

① let $p(x) = x^3 + 3x^2 + 3x + 1$

① when $p(x)$ is divided by $x+1$ remainder by remainder theorem

$$= p(-1)$$

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

$$= -1 + 3 - 3 + 1$$

$$= 0$$

② when $p(x)$ is divided by $x - \frac{1}{2}$ remainder by remainder theorem

$$= p\left(\frac{1}{2}\right)$$

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

$$= \frac{1}{8} + \frac{3}{4} + \frac{3}{2} + 1$$

$$= \frac{1 + 6 + 12 + 8}{8}$$

$$= \frac{27}{8}$$

③ when $p(x)$ is divided by x remainder by remainder theorem

$$= p(0)$$

$$= 0^3 + 3 \times 0^2 + 3 \times 0 + 1$$

$$= 1$$

④ when $p(x)$ is divided by $x + \pi$ remainder by remainder theorem

$$= p(-\pi)$$

$$= (-\pi)^3 + 3 \times (\pi)^2 + 3(-\pi) + 1$$

$$= -\pi^3 + 3\pi^2 - 3\pi + 1$$

⑤ when $p(x)$ is divided by $5 + 2x$ remainder by remainder theorem

$$= p\left(-\frac{5}{2}\right)$$

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

$$= -\frac{125}{8} + \frac{75}{4} - \frac{15}{2} + 1$$

$$= \frac{-125 + 150 - 60 + 8}{8}$$

$$= -\frac{27}{8}$$