$x^2 - x\left(\frac{2}{3}+\frac{1}{5}\right) + \left(\frac{2}{3}\right)\left(\frac{1}{5}\right) = 0$

$x^2 - x\left(\frac{13}{15}\right) + \frac{2}{15} = 0$ ← Multiply across by 15

$\Rightarrow \boxed{15x^2 - 13x + 2 = 0}$

Q1(f)

i)

$p^3 - 25p$

$= p(p^2 - 25)$

$= p((p)^2 - (5)^2)$

$= \boxed{p(p+5)(p-5)}$

ii)

$4x^2 - 8x - 12$

$= 4(x^2 - 2x - 3)$

$= \boxed{4(x-3)(x+1)}$

iii)

$3p^2 - 3p - 18$

$= 3(p^2 - p - 6)$

$= \boxed{3(p-3)(p+2)}$

iv)

$8m^3 - 50m$

$= 2m(4m^2 - 25)$

$= 2m((2m)^2 - (5)^2)$

$= \boxed{2m(2m+5)(2m-5)}$

Q1(g)

i)	ii)	iii)	iv)
$\frac{8a+8b}{a+b}$ $= \frac{8\cancel{(a+b)}}{1\cancel{(a+b)}}$ $= \boxed{8}$	$\frac{a-2}{a^2+5a-14}$ $= \frac{1\cancel{(a-2)}}{(a+7)\cancel{(a-2)}}$ $= \boxed{\frac{1}{a+7}}$	$\frac{x^2+x-30}{x-5}$ $= \frac{(x+6)\cancel{(x-5)}}{1\cancel{(x-5)}}$ $= \boxed{x+6}$	$\frac{ab-ac}{b-c}$ $= \frac{a\cancel{(b-c)}}{1\cancel{(b-c)}}$ $= \boxed{a}$
v)	**vi)**	**vii)**	**viii)**
$\frac{a^2b-a}{ab-a}$ $= \frac{\cancel{a}(ab-1)}{\cancel{a}(b-1)}$ $= \boxed{\frac{ab-1}{b-1}}$	$\frac{5-r}{r-5}$ $= \frac{-1\cancel{(-5+r)}}{\cancel{r-5}}$ $= \boxed{-1}$	$\frac{m-n}{3m-3n}$ $= \frac{1\cancel{(m-n)}}{3\cancel{(m-n)}}$ $= \boxed{\frac{1}{3}}$	$\frac{p^2-q^2}{p^2+2pq+q^2}$ $= \frac{\cancel{(p+q)}(p-q)}{\cancel{(p+q)}(p+q)}$ $= \boxed{\frac{p-q}{p+q}}$

Q2

a)

$x = 3t - 1 \qquad y = t + 7$

$$\frac{7x+y}{3y-x}$$

$$= \frac{7(3t-1)+(t+7)}{3(t+7)-(3t-1)}$$

$$= \frac{21t \cancel{-7} + t \cancel{+7}}{\cancel{3t} + 21 \cancel{-3t} + 1}$$

$$= \frac{\cancel{22}t}{\cancel{22}}$$

$$= \boxed{t}$$

c)

$x = 2$ is a root

$\Rightarrow$ we can fill it into our equation in place of x i.e.

$$3x^2 - 4x + c = 0$$
$$3(2)^2 - 4(2) + c = 0$$
$$3(4) - 8 + c = 0$$
$$12 - 8 + c = 0$$
$$4 + c = 0$$
$$\boxed{c = -4}$$

b)

$$(3x+b)(6x-2b) - (2y+b)(4y-2b)$$
$$= 3x(6x-2b) + b(6x-2b) - [2y(4y-2b) + b(4y-2b)]$$
$$= 18x^2 - \cancel{6xb} + \cancel{6bx} - 2b^2 - [8y^2 - \cancel{4by} + \cancel{4by} - 2b^2]$$
$$= 18x^2 - \cancel{2b^2} - 8y^2 + \cancel{2b^2}$$
$$= 18x^2 - 8y^2$$
$$= 2(9x^2 - 4y^2)$$
$$= 2((3x)^2 - (2y)^2)$$
$$= \boxed{2(3x+2y)(3x-2y)}$$

d)

$$x^2 - 10x + d = 0$$

Method 1:

Equal Roots $\Rightarrow b^2 - 4ac = 0$
$$(-10)^2 - 4(1)(d) = 0$$
$$100 - 4d = 0$$
$$\frac{100}{4} = \frac{4d}{4}$$
$$\boxed{25 = d}$$

Method 2:

$$x^2 - 10x + d = 0$$
$$(x - \bigcirc)(x - \bigcirc) = 0$$

These numbers have to be equal as the roots are equal $\Rightarrow$ have to be 5 and 5 to get 10 in the centre

$$\Rightarrow (x-5)(x-5) = 0$$
$$x(x-5) - 5(x-5) = 0$$
$$x^2 - 5x - 5x + 25 = 0$$
$$x^2 - 10x + 25 = 0$$
$$\Rightarrow \boxed{d = 25}$$

e)

Area Rectangle = $L \times w = 80$

$$\Rightarrow (3x+1)(x+5) = 80$$
$$3x(x+5) + 1(x+5) = 80$$
$$3x^2 + 15x + 1x + 5 - 80 = 0$$
$$3x^2 + 16x - 75 = 0$$
$$(3x+25)(x-3) = 0$$
$$3x + 25 = 0 \quad \underline{\text{OR}} \quad x - 3 = 0$$
$$3x = -25 \qquad \boxed{x = 3}$$
$$x = -\frac{25}{3}$$

x can't be $-25/3$ the length would be c+1 which would be gative

$$\Rightarrow \text{Length} = 3x+1$$
$$= 3(3)+1$$
$$= \boxed{10\text{m}}$$

f)

$$(3x-2y)^2 - y(5y-12x)$$
$$= (3x-2y)(3x-2y) - y(5y-12x)$$
$$= 3x(3x-2y) - 2y(3x-2y) - y(5y-12x)$$
$$= 9x^2 - \cancel{6xy} - \cancel{6xy} + 4y^2 - 5y^2 + \cancel{12xy}$$
$$= 9x^2 - y^2$$
$$= (3x)^2 - (y)^2$$
$$= \boxed{(3x+y)(3x-y)}$$

Diff of 2 Squares

g)

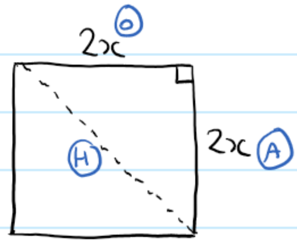
$x = 2$ is a root of

$x^2 - x + r = 0$

$\Rightarrow$ we can fill in 2 in place of x

$$\Rightarrow (2)^2 - (2) + r = 0$$
$$4 - 2 + r = 0$$
$$2 + r = 0$$
$$\Rightarrow \boxed{r = -2}$$

h)



Pythagoras Theorem

$$H^2 = O^2 + A^2$$
$$H^2 = (2x)^2 + (2x)^2$$
$$H^2 = 4x^2 + 4x^2$$
$$H^2 = 8x^2$$
$$\Rightarrow H = \sqrt{8x^2}$$
$$= \boxed{\sqrt{8}\,x}$$

i)

$$(97)^2 - (3)^2$$

Difference of 2 Squares

$$= (97+3)(97-3)$$
$$= (100)(94)$$
$$= \boxed{9400}$$

j)

$$x^2 + 4x + 5 = 0$$

Let's look at the $b^2 - 4ac$ part of the quadratic formula

$$b^2 - 4ac = (4)^2 - 4(1)(5)$$
$$= 16 - 20$$
$$= -4$$

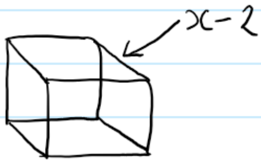
This means when we use our quadratic formula we would have to find $\sqrt{-4}$ which has no real solution

$\Rightarrow$ $\boxed{x^2 + 4x + 5 = 0 \text{ has no real solution.}}$

k)

- If $b^2 - 4ac > 0$, then there will be 2 real roots, that are different (distinct)
- If $b^2 - 4ac = 0$, then there will be 2 equal real roots
- If $b^2 - 4ac < 0$, then there will be no real roots.

l)



$$\text{Area of 1 face} = (x-2)(x-2)$$
$$= x(x-2) - 2(x-2)$$
$$= x^2 - 2x - 2x + 4$$
$$= x^2 - 4x + 4$$
$$\Rightarrow \text{Area of 6 faces} = 6(x^2 - 4x + 4)$$
$$= \boxed{6x^2 - 24x + 24}$$

$$\text{Surface Area} = 294$$
$$\Rightarrow \quad 6x^2 - 24x + 24 = 294$$
$$6x^2 - 24x - 270 = 0$$
$$x^2 - 4x - 45 = 0$$

dividing across by 6

$$(x-9)(x+5) = 0$$
$$x - 9 = 0 \quad \underline{\underline{OR}} \quad x + 5 = 0$$
$$\boxed{x = 9} \qquad \cancel{x = -5}$$

x can't be -5 because side length would be negative

$$\Rightarrow \text{Side length of cube} = x - 2$$
$$= 9 - 2$$
$$= 7$$
$$\Rightarrow \text{Vol} = l \times l \times l$$
$$= 7 \times 7 \times 7$$
$$= \boxed{343 \text{ cm}^3}$$

m)

Roots : $3b$ and $5b$

Formula: $x^2 - x\left(\begin{smallmatrix}\text{SUM OF}\\ \text{ROOTS}\end{smallmatrix}\right) + \left(\begin{smallmatrix}\text{PRODUCT OF}\\ \text{ROOTS}\end{smallmatrix}\right) = 0$

$$x^2 - x(3b + 5b) + ((3b)(5b)) = 0$$
$$x^2 - x(8b) + 15b^2 = 0$$
$$\boxed{x^2 - 8bx + 15b^2 = 0}$$

n)

$$a^4 - b^4$$
$$= (a^2)^2 - (b^2)^2$$
$$= (a^2 + b^2)(a^2 - b^2)$$
$$= (a^2 + b^2)((a)^2 - (b)^2)$$
$$= \boxed{(a^2 + b^2)(a + b)(a - b)}$$

o)

$$(2x-z)(6x+3z)-(6a-3z)(2a+z)$$
$$=2x(6x+3z)-z(6x+3z)-[6a(2a+z)-3z(2a+z)]$$
$$=12x^2+\cancel{6xz}-\cancel{6xz}-3z^2-[12a^2+\cancel{6az}-\cancel{6az}-3z^2]$$
$$=12x^2-\cancel{3z^2}-12a^2+\cancel{3z^2}$$
$$=12x^2-12a^2$$
$$=12(x^2-a^2)$$
$$=12((x)^2-(a)^2)$$
$$=\boxed{12(x+a)(x-a)}$$

p)

Crosses the x-axis at -2 and -4

$\Rightarrow$ Roots are -2 and -4

Method 1: Work in reverse

$x=-2$ OR $x=-4$

$x+2=0$ OR $x+4=0$

$$\Rightarrow (x+2)(x+4)=0$$
$$x(x+4)+2(x+4)=0$$
$$x^2+4x+2x+8=0$$
$$\boxed{x^2+6x+8=0}$$

Method 2: Formula

$$x^2-x\left(\begin{smallmatrix}\text{SUM OF}\\ \text{ROOTS}\end{smallmatrix}\right)+\left(\begin{smallmatrix}\text{PRODUCT OF}\\ \text{ROOTS}\end{smallmatrix}\right)=0$$
$$x^2-x(-2-4)+((-2)(-4))=0$$
$$x^2-x(-6)+8=0$$
$$\Rightarrow \boxed{x^2+6x+8=0}$$

q)

Let x = width of rectangle

$\Rightarrow x+3$ = Length of rectangle

Area Rectangle = $l \times w$ = 28

$$\Rightarrow (x+3)(x)=28$$
$$x^2+3x=28$$
$$x^2+3x-28=0$$
$$(x+7)(x-4)=0$$

$x+7=0$ OR $x-4=0$

$x=-7$ $\boxed{x=4}$

* x can't be -7 because the width would be negative

$\Rightarrow$ Length $=4+3$

$=\boxed{7\text{cm}}$

r)

$$x^2+y^2+z^2=29$$

$x=2$ and $z=-3$

$$\Rightarrow (2)^2+y^2+(-3)^2=29$$
$$4+y^2+9=29$$
$$13+y^2=29$$
$$y^2=29-13$$
$$y^2=16$$
$$\Rightarrow y=\sqrt{16}$$
$$\Rightarrow \boxed{y=\pm 4}$$

s)

$$h = 30t - 5t^2$$

i) 0m above the ground $\Rightarrow \boxed{h=0}$

$\Rightarrow$ $30t - 5t^2 = 0$

$5t(6-t) = 0$

$\frac{5t}{5} = \frac{0}{5}$ OR $6 - t = 0$

$\boxed{t=0}$ $\boxed{t=6}$

ii) 40m above the ground $\Rightarrow \boxed{h=40}$

$\Rightarrow$ $30t - 5t^2 = 40$

$-5t^2 + 30t - 40 = 0$ ← Multiply every term by -1

$5t^2 - 30t + 40 = 0$

$t^2 - 6t + 8 = 0$

$(t-4)(t-2) = 0$

$t - 4 = 0$ OR $t - 2 = 0$

$\boxed{t=4}$ $\boxed{t=2}$

t)

Roots are 2 and -1

Method 1: Work in reverse

$x = 2$ OR $x = -1$

$x - 2 = 0$ OR $x + 1 = 0$

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

$x(x+1) - 2(x+1) = 0$

$x^2 + x - 2x - 2 = 0$

$\boxed{x^2 - x - 2 = 0}$

Method 2: Formula

$x^2 - x\left(\begin{matrix}\text{SUM OF}\\\text{ROOTS}\end{matrix}\right) + \left(\begin{matrix}\text{PRODUCT OF}\\\text{ROOTS}\end{matrix}\right) = 0$

$x^2 - x(2-1) + ((2)(-1)) = 0$

$x^2 - x(1) - 2 = 0$

$\boxed{x^2 - x - 2 = 0}$

Method 3: Sim Eqns

$x^2 + ax + b = 0$

$x = 2$ is a root

$\Rightarrow$ $(2)^2 + a(2) + b = 0$

$2a + b = -4$ .... A

$x = -1$ is a root

$\Rightarrow$ $(-1)^2 + a(-1) + b = 0$

$1 - a + b = 0$

$-a + b = -1$ .... B

Solving A and B

A : $2a + \cancel{b} = -4$

B : $\overset{(+)}{-}a \overset{(-)}{+} \cancel{b} = \overset{(+)}{-}1$

ADD $\frac{3a}{3} = \frac{-3}{3}$

$\boxed{a = -1}$

Put a into A

A $2a + b = -4$

$2(-1) + b = -4$

$-2 + b = -4$

$b = -4 + 2$

$\boxed{b = -2}$