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St Dominic's Catholic School for Girls
Preliminary Examination

NAME : Marking Guidelines

CLASS: _____

150

Topic(s) : Paper I

Grade : 12

Examiner : Mrs S Adams

Date : 20 September 2023

Moderator(s) : Mrs S van Rooyen

Duration : 3 hours

INSTRUCTIONS :

1. This paper consists of 13 questions and 28 pages. Please check that the paper is complete.
2. Read the questions carefully.
3. **Answer ALL the questions on the question paper and hand this in at the end of the examination.**
4. You may use an approved non-programmable and non-graphical calculator, unless otherwise stated.
5. **Answers only will not necessarily be awarded full marks.**
6. Round off your answers to **two decimal digits** where necessary.
7. All the necessary working details must be clearly shown.
8. It is in your own interest to write legibly and to present your work neatly.
9. Pencil work will not be marked. Sketches may be done in pencil.
10. Correction fluid ("tippex") may not be used

Marks analysis

QUESTION	1	2	3	4	5	6	7	8	9	10	11	12	13
POSSIBLE MARKS	13	14	12	11	13	7	12	9	14	12	8	9	16
ACTUAL MARK													

(a) Solve for x , leaving answers correct to one decimal place if necessary.

(1) $x(x-3) + 2(3-x) = 0$ $\therefore x(x-3) - 2(x-3) = 0$ (3)

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

$$x = 3 \text{ or } x = 2 \quad \checkmark \text{ both}$$

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

$$x^2 - 5x + 6 = 0 \quad \checkmark$$

$$(x-3)(x-2) = 0 \quad \checkmark$$

$$x = 3 \text{ or } x = 2 \quad \checkmark \text{ both}$$

(2) $7 \cdot 3^{2x} = 21$ (2)

$$3^{2x} = 3 \quad \checkmark$$

$$2x = 1 \quad \checkmark$$

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

(3) $x(x-5) < 6$ (4)

$$x^2 - 5x - 6 < 0 \quad \checkmark$$

$$(x-6)(x+1) < 0 \quad \checkmark$$



must show number line

SOLUTION: $-1 < x < 6$

(b) Given: $x - 2 = \frac{4}{x-2}$ Downloaded from eduresourceza.com

If $y = x - 2$:

(1) Show that the given equation can be expressed as: (2)

$$y^2 + 4y + 4 = 0$$

(2) Hence, show that the equation has real and equal roots. (2)

(1) $y = -\frac{4}{y} - 4$ ✓ subs

∴ y : $y^2 = -4 - 4y$ ✓ $\times y$
 $y^2 + 4y + 4 = 0$

(2) $\Delta = b^2 - 4ac$
 $\Delta = 4^2 - 4(1)(4)$
 $\Delta = 16 - 16$
 $\Delta = 0$ ✓

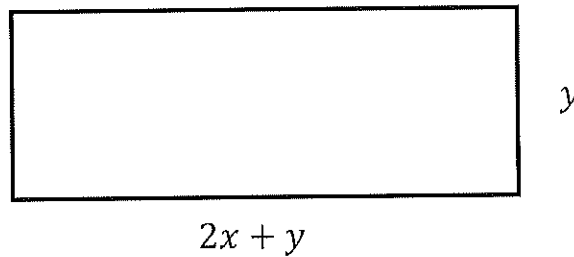
roots are real + equal

or

$$y^2 + 4y + 4 = 0$$
$$(y+2)(y+2) = 0 \quad \text{✓ factors}$$
$$(y+2)^2 = 0$$
$$y = -2 \text{ or } y = -2 \quad \text{✓}$$

∴ roots are real and equal

- (a) A rectangle has a length of $(2x + y)$ metres and a width of y metres as shown in the diagram below. The perimeter of the rectangle is 24 metres and the area is 32m^2 .



- (1) Show that the expression for the perimeter is: $24 = 4x + 4y$. (1)
- (2) Show that the expression for the area is: $32 = y^2 + 2xy$. (1)
- (3) Determine the dimensions of the rectangle if $x > 0$. (6)

(1) Perimeter = $2L + 2B$

$$24 = 2(2x + y) + 2y$$

$$24 = 4x + 2y + 2y$$

$$24 = 4x + 4y$$

(2) Area = $L \times B$

$$32 = (2x + y)y$$

$$32 = 2xy + y^2$$

(3) $24 = 4x + 4y$

$$6 = x + y$$

$$y = 6 - x \dots (1)$$

$$32 = 2xy + y^2 \dots (2)$$

Subs (1) into (2)

$$32 = 2x(6 - x) + (6 - x)^2$$

$$32 = 12x - 2x^2 + 36 - 12x + x^2$$

$$32 = 36 - x^2$$

$$x^2 - 4 = 0$$

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

$$x = 2 \text{ or } x = -2$$

$$y = 6 - 2 = 4$$

dimensions

$$2(2) + 4 = 8$$

$$\therefore 8\text{m} \times 4\text{m}$$

(b) Given: $h(x) = ax^2$, Downloaded from eduresourceza.com

Determine the value of a if it is given that $h^{-1}(8) = h'(4)$.

(6)

$$h(x) = ax^2$$

$$y = ax^2$$

$$x = ay^2$$

$$y^2 = \frac{x}{a}$$

$$y = \pm \sqrt{\frac{x}{a}}$$

$$h^{-1}(x) = \pm \sqrt{\frac{x}{a}}$$

$$h^{-1}(8) = \pm \sqrt{\frac{8}{a}}$$

$$h(x) = ax^2$$

$$h'(x) = 2ax$$

$$h'(4) = 2a(4)$$

$$h'(4) = 8a$$

equate:

$$\pm \sqrt{\frac{8}{a}} = 8a$$

$$\frac{8}{a} = 64a^2$$

$$8 = 64a^3$$

$$64a^3 - 8 = 0$$

$$8a^3 - 1 = 0$$

or

$$8a^3 - 1 = 0$$

$$a^3 = \frac{1}{8}$$

$$a = \frac{1}{2}$$

$$(2a-1)(4a^2 + 2a + 1) = 0$$

$$2a-1 = 0$$

$$a = \frac{1}{2}$$

(a) Determine $f'(x)$ from first principles if $f(x) = x^2 - 5$.

(5)

$$\begin{aligned} f(x+h) &= (x+h)^2 - 5 \\ &= x^2 + 2xh + h^2 - 5 \end{aligned}$$

$$f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$

$$= \lim_{h \rightarrow 0} \frac{x^2 + 2xh + h^2 - 5 - (x^2 - 5)}{h}$$

$$= \lim_{h \rightarrow 0} \frac{x^2 + 2xh + h^2 - 5 - x^2 + 5}{h}$$

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

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

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

$$= 2x$$

(b) Determine:

(1) $g'(x)$ if $g(x) = 5x^2 - \frac{2x}{x^3}$ (3)

(2) $D_x \left[-\frac{\sqrt[3]{x}}{2} + \left(\frac{1}{3x} \right)^2 \right]$ (4)

$$\begin{aligned} (1) \quad g(x) &= 5x^2 - \frac{2x}{x^3} \\ g(x) &= 5x^2 - 2x^{-2} \checkmark \\ g'(x) &= 10x + 4x^{-3} \end{aligned}$$

$$\begin{aligned} (2) \quad D_x \left[-\frac{\sqrt[3]{x}}{2} + \left(\frac{1}{3x} \right)^2 \right] \\ &= D_x \left[-\frac{1}{2} x^{\frac{1}{3}} + \frac{1}{9x^2} \right] \\ &= D_x \left[-\frac{1}{2} x^{\frac{1}{3}} + \frac{1}{9} x^{-2} \right] \\ &= -\frac{1}{6} x^{-\frac{2}{3}} - \frac{2}{9} x^{-3} \end{aligned}$$

(a) Given that $p = 0,\dot{7} = 0,77777 \dots$

- (1) Write down p as a geometric series. (1)
- (2) Represent the series in sigma notation. (3)
- (3) Determine the sum to infinity of the geometric series as a proper fraction. (2)

$$\begin{aligned}
 (a)(1) \quad p &= 0,\dot{7} \\
 &= 0,77777 \\
 &= \frac{7}{10} + \frac{7}{100} + \frac{7}{1000} + \dots
 \end{aligned}$$

$$(2) \quad \sum_{n=1}^{\infty} \frac{7}{10} \left(\frac{1}{10} \right)^{n-1}$$

$$(3) \quad S_{\infty} = \frac{\frac{7}{10}}{1 - \frac{1}{10}}$$

$$S_{\infty} = \frac{7}{9}$$

(b) The first three terms of an arithmetic sequence are $p+6$, $p-2$, and $p-2$.

(1) Show that $p = 11$.

(2)

(2) Calculate the smallest value of n for which $T_n < -55$.

(3)

$$\begin{aligned}(1) \quad p+6-(2p+3) &= (p-2)-(p+6) \\ p+6-2p-3 &= p-2-p-6 \\ -p+3 &= -8 \\ p &= 11\end{aligned}$$

$$(2) \quad 2(11)+3; \quad 11+6; \quad 11-2$$

$$25; \quad 17; \quad 9$$

$$a = 25; \quad d = -8$$

$$T_n < -55$$

$$a + (n-1)d < -55$$

$$25 + (n-1)(-8) < -55$$

$$25 - 8n + 8 < -55$$

$$33 - 8n < -55$$

$$-8n < -88$$

$$n > 11$$

$$\therefore n = 12$$

(a) The following information of a quadratic pattern is given:

* $T_1 = 10$

* The general term of the quadratic sequence of first differences is $T_n = 2n - 9$

(1) Determine the second (T_2) and third (T_3) terms of the quadratic pattern. (3)

(2) Determine the n^{th} term of the quadratic pattern. (3)

(3) Which term of the quadratic pattern will be equal to 2019? (3)

(1)

$$T_n = 2n - 9$$

$$T_1 = 2(1) - 9 = -7$$

$$T_2 = 2(2) - 9 = -5$$

$$T_3 = 2(3) - 9 = -3$$

Diagram showing the sequence of terms and first differences:

```

    T1 = 10
    /  \
   /    \
  /      \
 /        \
-7         -5         -3
 /  \     /  \     /  \
2    2   2    2   2    2

```

Handwritten calculations for first differences:

$$x = 3 \checkmark \leftarrow x = 10 - 7$$

$$y = -2 \checkmark \leftarrow y = x - 5$$

(2)

$$2a = 2$$

$$a = 1 \checkmark$$

$$3a + b = -7$$

$$3(1) + b = -7$$

$$b = -10 \checkmark$$

$$a + b + c = 10$$

$$1 - 10 + c = 10$$

$$c = 19 \checkmark$$

$$T_n = n^2 - 10n + 19$$

(3)

$$n^2 - 10n + 19 = 2019$$

$$n^2 - 10n - 2000 = 0$$

$$(n - 50)(n + 40) = 0$$

$$n = 50 \text{ or } n = -40$$

$n \nmid 9$

$$\therefore T_{50} = 2019$$

(b) Solve for x , if:

(4)

$$\sum_{t=1}^3 (2x + 3t) + \sum_{r=7}^{12} (3 \cdot 2^{r-1}) = 0$$

$$\sum_{t=1}^3 (2x + 3t)$$

$$= 2x + 3(1) + 2x + 3(2) + 2x + 3(3)$$

$$= 2x + 3 + 2x + 6 + 2x + 9$$

$$= 6x + 18$$

$$\sum_{r=7}^{12} 3 \cdot 2^{r-1}$$

$$= 3 \cdot 2^{7-1} + 3 \cdot 2^{8-1} + 3 \cdot 2^{9-1} + 3 \cdot 2^{10-1} + 3 \cdot 2^{11-1} + 3 \cdot 2^{12-1}$$

$$= 3 \cdot 2^6 + 3 \cdot 2^7 + \dots + 3 \cdot 2^{11}$$

$$S_6 = \frac{192(2^6 - 1)}{2 - 1}$$

$$= 12096$$

$$T_1 = 3 \cdot 2^6$$

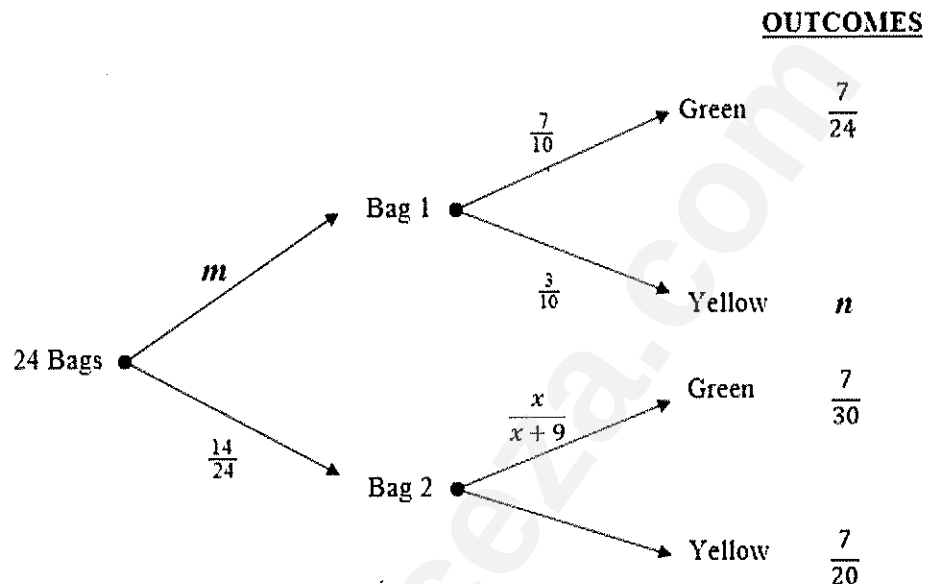
$$= 192$$

$$6x + 18 + 12096 = 0$$

$$6x = -12114$$

$$x = -2019$$

There are 24 bags of marbles for sale in a shop. In ten of the bags there are 7 green marbles and three yellow marbles. The other bags each have x green marbles and 9 yellow marbles. A bag is chosen at random and a marble is then chosen at random from the bag. The tree diagram below illustrates the process and the outcomes.



- (a) Determine the values of m and n . (2)
- (b) Determine the value of x . (3)
- (c) What is the probability that a marble chosen is green? (2)

$$(a) \quad m = \frac{10}{24} = \frac{5}{12} \quad \checkmark$$

$$n = \frac{10}{24} \times \frac{3}{10} = \frac{1}{8} \quad \checkmark$$

$$(b) \quad \frac{14}{24} \times \frac{9}{x+9} = \frac{7}{20} \quad \text{or} \quad \frac{14}{24} \times \frac{x}{x+9} = \frac{7}{30} \quad \checkmark$$

$$\frac{126}{24x + 216} = \frac{7}{20}$$

$$\frac{14x}{24x + 216} = \frac{7}{30} \quad \checkmark$$

$$168x + 1512 = 2520$$

$$168x = 1008$$

$$x = 6 \quad \checkmark$$

$$420x = 1682 + 1512$$

$$252x = 1512$$

$$x = 6 \quad \checkmark$$

(e) $P(\text{Green}) = \frac{7}{10} + \frac{7}{20}$ Downloaded from eduresourceza.com

$$= \frac{21}{40}$$

$$= 0,525$$

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The graph of $h(x) = \frac{a}{3-x} + p$ passes through points (2; -5) and (0; -1).

- (a) Write down the equation of the vertical asymptote of h . (1)
 (b) Write down the domain of h . (2)
 (c) Determine the values of a and p . (6)
 (d) Draw the graph of h , showing the intercepts with the axes as well as the asymptotes. (3)

$$(a) \quad 3 - x = 0$$

$$x = 3$$

$$(b) \quad x \in \mathbb{R}; x \neq 3$$

$$(c) \quad h(x) = \frac{a}{3-x} + p$$

$$-1 = \frac{a}{3-0} + p \quad \text{Subs (0; -1)}$$

$$-1 = \frac{a}{3} + p$$

$$-3 = a + 3p \dots (1)$$

$$-5 = \frac{a}{3-2} + p \quad \text{Subs (2; -5)}$$

$$-5 = a + p$$

$$a = -p - 5 \dots (2)$$

Subs (2) into (1)

$$-3 = -p - 5 + 3p$$

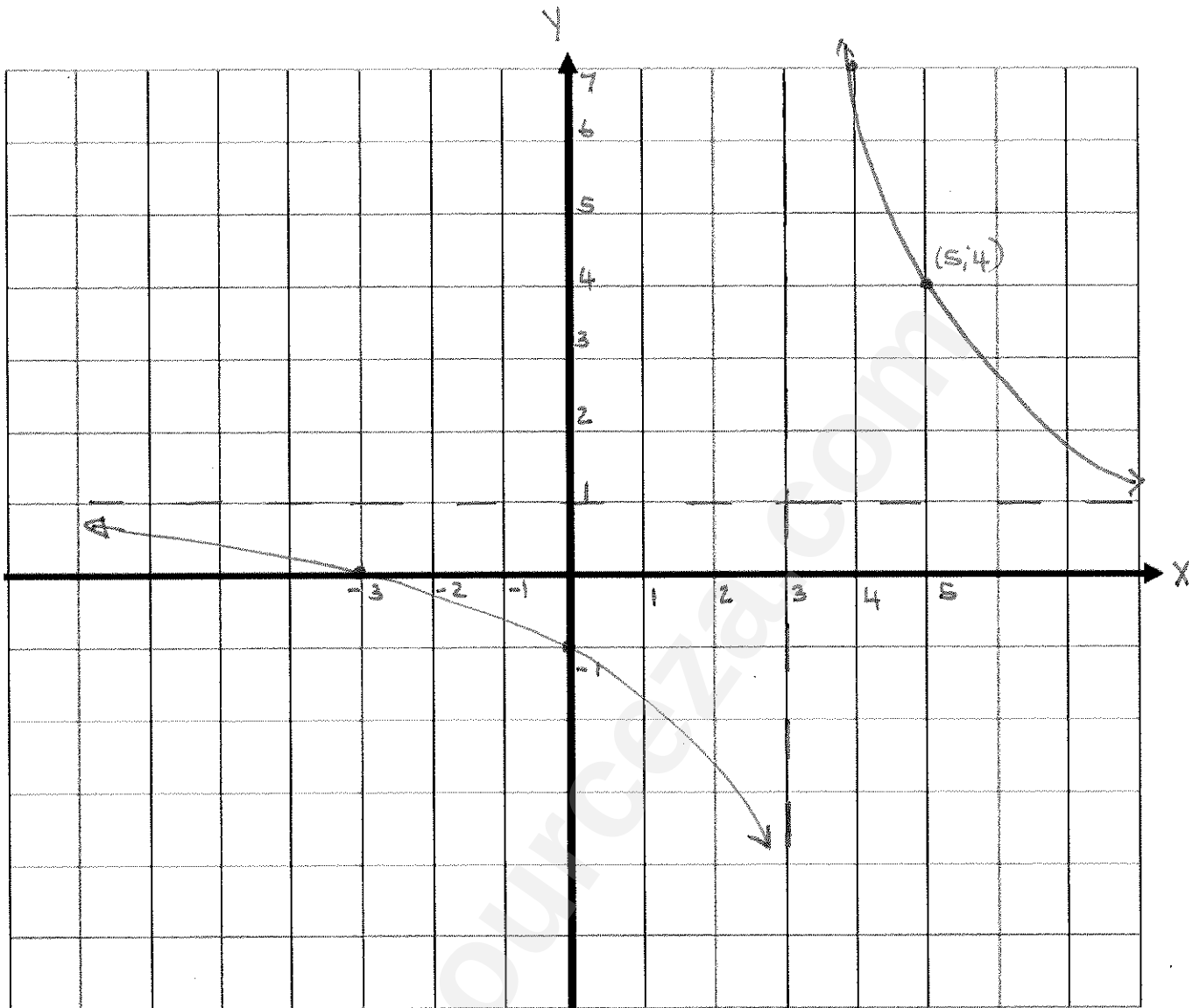
$$2 = 2p$$

$$p = 1$$

Subs $p = 1$ into (2)

$$-1 - 5 = a$$

$$a = -6$$



$$h(x) = \frac{-6}{-(x-3)} + 1$$

$$h(x) = \frac{6}{x-3} + 1$$

asymptotes ✓
quadrants 1 + 3 ✓
x and y-intercepts ✓

x-intercept

$$0 = \frac{6}{x-3} + 1$$

$$-1 = \frac{6}{x-3}$$

$$-x + 3 = 6$$

$$x = -3$$

$$(-3; 0)$$

y-intercept

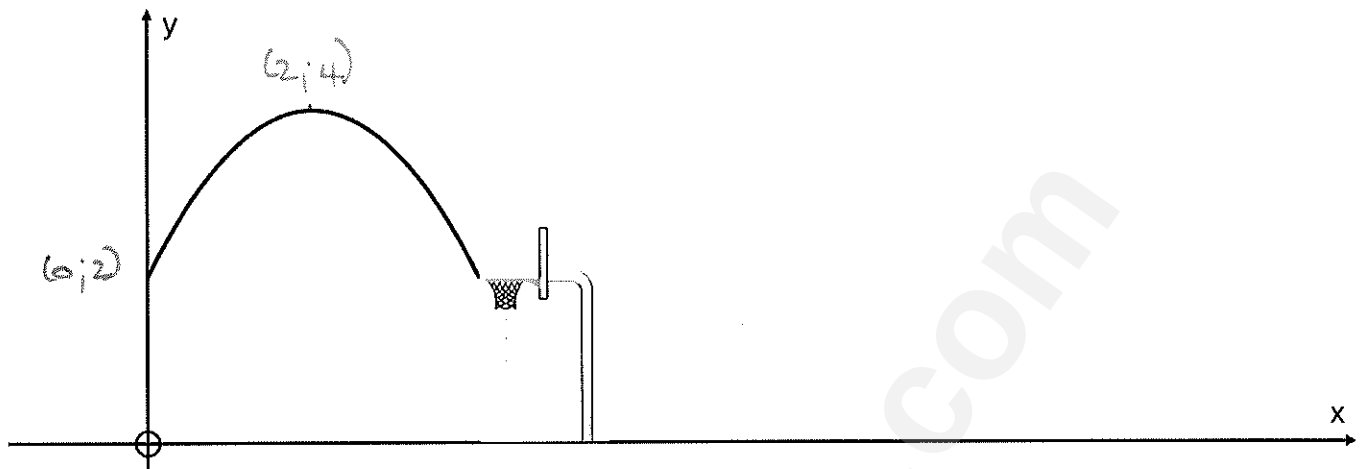
$$y = \frac{6}{0-3} + 1$$

$$y = -2 + 1$$

$$y = -1$$

$$(0; -1)$$

A basketball is thrown, and it follows the path of a parabola. If a basketball is thrown from a starting point (0; 2) and reaches its maximum height at a point (2; 4).



- (a) Show that the equation of the parabola is $y = -\frac{1}{2}x^2 + 2x + 2$ (4)

$$\begin{aligned}
 y &= a(x-p)^2 + q \\
 y &= a(x-2)^2 + 4 \quad \text{TP (2; 4)} \\
 2 &= a(0-2)^2 + 4 \quad \text{sub (0; 2)} \\
 2 &= 4a + 4 \\
 a &= -\frac{1}{2} \\
 y &= -\frac{1}{2}(x-2)^2 + 4 \\
 y &= -\frac{1}{2}(x^2 - 4x + 4) + 4 \\
 y &= -\frac{1}{2}x^2 + 2x + 2
 \end{aligned}$$

- (b) Determine the equation of the tangent to the curve in (a) that is perpendicular to the line $y = \frac{1}{2}x + 4$. (5)

$$\begin{aligned}
 m &= -2 \\
 y &= -\frac{1}{2}x^2 + 2x + 2 \\
 \frac{dy}{dx} &= -x + 2 \\
 -2 &= -x + 2 \\
 x &= 4 \\
 y &= -\frac{1}{2}(4)^2 + 2(4) + 2 \\
 y &= 2 \quad (4; 2)
 \end{aligned}$$

$$y - y_1 = m(x - x_1)$$

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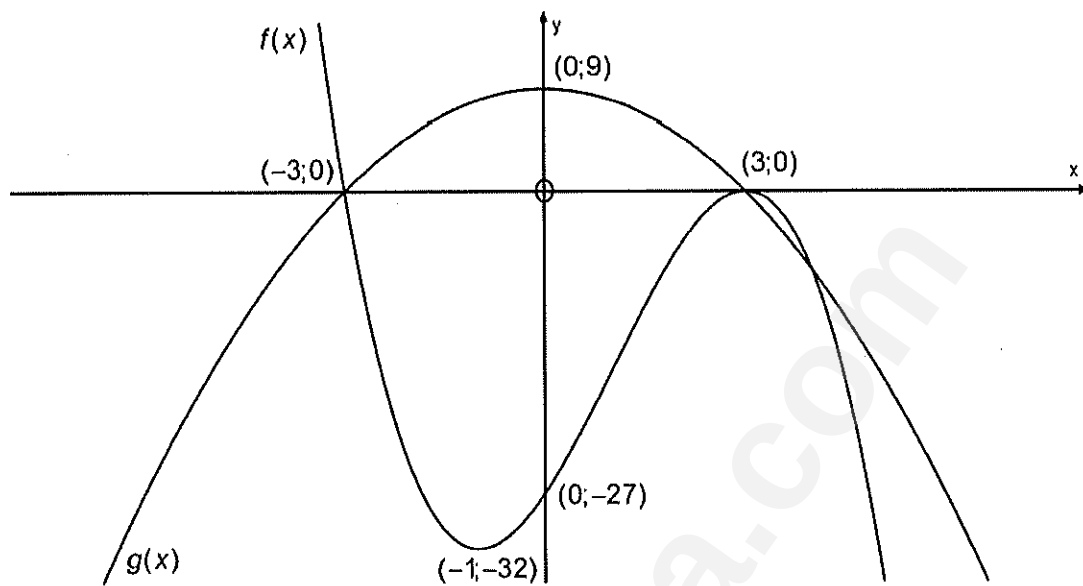
$$y - 2 = -2(x - 4)$$

$$y - 2 = -2x + 8$$

$$y = -2x + 10 \checkmark$$

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The figure below represents the graphs of $f(x)$ and $g(x)$.



- (a) Calculate the value of $g(3) - f(0)$. (2)

$$g(3) = 0 \checkmark$$

$$f(0) = -27 \checkmark$$

$$\therefore g(3) - f(0) \text{ or } 0 - (-27) \\ = 27 \checkmark \checkmark$$

- (b) State the common factor(s) of $g(x)$ and $f(x)$. (1)

$$x + 3 \text{ and } x - 3 \checkmark$$

- (c) State the values of x for which $\frac{f'(x)}{x} > 0$. (3)

$$\downarrow \quad \downarrow \quad \downarrow \\ 0 < x < 3 \text{ or } x < -1$$

(1)

$x \geq 0$ or $x \leq 0$

(4)

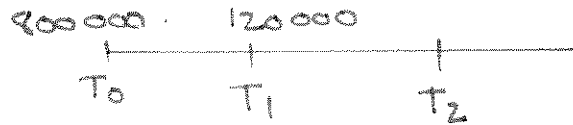
$$\begin{aligned} g(x): \quad y &= -x^2 + 9 \\ x &= -y^2 + 9 \\ x - 9 &= -y^2 \\ y^2 &= -x + 9 \\ y &= \pm \sqrt{-x + 9} \\ g^{-1}(x) &= \sqrt{-x + 9} \end{aligned}$$

(3)

$$k = 0 \quad \text{or} \quad k = -32$$

Kevin inherited R800 000 and invested the full amount at a bank. The bank paid him interest at a rate of 8% per annum, compounded monthly.

- (a) If Kevin withdrew R120 000 from the account one year after making the initial investment, how much was in the account two years after making the initial investment?(3)



$$A = P(1 + i)^n$$

$$A = 800\,000 \left(1 + \frac{0,08}{12}\right)^{12}$$

$$A_1 = R\,866\,399,61 \checkmark$$

$$A_2 = R\,866\,399,61 - R\,120\,000$$

$$= R\,746\,399,61 \checkmark$$

$$A_3 = 746\,399,61 \left(1 + \frac{0,08}{12}\right)^{12}$$

$$A_3 = R\,808\,350,40 \checkmark$$

$$A = 800\,000 \left(1 + \frac{0,08}{12}\right)^{24}$$

$$- 120\,000 \left(1 + \frac{0,08}{12}\right)^{12}$$

$$= R\,808\,350,40$$

- (b) Two years after making the initial investment, Kevin decided to enrol at a university. He decided to use the money from his investment to pay for his studies.

- (1) Convert the nominal interest rate from monthly to half-yearly.

(4)

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

$$i_{\text{eff}} = \left(1 + \frac{0,08}{12}\right)^{12} - 1$$

$$i_{\text{eff}} = 0,08299 \checkmark$$

$$i_{\text{eff}} + 1 = \left(1 + \frac{i}{2}\right)^2$$

$$0,08299 + 1 = \left(1 + \frac{i}{2}\right)^2$$

$$1,08299 = \left(1 + \frac{i}{2}\right)^2$$

$$1 + \frac{i}{2} = \sqrt{1,08299}$$

$$1 + \frac{i}{2} = 1,040672 \dots$$

$$\frac{i}{2} = 0,040672$$

$$r = 8,13\%$$

- (2) Kevin will need to withdraw R95 000 every 6 months to pay for his studies. The first withdrawal is at the beginning of the first semester. Calculate how many complete semesters this investment can finance his studies. (5)

$$\text{From (a): } P = R 808\,350,40 - R 95\,000 \\ = R 713\,350,40 \checkmark$$

$$P = \frac{x [1 - (1+i)^{-n}]}{i}$$

$$713\,350,40 = \frac{95\,000 [1 - (1 + \frac{0,0813}{2})^{-n}]}{\frac{0,0813}{2}}$$

$$\left(1 + \frac{0,0813}{2}\right)^{-n} = 0,69476 \dots \quad \text{Subs + simplifying log}$$

$$-n = \log \left(1 + \frac{0,0813}{2}\right) 0,69476 \dots \quad \log$$

$$-n = -9,13997$$

$$n = 9,13997$$

He will be able to pay $9 + 1 = 10$ semesters $\checkmark$

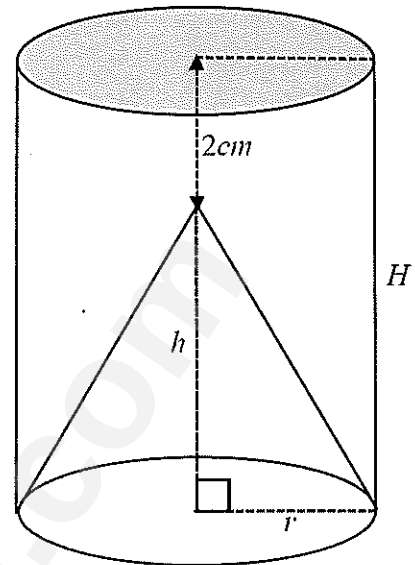
Formula PV $\checkmark$
 subs i $\checkmark$
 only n $\checkmark$
 log $\checkmark$
 add 1 $\checkmark$

In the given diagram, a cone is cut out of a cylindrical piece of wood. The cone and the cylinder have equal radii and the height of the cylinder (H) is 2cm more than the height of the cone (h).

The ratio of the radius to the height of the cylinder is $1 : 3$.

The volume of a right circular cone $= \frac{1}{3}\pi r^2 h$.

All measurements are in cm .



- (a) Show that the volume of wood left over, after the cone has been cut out of the cylinder is given by:

$$V = 2\pi r^3 + \frac{2}{3}\pi r^2$$

(5)

$$V_{\text{cylinder}} = \pi r^2 H$$

$$V_{\text{cylinder}} = \pi r^2 (3r) \quad H = 3r$$

$$V_{\text{cylinder}} = 3\pi r^3$$

$$V_{\text{cone}} = \frac{1}{3}\pi r^2 h$$

$$V_{\text{cone}} = \frac{1}{3}\pi r^2 (3r - 2) \quad h = 3r - 2$$

$$V_{\text{cone}} = \pi r^3 - \frac{2}{3}\pi r^2 \quad \text{expand}$$

$$\begin{aligned} V_{\text{left over wood}} &= 3\pi r^3 - \left(\pi r^3 - \frac{2}{3}\pi r^2\right) \quad \text{subtract volumes} \\ &= 2\pi r^3 + \frac{2}{3}\pi r^2 \end{aligned}$$

- (b) Calculate the rate of change of volume of a cone with respect to r when $r = 9\text{ cm}$.

Include appropriate units with your final answer.

(3)

$$V = 2\pi r^3 + \frac{2}{3}\pi r^2$$

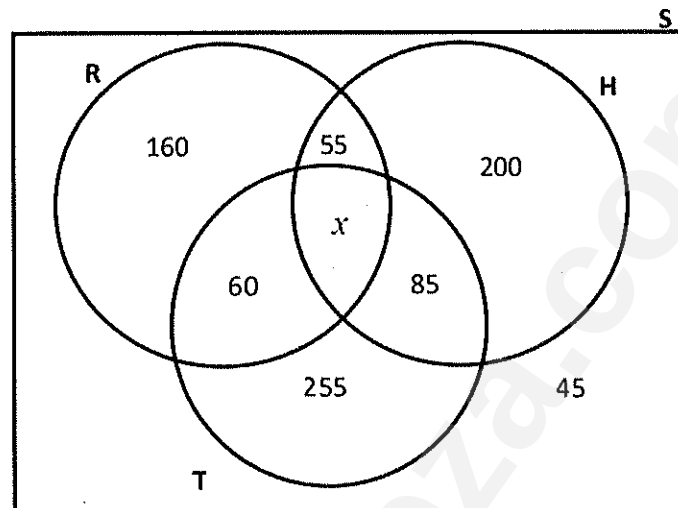
$$V'(r) = 6\pi r^2 + \frac{4}{3}\pi r$$

$$V'(9) = 6\pi(9)^2 + \frac{4}{3}\pi(9)$$

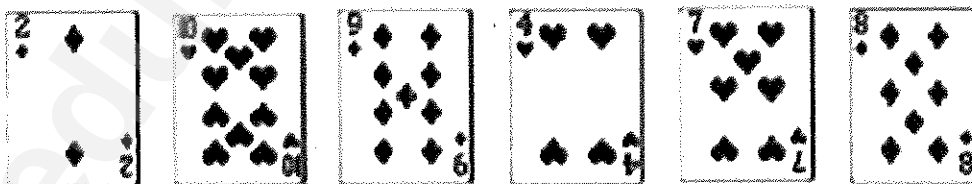
$$V'(9) = 498\pi$$

$$V'(9) = 1564,51 \text{ cm}^3/\text{cm}$$

- (a) During a survey at a certain school, 900 learners were asked to indicate what sport they would like to play as a winter sport code. Learners could choose at most three sport codes. The sport codes indicated by learners were Rugby (R), Hockey (H) and Tennis (T). There will be boys and girls teams in all three sport codes. The data collected is shown in the Venn diagram below.



- (1) Determine how many learners want to play all three sport codes. (2)
 - (2) If a learner is randomly chosen, what is the probability that he/she prefers to play hockey only? (2)
 - (3) Determine the percentage of learners who are likely to play at least 2 of the sport codes. (2)
- (b) The cards below are placed from left to right in a row:



- If these cards are randomly arranged in a row, calculate the probability that ALL hearts will be next to one another. (3)

$$(9)(1) 160 + 60 + x + 55 + 255 + 85 + 200 + 45 = 900$$

$$x = 900 - 860$$

$$x = 40 \checkmark$$

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$$(2) P(\text{only 4}) = \frac{200}{900}$$

$$= \frac{2}{9} \checkmark \checkmark$$

$$(3) P(\text{at least 2}) = \frac{240}{900} \quad \frac{55 + 60 + 85 + 40}{900} = \frac{4}{15}$$

$$\text{Percentage} = 26,7\% \checkmark \checkmark$$

$$(b) P(\text{hearts next to each other})$$

$$= \frac{3! \times 4!}{6!} \checkmark \checkmark$$

$$= \frac{144}{720}$$

$$= \frac{1}{5} \text{ or } 0,2 \text{ or } 20\%$$

or

$$= \frac{4 \times 3! \times 3!}{6!} \checkmark \checkmark$$

$$= \frac{144}{720}$$

$$= \frac{1}{5}$$

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Given: $f(x) = x^3 - 3x + 2$

- (a) Calculate the coordinates of the turning points of f . (4)
- (b) Calculate the x - intercepts of f . (3)
- (c) Determine the values of x for which f :
- (1) is decreasing (2)
 - (2) will be concave down (3)
- (d) Draw the graph of $g(x) = (x - 3)^3 - 3(x - 3) + 2$, clearly indicating the intercepts with the axes and the turning points. (4)

$$\begin{aligned} \text{(a)} \quad f(x) &= x^3 - 3x + 2 \\ f'(x) &= 3x^2 - 3 \\ 3x^2 - 3 &= 0 \\ x^2 - 1 &= 0 \\ (x-1)(x+1) &= 0 \\ x &= 1 \quad \text{or} \quad x = -1 \end{aligned}$$

$$\begin{aligned} f(1) &= 1^3 - 3(1) + 2 \\ &= 0 \\ (1; 0) \end{aligned}$$

$$\begin{aligned} f(-1) &= -(-1)^3 - 3(-1) + 2 \\ &= -1 + 3 + 2 \\ &= 4 \\ (-1; 4) \end{aligned}$$

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

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TP $(1; 0) \therefore x-1$ is a factor

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

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

$$x = 1 \text{ or } x = 1 \text{ or } x = -2$$

$$(c)(1) f'(x) < 0$$

$$3x^2 - 3 < 0$$

$$x^2 - 1 < 0$$

$$(x-1)(x+1) < 0$$

$$-1 < x < 1$$



$$(2) f''(x) = 6x$$

$$6x \leq 0$$

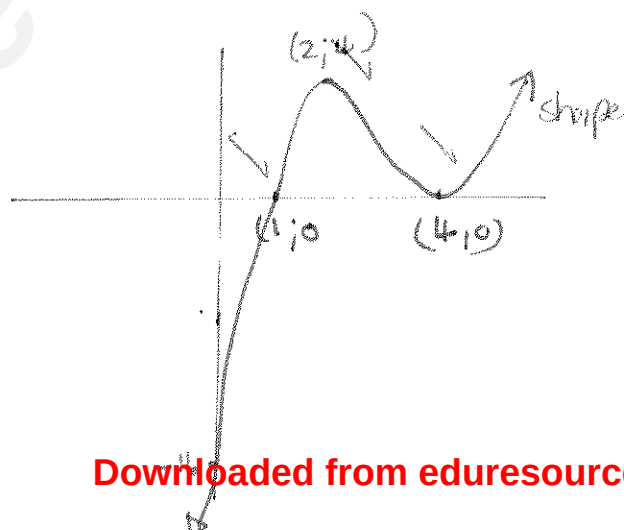
$$x \leq 0$$

$$(d) g(x) = f(x-3)$$

$$\text{TP } (-1; 4) \rightarrow (2; 4)$$

$$(1; 0) \rightarrow (4; 0)$$

$$\begin{aligned} \text{y-intercept: } (-3)^3 - 3(-3) + 2 \\ = -16 \end{aligned}$$



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