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## Question 1

$$a (1) \frac{2x(9-x^2)}{x(x+3)} \checkmark$$

$$= \frac{2x(3-x)(3+x)}{(3+x)} \checkmark$$

$$= 2x(3-x) \checkmark$$

(4)

$$(2) \frac{(2 \cdot 3)^x \cdot (2^4)^{x+1} \cdot 3^{1-x}}{2^{3x} \cdot (2^2)^{x+2} \cdot 3^x} \checkmark$$

$$= \frac{2^x \cdot 3^x \cdot 2^{4x+4} \cdot 3^{1-x}}{2^{3x} \cdot 2^{2x+4} \cdot 3^x} \checkmark$$

$$= 2^{x+4x+4-3x-2x-4} \cdot 3^{x+1-x-x} \checkmark$$

$$= 2^0 \cdot 3^{-1} \checkmark$$

$$= \frac{1}{3} \checkmark$$

(5)

$$b (1) (\sqrt{31-10x})^2 = (4-x)^2$$

$$31-10x = 16-8x+x^2 \checkmark$$

$$0 = x^2 + 2x - 15 \checkmark$$

$$0 = (x+5)(x-3) \checkmark$$

$$x = -5 \checkmark \quad \text{or} \quad x = 3 \checkmark$$

(✓)

(✓)

(5)

$$(2) x^2 + 4x - 5 \geq 0 \checkmark$$

$$(x+5)(x-1) \geq 0 \checkmark$$

CV's 1, -5



$$x \leq -5 \quad \text{or} \quad x \geq 1 \checkmark$$

(4)

$$* (3) 3^{9x} = 7$$

$$9x \log 3 = \log 7 \checkmark$$

$$\therefore x = 0,2 \checkmark \quad (\text{rounding})$$

$$9x = \frac{\log 7}{\log 3} \checkmark$$

$$x = 0,196 \checkmark$$

(4)

$$(4) \quad 3 \cdot 9^x - 4 \cdot 3^x + 1 = 0$$

$$3 \cdot 3^{2x} - 4 \cdot 3^x + 1 = 0 \quad \checkmark$$

$$\text{let } k = 3^x$$

$$3k^2 - 4k + 1 = 0 \quad \checkmark$$

$$(3k - 1)(k - 1) = 0 \quad \checkmark$$

$$k = \frac{1}{3} \quad \text{or} \quad k = 1$$

$$3^x = 3^{-1} \quad \checkmark \quad 3^x = 1 \quad \checkmark$$

$$3^x = 3^0$$

$$x = -1 \quad \text{or} \quad x = 0$$

✓

✓

(6)

$$(c) \quad (1) \quad \Delta = b^2 - 4ac \quad \checkmark$$

$$= (4k)^2 - 4(1)(4) < 0 \quad \checkmark$$

$$16k^2 - 16 < 0 \quad \checkmark$$

$$4k^2 - 4 < 0 \quad \checkmark$$

$$(k-1)(k+1) < 0 \quad \checkmark$$

$$\text{roots } -1, 1, 3$$

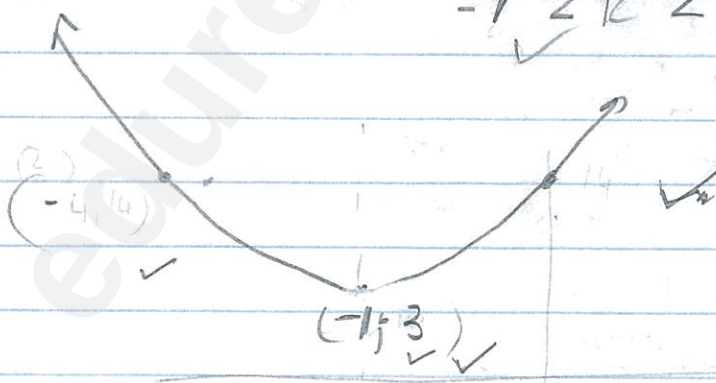
$$\begin{array}{c} + \quad 0 \quad - \quad 0 \quad + \\ | \quad | \quad | \quad | \\ -1 \quad 1 \quad 3 \end{array}$$

$$-1 < k < 1 \quad \checkmark$$

✓

✓

(5)



(3)

$$f(x) = x^2 + 2x + 4$$

$$2x + 2 = 0$$

$$x = -1$$

$$y = 3$$

Question 2.

(a)  $4 + 7 + 10 + 13 + \dots + 163$

(1)  $a = 4$   $d = 3$   $T_n = 163$

$$163 \checkmark = 4 + (n-1)3 \quad \checkmark$$

$$159 = 3n - 3$$

$$162 = 3n$$

$$54 = n \quad \checkmark$$

$$\therefore T_{54} = 163$$

(3)

$$\begin{aligned} (2) \quad S_n &= \frac{n}{2} [2a + (n-1)d] \\ &= \frac{54}{2} [2(4) + (54-1)3] \quad \checkmark \checkmark \\ &= 4509 \quad \checkmark \end{aligned}$$

(3)

$$(3) \quad \sum_{a=1}^{54} (3a+1) \quad \checkmark \quad (3)$$

(b)  $T_1 + T_2 = 30$

$$T_{20} = a + 19d = 89 \quad \checkmark \quad (2)$$

$$a + a + d = 30 \quad \checkmark$$

$$2a + d = 30 \quad \checkmark$$

$$d = 30 - 2a \quad (1)$$

Subst (1) into (2)

$$a + 19(30 - 2a) = 89 \quad \checkmark$$

$$a + 570 - 38a = 89$$

$$-37a = -481$$

$$a = 13 \quad \checkmark$$

$$\therefore d = 30 - 2(13) \quad \checkmark$$

$$= 4$$

$$\therefore 13; 17; 21 \quad \checkmark \checkmark$$

(7)

Question 3:

$$(a) f(x) = 3x^2 + 2x$$

$$f(x+h) = 3(x+h)^2 + 2(x+h) \\ = 3x^2 + 6xh + 3h^2 + 2x + 2h$$

$$\therefore f'(x) = \lim_{h \rightarrow 0} \frac{3x^2 + 6xh + 3h^2 + 2x + 2h - (3x^2 + 2x)}{h}$$

$$= \lim_{h \rightarrow 0} \frac{6xh + 3h^2 + 2h}{h}$$

$$= \lim_{h \rightarrow 0} \frac{h(6x + 3h + 2)}{h}$$

$$= 6x + 2 \quad \checkmark \quad (5)$$

$$= -\frac{3}{x^2} \quad (5)$$

$$b) 1) f(x) = \frac{(2x^2 - 5)(3x + 2)}{x^2} \\ = \frac{6x^3 + 4x^2 - 15x - 10}{x^2} \quad \checkmark$$

$$= \frac{6x^3}{x^2} + \frac{4x^2}{x^2} - \frac{15x}{x^2} - \frac{10}{x^2}$$

$$= 6x + 4 - 15x^{-1} - 10x^{-2} \quad \checkmark$$

$$\therefore f'(x) = 6 + 15x^{-2} + 20x^{-3} \quad \checkmark \\ = 6 + \frac{15}{x^2} + \frac{20}{x^3} \quad \checkmark \quad (4)$$

$$2) f(x) = \frac{3x}{x^{\frac{1}{6}}} - x(x^{\frac{1}{2}}) \\ = 3x^{\frac{5}{6}} - x^{\frac{3}{2}} \quad \checkmark$$

$$f'(x) = \frac{5}{2}x^{-\frac{1}{6}} - \frac{3}{2}x^{\frac{1}{2}} \quad \checkmark$$

$$= \frac{5}{2x^{\frac{1}{6}}} - \frac{3}{2}x^{\frac{1}{2}} \quad \checkmark \quad (4)$$

$$c) f(x) = ax^3 + bx^2 + cx + d \quad f'(x) = 6x^2 - 10x + 4$$

$$f'(x) = 3ax^2 + 2bx + c$$

$$\therefore 3a = 6$$

$$2b = -10$$

$$c = 4$$

$$a = 2$$

$$b = -5$$

$$c = 4$$

$$\therefore f(x) = 2x^3 - 5x^2 + 4x + 3$$

(5)

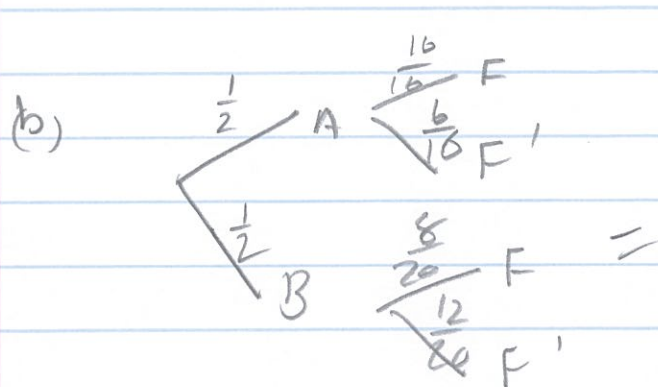
Question 1

$$(a) (1) \frac{6!}{2!2!} = 180 \checkmark$$

(2)

$$(2) (PN) \frac{5! \cdot 2!}{2! \cdot 2!} = 60 \checkmark$$

(3)



$$(1) \frac{1}{2} \times \frac{6}{16} + \frac{1}{2} \times \frac{12}{20} = 0,49 \quad \left( \frac{39}{80} \right) \checkmark$$

$$(2) 1 - \frac{1}{2} \times \frac{8}{20} = 0,8 \checkmark \quad (3)$$

$$(c) \quad P(L) = 0,4 \quad P(J) = 0,5$$

$$P(L \cap J) = 0,4 \times 0,5$$

$$= 0,2 \checkmark$$

$$P(L \cup J) = 0,4 + 0,5 - 0,2 \checkmark$$

$$= 0,7 \checkmark \quad (4)$$

$$\therefore P(\text{neither}) = 1 - 0,7$$

$$= 0,3 \checkmark$$

Question 5

a (1)  $1 + i_{\text{eff}} = \left(1 + \frac{i_{\text{nom}}}{m}\right)^m$

$$1 + i_{\text{eff}} = \left(1 + \frac{0,075}{12}\right)^{12} \quad \checkmark$$

$$i_{\text{eff}} = 0,0776 \dots$$

$$r = 7,76\% \quad \checkmark$$

(2)

(2)  $12\,450,84 = 8\,557 \left(1 + \frac{0,075}{12}\right)^{12n} \quad \checkmark$

$$\log 1,455 \dots = \log \left(\frac{12,075}{12}\right)^{12n} \quad \checkmark$$

$$12n = \frac{\log 1,455 \dots}{\log \left(\frac{12,075}{12}\right)}$$

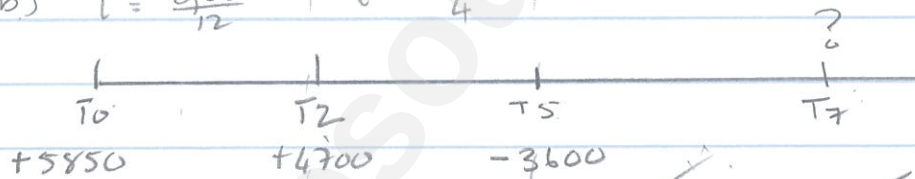
$$12n = 60,19 \dots \quad \checkmark$$

$$n = 5 \quad \checkmark$$

$$\therefore 5 \text{ yrs.} \quad \checkmark$$

(6)

(b)  $n = 24$   $n = 20$   $n = 8$   
 $i = \frac{0,063}{12}$   $i = \frac{0,08}{4}$   $i = 0,08$



$$A = 5850 \left(1 + \frac{0,063}{12}\right)^{24} - 3600 \left(1 + \frac{0,08}{4}\right)^8 + 4700 \left(1 + \frac{0,08}{4}\right)^{20}$$

$$= 12\,622,81 \quad \checkmark \quad \checkmark \quad \checkmark$$

(7)

13

Question 6

$$a) \quad 1) \quad 2 = \log_a 9 \quad \checkmark$$

$$a^2 = 3^2 \quad \checkmark$$

$$\therefore a = 3$$

$$f(x) = \log_3 x$$

(2)

$$(2) \quad y = 3^x \quad \checkmark \checkmark$$

(2)

$$(3) \quad y > 0 \quad \checkmark$$

(2)

$$(4) \quad -1 = \log_3 x \quad \checkmark$$

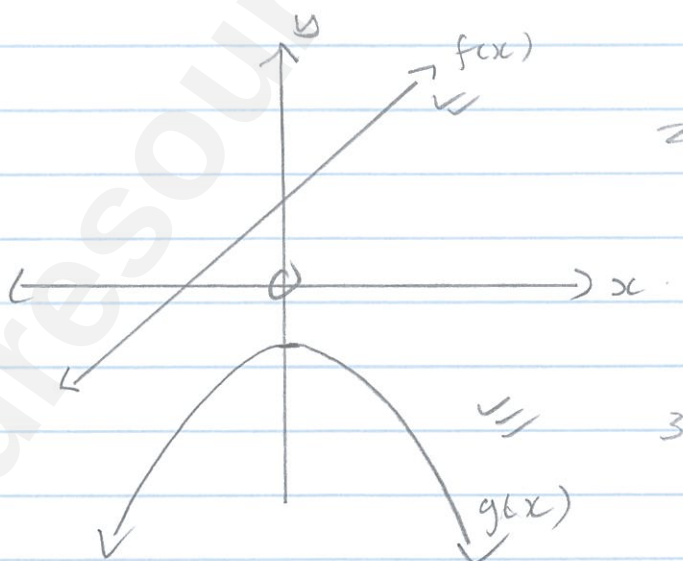
$$\frac{1}{3} = x$$

$$\therefore 0 < x < \frac{1}{3}$$

$$\checkmark \quad \checkmark$$

(3)

b) (1)



(5)

$$(2) \quad y = x^2 + \frac{2}{3}x + 7$$

$$y' = 2x + \frac{2}{3}$$

$$0 = 2x + \frac{2}{3}$$

$$x = -\frac{1}{3}$$

$$\therefore y = \left(-\frac{1}{3}\right)^2 + \frac{2}{3}\left(-\frac{1}{3}\right) + 7$$

$$= \frac{62}{9} \text{ units} \quad (6.89)$$

Question 7:

$$(a) \quad y = -\frac{1}{30}x^3 - \frac{1}{10}x^2 + \frac{3}{10}x + \frac{9}{10}$$

$$y' = -\frac{1}{10}x^2 - \frac{1}{5}x + \frac{3}{10} \quad \checkmark$$

$$0 = x^2 + 2x - 3 \quad \checkmark$$

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

$$x = -3 \quad \text{or} \quad x = 1$$

$$y = 0 \quad \text{or} \quad y = \frac{16}{15} \quad \checkmark$$

$$(-3; 0) \quad \checkmark$$

$$(1; \frac{16}{15}) \quad \checkmark$$

(4)

$$(b) \quad y' = -\frac{1}{10}(0)^2 - \frac{1}{5}(0) + \frac{3}{10} = \frac{3}{10} \quad \checkmark$$

$$\therefore y - \frac{9}{10} = \frac{3}{10}(x - 0) \quad \checkmark$$

$$y = \frac{3}{10}x + \frac{9}{10} \quad \checkmark$$

(3)

$$(c) \quad \frac{3}{10}x + \frac{9}{10} = -\frac{1}{30}x^3 - \frac{1}{10}x^2 + \frac{3}{10}x + \frac{9}{10} \quad \checkmark$$

$$\frac{1}{30}x^3 + \frac{1}{10}x^2 = 0$$

$$x^2 \left( \frac{1}{30}x + \frac{1}{10} \right) = 0$$

$$x = 0 \quad \text{or} \quad x = -3 \quad \checkmark$$

$$y = 0$$

$$(-3; 0) \quad \checkmark \quad (3)$$

$$(d) \quad f''(x) > 0$$

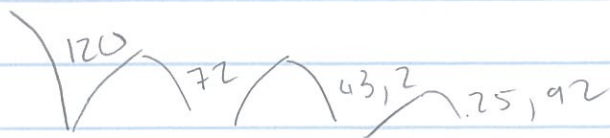
$$y'' = -\frac{1}{5}x - \frac{1}{5} \quad \checkmark$$

$$-\frac{1}{5}x - \frac{1}{5} > 0$$

$$-\frac{1}{5}x > \frac{1}{5} \quad \checkmark$$

$$x < -1 \quad \checkmark$$

(3)

Question 8:9

$$\therefore a) 120 \times 60\% = 72 \text{ m.} \quad (2)$$

$$\begin{aligned} b) T_n &= ar^{n-1} \\ &= 72(0,6)^{6-1} \\ &= 5,6 \text{ m} \end{aligned} \quad (3)$$

$$\begin{aligned} c) S_{\infty} &= \frac{a}{1-r} \\ &= \frac{72}{1-0,6} \\ &= 180 \end{aligned}$$

$$\therefore \text{Total distance} = 2 \times 180 + 120 = 480 \text{ m.} \quad (4)$$

Question 9:

$$\begin{aligned}
 (1; -4) &: -4 = a + b + c \quad \dots (1) \\
 (2; -4) &: -4 = 4a + 2b + c \quad \dots (2) \quad (2-1) \\
 &\quad b + 3a = 0 \\
 &\quad b = -3a. \quad \checkmark
 \end{aligned}$$

$$\begin{aligned}
 (3; -2) &\quad -2 = 9a + 3b + c \quad \dots (3) \\
 &\quad -4 = a + b + c \quad \dots (1) \quad (3-1) \\
 &\quad 2 = 8a + 2b \quad \checkmark
 \end{aligned}$$

$$\begin{aligned}
 \text{subst } b &= -3a \\
 2 &= 8a + 2(-3a) \\
 2 &= 2a \\
 1 &= a \quad \checkmark \\
 \therefore b &= -3 \quad \checkmark \\
 -4 &= 1 - 3 + c \\
 -2 &= c \quad \checkmark
 \end{aligned}$$

$$\therefore T_n = n^2 - 3n - 2.$$

(Alt)

$$\begin{array}{ccccc}
 -4 & & -4 & & -2 & & 2 \\
 & \swarrow & \searrow & & \swarrow & \searrow & \\
 0 & & 2 & & 4 & & \\
 & \swarrow & \searrow & & \swarrow & \searrow & \\
 & 2 & & & 2 & & 
 \end{array}$$

$$\begin{aligned}
 2a &= 2 \\
 a &= 1 \quad \checkmark
 \end{aligned}$$

$$\begin{aligned}
 3a + b &= 0 \\
 3 + b &= 0 \\
 b &= -3 \quad \checkmark
 \end{aligned}$$

$$\begin{aligned}
 a + b + c &= -4 \\
 1 + (-3) + c &= -4 \\
 c &= -2 \quad \checkmark
 \end{aligned}$$

$$T_n = n^2 - 3n - 2. \quad \checkmark$$

Question 10:

$$(50+x)(800-10x) = \text{Total Apples.}$$

$$40000 - 500x + 800x - 10x^2 = T.A.$$

$$40000 + 300x - 10x^2 = T.A.$$

$$0 = 300 - 20x$$

$$-300 = -20x$$

$$15 = x.$$

∴ Add 15 trees. (6)