Chapter - 8
Polynomials

- Polynomial is an algebric expression in which power of the variable is a whole number
- Highest power of the variable is called degree of the polynomial
- A polynomial of degree
  1 is called linear polynomial
  2 is called Quadratic polynomial
  3 is called Cubic polynomial
  4 is called Biquadratic or quatric polynomial
- A polynomial having
  1 term is called monomial
  2 term is called binomial
  3 term is called trinomial
  4 term is called quadrinomial
- Degree of non-zero constant polynomial (ie 5, 6, 7 etc) is 0
- Degree of zero polynomial (ie 0) is not defined.

WS-1

Q1: Find

1. $5x^3-4x^2+\frac{1}{2}$

Yes

(ii) $\sqrt{3z^2}-5\sqrt{z+6}$

$\therefore$ No because power of variable is not a whole number

(iii) $6x^4+\frac{2}{3}x^3-\frac{3}{4}x^2-1$

Yes

(iv) $7x^{\frac{2}{3}}-8x^{\frac{3}{2}}+x^2$

$\therefore$ No because power of variable is not a whole number

(v) $5x-\frac{1}{x}+\frac{1}{x^2}-2$

No because power of variable is not a whole number.

(vi) p^4-3p^3-p+1

Yes

Q2:

(i) $p^2-8p^9+p^7+5$

standard form

$-8p^9+p^7+p^2+5$

Degree is 9

(ii) $4z^3 - 3z^5 + 2z^4 + z + 1$

$-3z^5 + 2z^4 + 4z^3 + z + 1$

Degree is 5

(iii) $\left(x + \frac{2}{3}\right)\left(x + \frac{3}{4}\right)$

Using $(x+a)(x+b) = x^2 + (a+b)x + ab$

$x^2 + \left[\frac{2}{3} + \frac{3}{4}\right]x + \frac{\cancel{2}}{\cancel{3}} \times \frac{\cancel{3}}{\cancel{4}2} = \frac{1}{2}$

$x^2 + \left[\frac{8+9}{12}\right]x + \frac{1}{2}$

$x^2 + \frac{17}{12} + \frac{1}{2}$

(iv) $\left[x^2 - \frac{2}{3}\right]\left[x + \frac{4}{3}\right]$

Using $(x+a)(x+b) = x^2 + (a+b)x + ab$

In standard form

$(x^2)^2 + \left[\frac{-\cancel{2}}{3} + \frac{4}{3}\right]x^2 + \left(\frac{-2}{3}\right) \times \left(\frac{4}{3}\right)$

$= x^4 + \frac{2}{3}x^2 - \frac{8}{9}$

Degree is 4

(v) $(z^2 + 5)(z^2 - 6)$

Using $(x+a)(x+b) = x^2 + (a+b)x + ab$

In standard form

$(z^2)^2 + (5-6)z^2 + (-6 \times 5)$

$= z^4 - 1z^2 - 30$

$\therefore$ Degree is 4

(vi) $(y^3-4)(y^3-5)$

Using $(x+a)(x+b) = x^2+(a+b)x+ab$

$(y^3)^2+(-4-5)y^3+(-4)\times(-5)$

$= y^6-\cancel{20}\,9y^3+20$

Degree is 6

(vii) $(p^2+2)(p^2+7)$

In standard form

$\therefore (x+a)(x+b) = x^2+(a+b)x+ab$

$(p^2)^2+(2+7)p^2+2\times7$

$= p^4+9p^2+14$ $\therefore$ Degree is 4

(viii) $\left[\frac{5}{6}z-\frac{3}{4}z^2-\frac{2}{3}z^3+1\right]$

In standard form

$\left[-\frac{2}{3}z^3-\frac{3}{4}z^2-\frac{5}{6}z+1\right]$

$\therefore$ Degree is 3

(ix) $4p+15p^6-p^5+4p^2+3$

In standard form

$15p^6-p^5+4p^2+4p+3$

$\therefore$ Degree is 6

(x) $q^{10} + q^6 - q^4 + q^8$

In standard form

$q^{10} + q^8 + q^6 - q^4$ $\therefore$ Degree is 10

WS - 2

Q1: Divide the following

(i) $6x^3$ by $3x^2$

$= \frac{{}^{2}\cancel{6}x^3}{\cancel{3}x^2}$

$= 2x$

(ii) $\frac{-35x^4}{-7x^3}$

$= \frac{\cancel{+}\,{}^{5}\cancel{35}x^4}{\cancel{+}\cancel{7}x^2}$

$= 5x$

(iii) $\frac{-5z^2}{\sqrt{5}z}$

$= -\frac{\cancel{\sqrt{5}} \times \sqrt{5}z^2}{\cancel{\sqrt{5}}z}$

$= \sqrt{5}z$

(iv) $16p^4$ by $-6p^2$

$$\frac{\cancel{16}^{8}p^4}{-\cancel{6}_{3}p^2}$$

$$= -\frac{8}{3}p^2$$

(v) $4\sqrt{2}y^3$ by $3\sqrt{2}y^2$

$$\frac{4\cancel{\sqrt{2}}y^3}{3\cancel{\sqrt{2}}y^2}$$

$$= \frac{4}{3}y$$

(vi) $\frac{3}{4}p^2$ by $\frac{4}{3}p^2$

$$\frac{3}{4}\cancel{p^2} \times \frac{3}{4}\cancel{p^2}$$

$$= \frac{9}{16}$$

Q2: Divide

(i) $6x^4 - 24x^3 + 15x^2 + 9$ by $(-3x^2)$

$$\frac{6x^4 - 24x^3 + 15x^2 + 9}{-3x^2}$$

$$= \frac{\cancel{6}x^4}{-\cancel{3}x^2} + \frac{\cancel{24}x^3}{\cancel{3}x^2} - \frac{\cancel{15}x^2}{\cancel{3}x^2} - \frac{\cancel{9}}{\cancel{3}x^2}$$

$$= -2x^2 + 8x - 5 - \frac{3}{x^2}$$

(ii) $-12x + 22x^2 - 16x^2 + 4$ by $2x$

$$\frac{-12x + 22x^2 - 16x^3 + 4}{2x}$$

$$= -\frac{\overset{6}{\cancel{12}}x}{\cancel{2}x} + \frac{\overset{11}{\cancel{22}}x^2}{2x} - \frac{\overset{8}{\cancel{16}}x^3}{2x} + \frac{\overset{2}{\cancel{4}}}{2x}$$

$$= -6 + 11x - 8x^2 + \frac{2}{x}$$

$$= -8x^2 + 11x - 6 + \frac{2}{x}$$

(iii) $\frac{2}{3}z^4 - \frac{1}{3}z^2 - 1$ by $\frac{1}{3}z$

$$= \left(\frac{2}{3}z^4 \div \frac{1}{3}z\right) - \left(\frac{-1z^2}{3} \div \frac{z}{3}\right) - \left(1 \times \frac{1}{3}z\right)$$

$$= \left(\frac{2}{\cancel{3}}z^4 \times \frac{\cancel{3}}{z}\right) - \left(\frac{1z^2}{\cancel{3}} \times \frac{\cancel{3}}{z}\right) - \left(1 \times \frac{3}{z}\right)$$

$$= 2z^3 - z - \frac{3}{z}$$

~~(iv) $-8x^3 + 6x^4 - 4 + 12x$ by $2x^2$~~

(iv) $2\sqrt{2}q^4 + 4\sqrt{2}q^3 + q^2$ by $(-2\sqrt{2}q^2)$

$$= \frac{2\sqrt{2}q^4}{-2\sqrt{2}q^2} + \frac{4\sqrt{2}q^3}{-2\sqrt{2}q^2} + \frac{q^2}{-2\sqrt{2}q^2}$$

$$q^2 + 2q \quad \frac{1}{-2\sqrt{2}}$$

Q3:

(i) $-8x^3 + 6x^4 - 4 + 12x$ by $2x^2$

$$3x^2 - 4x$$

$$2x^2 \,\big)\, 6x^4 - 8x^3 + 12x - 4$$

$$-6x^4$$

$$-8x^3 + 12x - 4$$

$$\mp 8x^3$$

$$12x - 4$$

$Q = 3x^2 - 4x$

$R = 12x - 4$

(ii) $5x^{10} - 9x^8 - 9x^5 + 7x$ by x^5

$$5x^5 - 9x^3 - 9$$

$$x^5 \,\big)\, 5x^{10} - 9x^8 - 9x^5 + 7x$$

$$-5x^{10}$$

$$-9x^8 - 9x^5 + 7x$$

$$\mp 9x^8$$

$$-9x^5 + 7x$$

$$9x^5$$

$Q =$

$R =$

(iii) $5z^3 - 6z^2 + 7z$ by $2z$

$$2z\overline{)5z^3-6z^2+7z}\left(\frac{5}{2}z^2-3z+\frac{7}{2}\right.$$
$$\underline{-5z^3}$$
$$-6z^2+7z$$
$$\underline{6z^2}$$
$$7z$$
$$\underline{-7z}$$

$Q = \frac{5}{2}z^2 - 3z + \frac{7}{2}$

$R = 0$

WS - 3

Q1: Using factor Method

(i) $x^2 + 3x + 2$ by $x + 1$

$$\frac{x^2+3x+2}{x+1}$$

$$= \frac{x^2+2x+1x+2}{x+1}$$

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

$$= \frac{(x+2)\cancel{(x+1)}}{\cancel{(x+1)}}$$

$$= (x+2)$$

(ii) $x^2 - 7x - 18$ by $x - 9$

$$\frac{x^2 - 9x + 2x - 18}{x - 9}$$

$$\frac{x(x - 9) + 2(x - 9)}{(x - 9)}$$

$$= \frac{\cancel{(x-9)}(x+2)}{\cancel{(x-9)}}$$

$$= (x + 2)$$

(iii) $p^2 + 6p + 8$ by $p + 2$

$$\frac{p^2 + 4p + 2p + 8}{p + 2}$$

$$\frac{p(p+4) + 2(p+4)}{(p+2)}$$

$$= \frac{(p+4)\cancel{(p+2)}}{\cancel{(p+2)}}$$

$$= (p + 4)$$

(iv) $p^2 - p - 42$ by $p + 6$

$$\frac{p^2 - 7p + 6p - 42}{(p + 6)}$$

$$\frac{p(p-7)+6(p-7)}{p+6}$$

$$= \frac{(p-7)\cancel{(p+6)}}{\cancel{(p+6)}}$$

$$= (p-7)$$

(v) $y^2+12y+35$ by $y+7)$

$$\frac{y^2+5y+7y+35}{y+7}$$

$$= \frac{y(y+5)+7(y+5)}{y+7}$$

$$= \frac{\cancel{(y+7)}(y+5)}{\cancel{y+7}}$$

$$= y+5$$

(vi) $z^2-10z+16$ by $z-2$

$$\frac{z^2-10z+16}{z-2}$$

$$\frac{z^2-8z-2z+16}{z-2}$$

$$\frac{z(z-8)-2(z-8)}{z-2}$$

$$\frac{(z-8)\cancel{(z-2)}}{\cancel{(z-2)}}$$

$$= (z-8)$$

(VII) $x^4 + 3x^2 - 10$ by $x^2 + 5$

$\therefore$ put $x^2 = y$

$$= \frac{y^2 + 5y - 2y - 10}{y + 5}$$

$$= \frac{y(y+5) - 2(y+5)}{(y+5)}$$

$$= \frac{\cancel{(y+5)}(y-2)}{\cancel{(y+5)}}$$

$$= x^2 - 2$$

Q2: (i) $4p^3 - 4p^2 + 6p - \frac{5}{2}$ by $2p-1$

$$2p-1 \overline{\big)\, 4p^3 - 4p^2 + 6p - \frac{5}{2}} \quad \Big(2p^2 - p^2 + \frac{5}{2}$$

$$-\cancel{4p^3} \mp 2p^2$$

$$-\cancel{2p^2} + 6p - \frac{5}{2}$$

$$\mp \cancel{2p^2} \pm p$$

$$\cancel{5p} - \frac{5}{2}$$

$$-\cancel{5p} + \frac{5}{2}$$

$$0$$

Check = Dividend = $Q \times D + R$

$$= (2p^2 - 1)(2p^2 - p^2 + \frac{5}{2})$$

$$= 2p(2p^2 - p^2 + \frac{5}{2}) - 1(2p^2 - p^2 + \frac{5}{2})$$

$Q = 2p^2 - p^2 + \frac{5}{2}$

$R = 0$

(ii) $x-6+15x^2$ by $2+3x$

$$3x+2 \overline{)\, 15x^2+x-6 \,} \; 5x-3$$
$$\underline{-15x^2+10x}$$
$$-9x-6$$
$$\underline{+9x-6}$$
$$0$$

$Q = 5x-3$
$R = 0$

Checking:

Dividend = $D \times Q + R$

$15x^2+x-6 = (3x+2)(5x-3)$
$= 15x^2+x-6 = 3x(5x-3)+2(5x-3)$
$= 15x^2-9x+10x-6$
$= 15x^2+x-6$

LHS = RHS
Hence Checked

(iii) $4x^3-37x^2+52x-15$ by $4x-5$

$$4x-5 \overline{)\, 4x^3-37x^2+52x-15 \,} \; x^2-8x+3$$
$$\underline{-4x^3-5x^2}$$
$$-32x^2+52x-15$$
$$\underline{-32x^2+40x}$$
$$12x-15$$
$$\underline{-12x+15}$$
$$0$$

Checking: $D \times Q + R$
$4x^3-37x^2+52x-15 = (4x-5)(x^2-8x+3)+0$

$= 4x(x^2-8x+3)-5(x^2-8x+3)$

$= 4x^3-32x^2+12x-5x^2+40x-15$

$= 4x^3-37x^2+52x-15$

LHS = RHS

(IV) y^3-8 by $y-2$

$$
\begin{array}{r|l}
 & y^2+2y+4 \\
\hline
y-2 & y^3-8 \\
 & \underline{\pm y^3 \quad \mp 2y^2} \\
 & 2y^2-8 \\
 & \underline{-2y^2 \quad -4y} \\
 & 4y-8 \\
 & \underline{-4y \mp 8} \\
 & 0
\end{array}
$$

Checking = Divided = $D \times Q + R$

$y^3-8 = (y-2)(y^2+2y+4)+0$

$y^3-8 = y(y^2+2y+4)-2(y^2+2y+4)+0$

$y^3+\cancel{2y^2}+\cancel{4y}-\cancel{2y^2}-\cancel{4y}-8+0$

$y^3-8+0 = y^3-8$

LHS = RHS

(v) $29z-6z^2-28$ by $3z-4$

$$3z-4 \overline{\big) \cancel{-6z^2} + 29z + 28} \; \big\lfloor -2z+7$$

$$- \cancel{6z^2} \pm 8z$$

$$- \cancel{21z} + \cancel{28}$$

$$\cancel{21}z + \cancel{28}$$

$$0$$

Checking = Dividend = $D \times Q + R$

$= (3z-4)(-2z+7) + 0$

$= 3z(-2z+7) - 4(-2z+7)$

$= -6z^2 + 21z + 8z \mp 28$

$= -6z + 29z - 28$

LHS = RHS $\therefore$ Hence Checked.

(VI) $p^4 + p^3 - p^2 + 1$ by $p-1$

$$p-1 \overline{\big) p^4 + p^3 - p^2 + 1} \; \big\lfloor p^3 + 2p + p + 1$$

$$-\cancel{p^4} \mp p^3$$

$$\cancel{2p^3} - p^2 + 1$$

$$-\cancel{2p^3} \mp 2p^2 + 1$$

$$\cancel{p^2} + 1$$

$$-\cancel{p^2} \mp p$$

$$\cancel{p} + 1$$

$$\mp \cancel{p} \mp 1$$

$$2$$

$Q = p^3 + 2p + p + 1$

$R = R2$

Check = Dividend = Divisor $\times$ Q + R

$(p-1)(p^3 + 2p + p + 1)$

$p(p^3 + 2p^2 + p + 1) - 1(p^3 + 2p + p + 1)$

$p^4 + 2p^3 + p^2 + \cancel{p} - p^3 - 2p^2 - \cancel{p} - 1 + 2$

$p^4 + 2p^3 - p^3 + p^2 \mp 2p^2 - 1 + 2$

$p^4 + p^3 - p^2 + 1$

LHS = RHS

(vii) $12z^3 + 4z + 3z^2 + 1$ by $4z+1$

$$\begin{array}{r|l} 4z+1 & 12z^3 + 3z^2 + 4z + 1 \quad \lfloor 3z^2 + 1 \\ & \underline{-12z^3 - 3z^2} \\ & \qquad 4z + 1 \\ & \qquad \underline{-4z - 1} \\ & \qquad\quad 0 \end{array}$$

CHECK

Dividend = $D \times Q + R$

$(4z+1)(3z^2+1)+0$

$4z(3z^2+1)1(3z^2+)+0$

$12z^3 + 4z + 3z + 1$

LHS = RHS ∴ Hence Checked

(viii) $8x^2 - 2 - 3x + 12x^3$ by $4x^2 - 1$

$= 12x^3 + 8x^2 - 3x - 2$

$$\begin{array}{r|l} 4x^2-1 & 12x^3 + 8x^2 - 3x - 2 \quad \lfloor 3x + 2 \\ & \underline{-12x^3 + 8x^2 + 3x} \\ & \qquad 8x^2 - 3x - 2 \\ & \qquad \underline{-8x^2 \mp 2} \\ & \qquad\quad 0 \end{array}$$

CHECK

Dividend = $D \times Q + R$

$(4x^2-1)(3x+2)+0$

$4x^2(3x+2) - 1(3x+2) + 0$

$12x^3 + 8x^2 - 3x - 2$

LHS = RHS

Hence Checked

Q 3: Using long division method.

(i) $z^4 - z^3 + 3z^2 - 2z + 2$ by $z^2 + 2$

$$
\begin{array}{r|l|l}
z^2+2 & z^4 - z^3 + 3z^2 - 2z + 2 & z^2 - z + 1 \\
 & \underline{\pm \cancel{z^4} \qquad\quad \pm 2z^2} & \\
 & \quad -\cancel{z^3} + z^2 - 2z + 2 & \\
 & \quad \underline{\mp \cancel{z^3} \qquad\quad \mp 2z} & \\
 & \qquad\quad z^2 + 2 & \\
 & \qquad\quad \underline{-z^2 \pm 2} & \\
 & \qquad\qquad \underline{0} &
\end{array}
$$

∴ Since Reminder is 0

∴ $z^2 + 2$ is a factor of $z^4 - z^3 + 3z^2 - 2z + 2$

(ii) $x^3 - 4x^2 - 3x + 5$ by $x - 3$

$$
\begin{array}{r|l|l}
x-3 & x^3 - 4x^2 - 3x + 5 & x^2 - x - 6 \\
 & \underline{-\cancel{x^3} \mp 3x^2} & \\
 & \quad -\cancel{x^2} - 3x + 5 & \\
 & \quad \underline{\mp \cancel{x^2} \pm 3x} & \\
 & \qquad -6x + 5 & \\
 & \qquad \underline{\mp 6x \pm 18} & \\
 & \qquad\quad \underline{-13} &
\end{array}
$$

Since remainder is -13

∴ $x - 3$ is not a factor of $x^4 - 4x^2 - 3x + 5$

(iii) $4p^3 - 12p^2 - 37p - 15$ by $2p + 1$

$2p+1 \overline{)\ 4p^3 - 12p^2 - 37p - 15\ }$ $\big(2p^2 - 7p - 15$

$-\cancel{4p^3} \overset{+}{-} 2p^2$

$-14p^2 - 37p - 15$

$\mp 14p^2 \mp 7p$

$-30p - 15$

$\mp 30p \mp 15$

0

Since remainder is 0

(IV) $6x^3 + 19x^2 + 13x - 3$ by $6x^3 + 9x^2$

$2x+3$
$6x^3+9x^2 \overline{)\ 6x^3 + 19x^2 + 13x - 3\ }$ $\big(3x^2 + 5x - 1$

$-\cancel{6x^3} \pm 9x^2$

$10x^2 + 13x - 3$

$-\cancel{10x^2} \pm 15x$

$\mp 2x - 3$

$-2x \mp 3$

0

Value Based Questions

Q1: a) Money donated = ₹ $(x^2 + 12x + 35)$
No. of children = $x + 7$

Amount received by each

$$\frac{x^2 + 12x + 35}{x + 7}$$

$$
\begin{array}{r|l}
x+7 & x^2 + 12x + 35 \;\;(x+5 \\
 & -\,x^2 \pm 7x \\
\hline
 & 5x + 35 \\
 & -\,5x \pm 35 \\
\hline
 & 0 \\
\hline
\end{array}
$$

So req. Amount is ₹ $(x+5)$

b) To make them a successful person in life

Q2: Distance = $(2t^4 + 3t^3 - 2t^2 - 9t - 12)$ km
Speed = $(t^2 - 3)$ km/hr

Time = $\frac{D}{S}$

$$\frac{2t^4 + 3t^3 - 2t^2 - 9t - 12}{t^2 - 3}$$

$$t^2-3 \overline{\big)\, 2t^4+3t^3-2t^2-9t-12} \;\big(\, 2t^2+3+4$$

$$-2t^4 \quad \mp 6t^2$$

$$3t^3+4t^2-9t-12$$

$$-3t^3 \quad \mp 9t$$

$$4t^2-12$$

$$-4t^2 \mp 12$$

$$0$$

Time = $(2t^2+3+4)$

b) keep us fit.

Brain Teasers

Q1: A a) $x-2 \overline{\big)\, x^2+3x+p} \;\big(\, x+5$

$$-x^2 \mp 2x$$

$$5x+p$$

$$-5x \mp 10$$

$$p+10$$

When x^2+3x+p is divisible by $x-2$ then remainder is 0

$$p+10=0$$

$$p=-10$$

b) $x+7 \overline{\big)\, x^2+7x-4} \;\big(\, x$

$$-x^2 \pm 7x$$

$$-4$$

$Q = x$

c) Divisor $= -x^2 + x - 1$

$Q = x - 2$

$R = 3$

Dividend = $D \times Q + R$

$(-x^2 + x - 1) \times (x - 2) + 3$

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

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

d) $x - 3 \overline{)\, x^2 - 5x + 4 \,}(x - 2$

$\cancel{-x^2} \mp 3x$

$-2\cancel{x} + 4$

$\mp 2x \pm 6$

-2

So $-(-2)$

$= +2$ is req. Polynomial

e) $x - 15 \overline{)\, x^2 - 16x + 30 \,}(x - 1$

$\cancel{-x^2} \mp 15x$

$-\cancel{x} + 30$

$\mp x - 15$

$+15$

So $+15$ is req. poly.

~~B a)~~

B a)

$$x^3-6x^2+11x-6 \quad \lfloor x^2-7x+18$$

$$-x^3 \pm x^2$$

$$-7x^2+11x-6$$

$$\mp 7x^2-7x$$

$$18x-6$$

$$-18x \pm 18$$

$$-24$$

Q-R

$$x^2-7x+18-(-24)$$

$$x^2-7x+18+24$$

$$x^2-7x+42$$

Q3: Divide

(i) $4x^2+7x-11$ by $2x-4$

$$2x-4 \,\big)\, 4x^2+7x-11 \quad \lfloor 2x+\frac{15}{2}$$

$$\pm 4x^2 \mp 8x$$

$$15x-11$$

$$-15x \mp 30$$

$$19$$

Check

$$(2x-4)(4x^2+7x-11)$$

$$2x\left(2x+\frac{15}{2}\right)-4\left(2x+\frac{15}{2}\right)$$

$$=4x^2+15x-8x-30+19$$

$$=4x^2+7x-11$$

(ii) $125 - 225x + 135x^2 - 27x^3$ by $5 - 3x$

$$5-3x \overline{)\,125-225x+135x^2-27x^3\,}\; (9x^2-30x+25$$

$$= 5-3x \overline{)\,-27x^3+135x^2-225x+125\,}\; (9x^2-30x+25$$

$$\underline{\mp 27x^3 \pm 45x^2}$$

$$90x^2 - 225x + 125$$

$$\underline{-90x^2 \mp 150x}$$

$$-75x + 125$$

$$\underline{\mp 75x \pm 125}$$

$$0$$

Check

$(-3x+5)(9x^2-30x+25)$

$-3x(9x^2-30x+25) + 5(9x^2-30x+25)$

$= -27x^3 + 90x^2 - 75x + 45x^2 - 150x + 125$

$= -27x^3 + 135x^2 - 225x + 125$

(iii) $y^3 + 5y^2 + 12y + 9$ by $y+2$

$$y+2 \overline{)\,y^3+5y^2+12y+9\,}\; (y^3+3y+6$$

$$\underline{-y^3 \pm 2y^2}$$

$$3y^2 + 12y + 9$$

$$\underline{-3y^2 \pm 6y}$$

$$6y + 9$$

$$\underline{-6y \pm 12}$$

$$-3$$

Check

$(y+2)(y^3+3y+6)$

$y(y^2+3y+6)+(-3)+2(y^2+3y+6)+(-3)$

$y^3+3y^2+6y+2y^2+6y+12+(-3)$

$y^3+5y^2+12y+9$

(v) q^4+3q^2-4 by q^2-1

$$
\begin{array}{r|l}
q^2-1 & q^4+3q^2-4 \quad (q^2+4 \\
 & \underline{-q^4 \mp q^2} \\
 & \quad 4q^2-4 \\
 & \quad \underline{-4q^2 \mp 4} \\
 & \quad \underline{0}
\end{array}
$$

Check

$q^2-1(q^2+4)$

$q^2(q^2+4)-1(q^2+4)$
$=q^4+4q^2-q^2-4$
$=q^4+3q^2-4$

Q4: (i) $3x+2,\ 3x^4+5x^3-x^2+13x+10$

$$
\begin{array}{r|l}
3x+2 & 3x^4+5x^3-x^2+13x+10 \quad (x^3+x^2-x+5 \\
 & \underline{-3x^4 \pm 2x^3} \\
 & \quad 3x^3-x^2+13x+10 \\
 & \quad \underline{-3x \pm 2x^2} \\
 & \quad -3x^2+13x+10 \\
 & \quad \underline{\mp 3x^2 \mp 2x} \\
 & \quad 15x+10 \\
 & \quad \underline{-15x \pm 10} \\
 & \quad \underline{0}
\end{array}
$$

(ii) $x^2+1,\ x^4-3x^3-4x^2+3x+2$

$$
\begin{array}{r|l|l}
x^2+1 & x^4-3x^3-4x^2+3x+2 & x^2-3x-5 \\
 & \cancel{-x^4} \quad\quad +x^2 & \\
 & \quad -3x^3-5x^2+3x+2 & \\
 & \quad \mp 3x^3 \quad\quad \mp 3x & \\
 & \quad\quad -5x^2+6x+2 & \\
 & \quad\quad \mp 5x^2 \quad\quad \mp 5 & \\
 & \quad\quad\quad 6x+7 &
\end{array}
$$

B(b)

$$
\begin{array}{r|l|l}
x-3 & 2x^2+x+k & 2x+7 \\
 & -2x^2 \mp 6x & \\
 & \quad 7x+k & \\
 & \quad -7x \mp 21 & \\
 & \quad 21+k &
\end{array}
$$

Since $x-3$ is factor of $2x^2+x+k$

$21+k=0$

$k=-21$

Q2 Divide

(i) $\dfrac{-39x^4}{\sqrt{13}x^2}$

$\dfrac{-13\times 3x^4}{\sqrt{13}\,x^2}$

$-\dfrac{\sqrt{13}\times\sqrt{13}\times 3x^2}{\sqrt{13}}$

$= -3\sqrt{13}x^2$

(ii) $\frac{\sqrt{125y^2}}{5y^2} = \frac{\sqrt{5 \times 5 \times 5}}{5}$

$\frac{5\sqrt{5}}{\sqrt{5}} = 5$

(iii) $\frac{49p^3}{-7\sqrt{7}p^2} = \frac{-7p}{\sqrt{7}}$

$-\frac{\sqrt{7} \times \sqrt{7}p}{\sqrt{7}}$

$= -\sqrt{7}p$

(V) $6x^3 - 4x^2 + 8x$ by $\frac{2}{3}x$

$6x^3 - 4x^2 + 8x \times \frac{3}{2x}$

$6x^3 \times \frac{3}{2}x - 4x^2 \times \frac{3}{2}x + 8x \times \frac{3}{2}x$

$9x^2 - 6x + 12$

(IV) $\frac{14z^6}{14z^6} \div \frac{14z^3}{3}$

$\frac{14z^6 \times 3}{14z^3}$

$= 3z^3$

(VII) $18a^3 - 12a^2 + 9a$ by $3a$

$\frac{18a^3 - 12a^2 + 9a}{3a}$

$= \frac{18a^3}{3a} - \frac{12a^2}{3a} + \frac{9a}{3a}$

$= 6a^2 - 4a + 3$

(VI) $(y^2 - 5y + 1) \div \left(\frac{-1}{3}y\right)$

$y^2 - 5y + 1 \times \frac{-3}{y}$

$y^3 \times \left(\frac{-3}{y}\right) - 5y \times \left(\frac{-3}{y}\right) + 1\left(\frac{-3}{y}\right)$

$-3y + 15 - \frac{3}{y}$

HOTS

$x-2 \,\big)\, x^3 + (k+8)x + k \,\big(\, x^2 + 2x + k + 12$

$\cancel{-x^3} \mp 2x^2$

$\cancel{2x^2} + (k+8)x + k$

$\cancel{-2x^2} \mp 4x$

$\cancel{(k+12)x} + k$

$+ \cancel{(k+12)x} \mp 2k - 24$

$3k + 24$

$x-1 \,\big)\, x^3 + (k+8)x + k \,\big(\, x^2 - x + k + 9$

$\cancel{-x^3} \mp x \qquad \pm x^2$

$\cancel{-x^2} + (k+8)x + k$

$\mp \cancel{x^2} \mp x$

$\cancel{x(k+9)} + k$

$\cancel{-x(k+9)} + (k+9)$

$k - (k+9)$

ATQ

$k + 2(k+12) + k - (k+9) = 0$

$k + 2k + 24 + k - k - 9 = 0$

$3k + 15 = 0$

$3k = -15$

$k = \frac{-\cancel{15}}{\cancel{3}} = -5$