

**System Of Linear Equations****1. CJC Prelim/2020/02/Q1**

The graph of a curve  $C$  is a cubic polynomial and it passes through the origin,  $(2,0)$  and  $(2.55, -0.0631)$ . Given that it has a turning point when  $x = 0.785$ , find the equation of  $C$ , giving its coefficients correct to 1 decimal place. [5]

**2. NYJC Prelim/2020/01/Q1**

A household's monthly utility bill is calculated by summing up the charges it incurs for its usage of electricity, gas and water based on the prevailing price rate per unit. The table below shows Mrs Ang's household utilities usage for the months of April, May, June and July in a particular year.

|             | Monthly usage (units) |     |      |      |
|-------------|-----------------------|-----|------|------|
|             | April                 | May | June | July |
| Electricity | 23                    | 33  | 49   | 35   |
| Gas         | 12                    | 16  | 22   | 17   |
| Water       | 16                    | 21  | 33   | 26   |

The prevailing price rate per unit were unchanged for the period of April to June. However, in the month of July, the electricity rate was increased by 7%, the gas rate was reduced by 5% and the water rate remained unchanged. Given that Mrs Ang's monthly utility bills for April, May and June were \$103.00, \$142.00 and \$209.00 respectively, find her monthly utility bill for the month of July. [4]

**3. PJC/2010/I/1**

It is known that the number of diagonals that can be drawn in a polygon of  $n$  sides can be expressed as a quadratic polynomial in  $n$ . By considering the number of diagonals in a triangle, a quadrilateral and a pentagon, find the number of diagonals that can be drawn in a polygon of 200 sides. [4]

**4. AJC/2011/1/2**

The usual selling price of a T-box game console, a Kinect sensor and a game DVD is \$499 in total. During the Great Singapore Sale, two companies, P and Q, offered the following discounts to their customers:

| Company | Discounts given for each item |               |          | Total price after the discount |
|---------|-------------------------------|---------------|----------|--------------------------------|
|         | T-box game console            | Kinect sensor | Game DVD |                                |
| P       | 10%                           | 15%           | 10%      | \$439.15                       |
| Q       | 5%                            | 25%           | 20%      | \$426.30                       |

The employees from Company P are offered a further 5% discount on the original price of both the Kinect sensor and the Game DVD. Determine if this additional discount will make it more attractive for the employees to purchase all the 3 items from their own company than from Company Q. [4]

5. **ACJC/2011/II/1**

The graph of  $y = f(x)$  passes through the points  $(1,2)$ ,  $(-1,3)$  and  $(2,2)$ . Given that  $f'(x) = 3ax^2 + 2bx + 2$ , where  $a$  and  $b$  are constants, find  $f(x)$ .

6. **NJC/2013/I/1**

Jacob wants to purchase 4 packets of cashew nuts, 6 packets of macadamia nuts and 7 packets of almonds. Based on the usual retail price, his total bill will be \$57.05.

Supermarket A is having a sale and there is 30% off each packet of cashew nuts and a 'Buy 2 packets get 1 packet free' promotion for macadamia nuts. After using a \$10 voucher, Jacob's bill is \$33.05 if he made his purchase at Supermarket A.

Supermarket B is also having a sale and there is 20% off each packet of cashew nuts, a '2 packets for the price of 1 packet' promotion for macadamia nuts, and 15 cents off each packet of almonds. Jacob's bill at Supermarket B will exceed his final bill at Supermarket A by \$5.45.

Assume that the usual retail prices of nuts in both supermarkets are the same. Write down and solve equations to find the usual retail price of each of the following: a packet of cashew nuts, macadamia nuts and almonds. [4]

7. **TPJC/2014/I/1**

Two curves with equations  $y = \sqrt{a}x + bx^2$  and  $y = \ln(cx)$  intersect at the points where  $x = 1$ ,  $x = 2$  and  $x = 3$ . Find the values of  $a$ ,  $b$  and  $c$ , correct to 3 decimal places. [4]

8. **RI/2012/I/1**

A study conducted by the Department of Health classified a population of size 21000 into three categories: underweight, normal and overweight. At the start of the study, it was found that  $x$ ,  $y$  and  $z$  (in thousands) were the number of individuals in the population who were underweight, normal and overweight respectively. At that time, the number of individuals who were overweight was three times the number of individuals who were underweight.

Two years later, the Department found that 10% of the individuals who were underweight and 20% of the individuals who were overweight became normal but 5% of the individuals who were normal became overweight. The weight categories of the rest of the individuals remain unchanged. However, the number of individuals who were overweight was still three times the number of individuals who were underweight.

Assuming that the population remains unchanged during the period of study, find the values of  $x$ ,  $y$  and  $z$ . [3]

9. **VJC/2015/I/2**

The function  $h$  is given by

$$h: x \mapsto ax^3 + bx^2 + cx + d, \quad x \in \mathbb{R},$$

where  $a$ ,  $b$ ,  $c$  and  $d$  are real constants.

The graph of  $y = h(x)$  passes through the point  $(1, 1)$ . Given that  $(2, 2)$  is a stationary point, find three linear equations involving  $a$ ,  $b$ ,  $c$  and  $d$ . [3]

By writing each of  $a$ ,  $b$  and  $c$  in terms of  $d$ , find the exact set of values of  $d$  such that  $\frac{ab}{c} \leq 0$ . [3]

10. **CJC/2018/I/2**

It is given that  $f(x) = x^3 \ln a + bx^2 + cx + d$ , where  $a$ ,  $b$ ,  $c$  and  $d$  are constants. The curve with equation  $y = f(x)$  has a minimum point with coordinates  $\left(\frac{5}{3}, \frac{320}{27}\right)$ . When this curve is translated 1 unit in the negative  $x$ -direction, it has a maximum point with coordinates  $(0, 12)$ . Find the values of  $a$ ,  $b$ ,  $c$ , and  $d$ . [4]

11. **RI/2021/I/1**

Given the polynomial  $x^4 + ax^2 + bx + c$  has a factor  $(x - 2)$  and gives remainders 12 and 26 when divided by  $(x - 3)$  and  $(x - 4)$  respectively, find the values of  $a$ ,  $b$  and  $c$ . [4]

12. **NYJC/2022/I/1**

A function  $f$  is defined by  $f(x) = ax^3 + bx^2 + cx + d$ . The graph of  $y = f(x)$  has a minimum point at  $(-1, -1)$  and  $\int_0^1 f(x) dx = \frac{9}{4}$ . When  $f(x)$  is divided by  $(x + 2)$ , the remainder is 3. Find the values of  $a$ ,  $b$ ,  $c$  and  $d$ . [5]

13. **EJC Prelim 9758/2024/01/Q1**

The sum of the digits of a certain three-digit number is 15. The sum of the digit in the tens placing and twice the digit in the hundreds placing is equal to the digit in the units placing.

If the digits are reversed, the new number is 21 more than 5 times the old number.

What is the number?

[4]

**14. TJC Prelim 9758/2024/01/Q1**

A ball is rolling in a straight line such that its distance away from the starting point,  $s$  cm, can be modelled using the equation

$$s = at + \frac{b}{\sqrt{t+4}} + c,$$

where  $t$  is the time taken in seconds, and  $a$ ,  $b$  and  $c$  are real constants.

The ball is at the starting point when  $t = 0$ , and moved 10 cm in the first 5 seconds. It moved another 9 cm in the next 16 seconds. Find the ball's distance away from the starting point when  $t = 50$ . [4]

**15. NYJC Prelim 9758/2025/P1/Q1**

Curve  $C$  has equation  $y = \frac{px^2 + qx + r}{x-1}$ , where  $p$ ,  $q$  and  $r$  are real numbers. Given that  $C$  has a turning point at  $(3, 7)$  and an oblique asymptote parallel to the line  $y = \frac{3}{2}x + \sqrt{5}$ , find  $p$ ,  $q$  and  $r$ . [4]

**16. SAJC Prelim 9758/2025/P1/Q1**

A function  $f$  is defined by  $f(x) = ax^3 + bx^2 + cx + d$  where  $a$ ,  $b$ ,  $c$  and  $d$  are constants. The graph of  $y = f(x)$  has a turning point at  $x = -1$  and passes through the points  $(2, 10)$  and  $(-2, -2)$ . Given also that  $\int_{-2}^2 f(x) dx = 16$ , find the values of  $a$ ,  $b$ ,  $c$  and  $d$ . [4]

**Answers**

1.  $y = 0.1x^3 - 0.5x^2 + 0.6x$ .
2. 159.17
3. 19700
4. No
5.  $f(x) = -\frac{5}{2}x^3 + \frac{31}{6}x^2 + 2x - \frac{8}{3}$
6. \$3.50, \$4.90 and \$1.95
7.  $a = 1.265$ ,  $b = -0.144$ ,  $c = 2.667$
8.  $x = 2.1$ ,  $y = 12.6$  and  $z = 6.3$
9.  $a = -\frac{1}{2} - \frac{1}{4}d$ ,  $b = \frac{3}{2} + \frac{5}{4}d$ ,  $c = -2d$ ;  $\{d \in \mathbb{R} : d \leq -2 \text{ or } -\frac{6}{5} \leq d < 0\}$
10.  $a = e$ ,  $b = -4$ ,  $c = 5$ ,  $d = 10$
11.  $a = -54$ ,  $b = 217$ ,  $c = -234$
12.  $a = -1$ ,  $b = 0$ ,  $c = 3$  and  $d = 1$
13. 168
14. 25.1 cm
15.  $p = 1.5$ ,  $q = -2$ ,  $r = 6.5$
16.  $a = 3$ ,  $b = 0$ ,  $c = -9$ ,  $d = 4$