Name/Student Number: _____

Teacher: _____

Sydney Technical High School

2024

YEAR 9
YEARLY EXAMINATION

Mathematics

General Instructions

- Working Time – 90 minutes
- Write using black pen

Total marks: 80

Section I MULTIPLE CHOICE— 10 marks (pages 2 - 5)

- Attempt Questions 1-10
- Use the multiple-choice answer sheet provided.
- Allow about 10 minutes for this section.

Section II — 70 marks (pages 6 – 13)

- Attempt Questions 11-16
- Allow about 80 minutes for this section.
- Answer each question in the writing booklet.
- Start each question on a new page.

SECTION I **Multiple Choice** **(10 Marks)**

Allow approximately 10 minutes for this section.
Use the multiple-choice answer sheet for questions 1 – 10

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1. $(12.9 \times 10^4) \div (7.08 \times 10^{-9})^2$ in scientific notation with two significant figures is:

   A. 1.82×10^{13}

   B. 1.8×10^{13}

   C. 2.6×10^{21}

   D. 2.57×10^{21}

2. Simplify $3(k-1)(k+1) - 2(2k-1)$

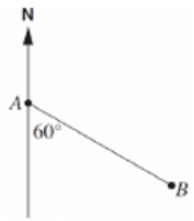
   A. $k^2 - k - 5$

   B. $3k^2 - 4k - 5$

   C. $k^2 - 4k - 5$

   D. $3k^2 - 4k - 1$

3. What is the true bearing of A from B?



   A. $060°$

   B. $120°$

   C. $150°$

   D. $300°$

4. $\left(2x^{-\frac{3}{2}}\right)^2$ is equivalent to:

A. $-\frac{4}{x^9}$

B. $\sqrt[3]{x^4}$

C. $\frac{4}{x^3}$

D. $\frac{2}{x^3}$

5. Which of the following has $(x-y)$ as a factor?

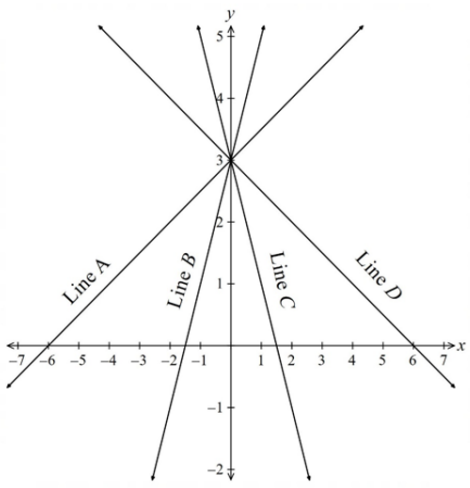
A. $-x^2-xy$

B. x^2-y^2

C. $-y^2-xy$

D. x^2+y^2

6. There are four linear graphs shown on the set of axes below.



Which line has the equation $y=\frac{6-x}{2}$?

A. Line A

B. Line B

C. Line C

D. Line D

7. What must be added to $25m^2 - 30m$ to form a perfect square?

A. -9

B. 9

C. -225

D. 225

8. A group of 485 people was surveyed. The people were asked whether they eat Brussel sprouts. The results are recorded in the table.

	Eats Brussel sprouts	Does not eat Brussel sprouts	Total
Male	88	176	264
Female	68	153	221
Total	156	329	485

A person is selected at random from the group.
What best describes the probability that a person selected eats Brussel sprouts OR is male?

A. 33%

B. 18%

C. 68%

D. 87%

9. Tiffany the pigmy hippo had her mass recorded as 50.2 kg. What is the percentage error in this measurement?

A. 0.1%

B. 0.2%

C. 0.4%

D. 0.8%

10. What is the mean of the data set below?

Score	1	3	5	7
Cumulative Frequency	2	6	12	20

A. 4

B. 4.5

C. 5

D. 5.5

End of section 1

Section II

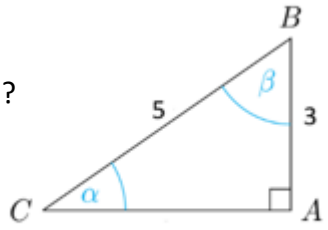
70 marks
Attempt Questions 11-16
Allow approximately 80 minutes for this section.
Answer each question in the writing booklet.

Start each question on a new page.

QUESTION 11 (12 Marks) Start a new page **Marks**

a) Evaluate $a - 3a^2 + 12$ when $a = -4$ **1**

b) Which trigonometric ratio is equal to $\frac{3}{4}$? **2**



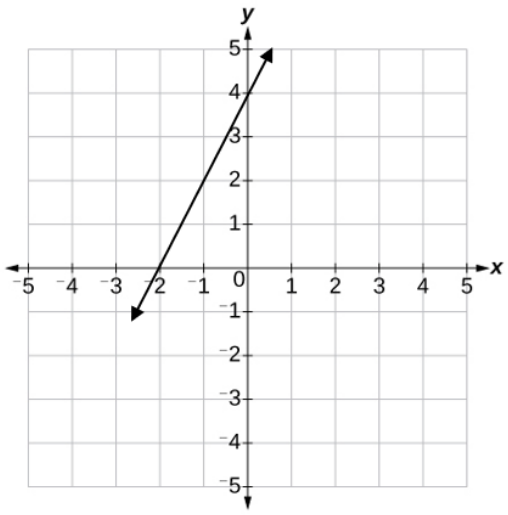
c) Find the value of a, if $2\sqrt{24} - \sqrt{150} = a\sqrt{6}$. **1**

d) Solve $\frac{2x}{3} + 2 = -x$ **2**

e) Find the Volume of a Sphere if it has a radius of 6 cm.
Answer correct to 3 significant figures. **2**

Question 11 continues on the next page……

f) What is the equation of the line parallel to the line below passing through the origin? **2**



g) Fully simplify, $\frac{3\sqrt{2}}{\sqrt{6}}$, leaving your solution with a rational denominator **2**

QUESTION 12 (12 Marks) Start a new page.

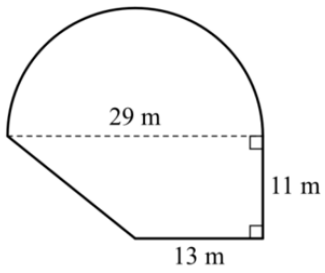
a) i. Factorise $36 - a^2$ **1**

ii. Factorise $a^2 - 11a + 30$ **1**

iii. Hence, simplify $\frac{2a^2+12a}{a^2-5a} \times \frac{a^2-11a+30}{36-a^2}$ **3**

b) Solve $3 - \frac{2x}{7} > -2$ **1**

c) A field is designed to combine a trapezium and semi-circle as shown in the diagram below.



NOT TO SCALE

i. Calculate the perimeter of the field, correct to 2 decimal places. **2**

ii. Find the area of the field, correct to 1 decimal place. **2**

iii. The field is then covered evenly with a layer of topsoil 8 mm deep. Find the volume of topsoil, correct to the nearest cubic cm. **2**

QUESTION 13 (12 Marks) Start a new page.

a) The point $(a, 4a)$ lies on the line $3x + y - 21 = 0$ **2**

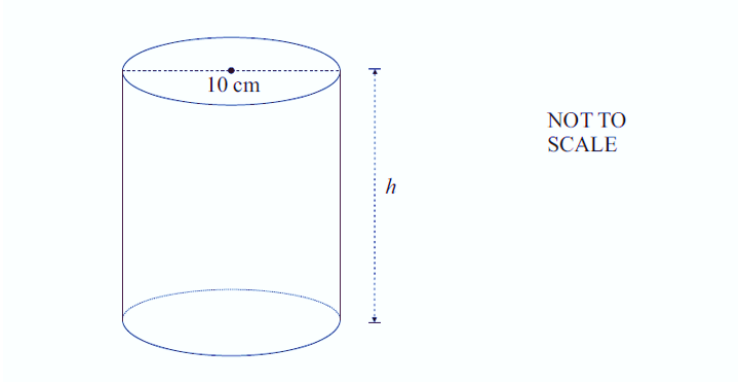
Find the value of a

b) Express $a^{-1} + b^{-1}$ as a single term with positive indices **2**

c) If $sin\theta = cos50°$ find the acute value of θ **1**

d) Expand and simplify $\left(2\sqrt{2} + 3\right)^2$ **2**

e) A block of wood is carved to form a cylinder. The cylinder has a diameter of 10 cm, a height h cm and a total volume of 628 cm^3.



What is the surface area of the cylinder, correct to the nearest square centimetre? **3**

f) Expand and simplify,

$(3 - 2x)(3 + 2x) - (2x + 3)^2$ **2**

QUESTION 14 (12 Marks) Start a new page.

a) The points *A* and *B* have coordinates $(3, -4)$ and $(-2,1)$ respectively.

Find the

i. Coordinates of *P* if *B* is the midpoint of the interval joining AP **1**

ii. Exact length of AB **1**

iii. Gradient of AP **1**

iv. Equation of the line, l, passing through *P* perpendicular to AB.
Give your answer in general form. **3**

v. Sketch the line l and the line AB, showing their intercepts with the coordinate axes. Use a ruler. **3**

b) Write the formula $h = \frac{rs+t}{4r}$ with r as the subject. **3**

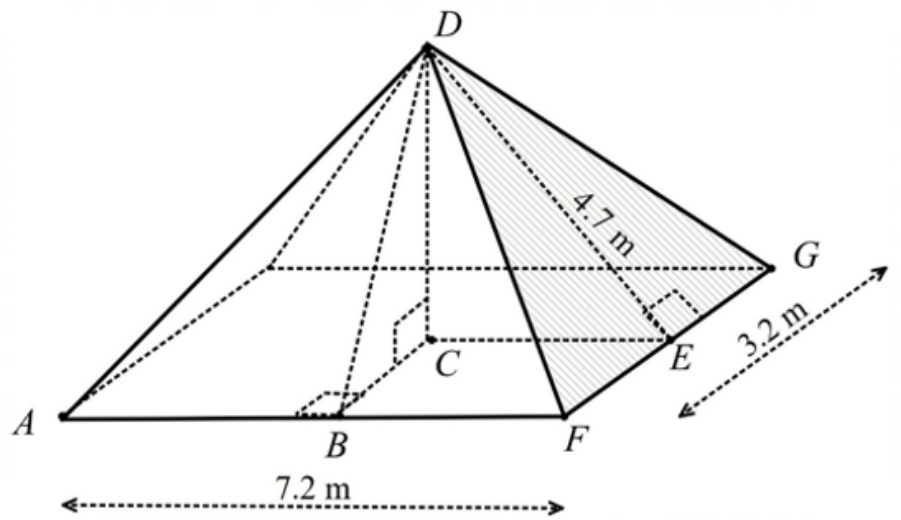
QUESTION 15 (12 Marks) Start a new page.

a) The following information is given about the locations of three towns X, Y and Z:

- X is due east of Z
- X is on a bearing of $145°$ from Y
- Y is on a bearing of $060°$ from Z

Draw a diagram that best represents this information. **2**

b) A cabin has a roof in the shape of a rectangular pyramid, as shown below.



$AF = 7.2$ m, $FG = 3.2$ m and $DE = 4.7$ m

i. Find the length of DB and hence find the surface area of the four sides of the roof. (Answers are to be given with 3 significant figures.)

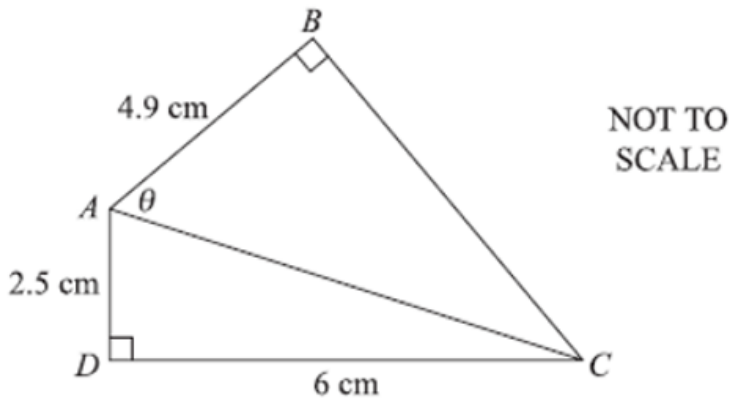
3

ii. Calculate the volume of air that is contained within the roof, correct to the nearest cubic metre. **2**

c) Simplify $\frac{3}{x^2-9} - \frac{1}{x^2-4x+3}$ **3**

Question 15 continues on the next page……

d) Two right- angled triangles ABC and ADC are shown.

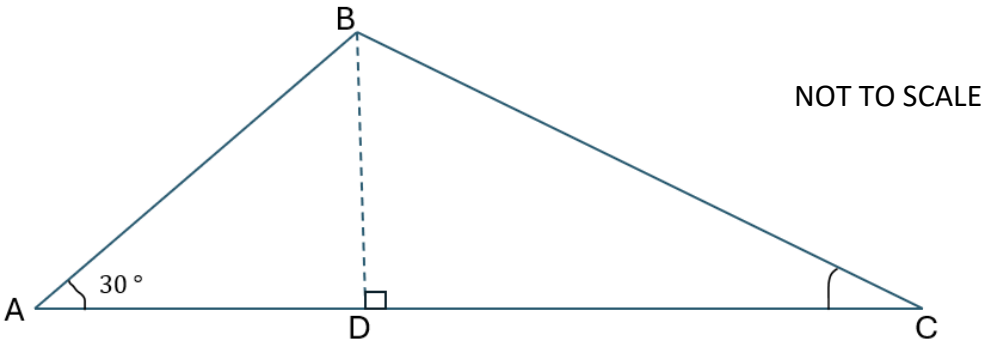


Calculate the size of angle θ, correct to the nearest minute. **2**

QUESTION 16 (10 Marks) Start a new page

a) Factorise fully $4x^2 - 4x + 1 - y^2$ **2**

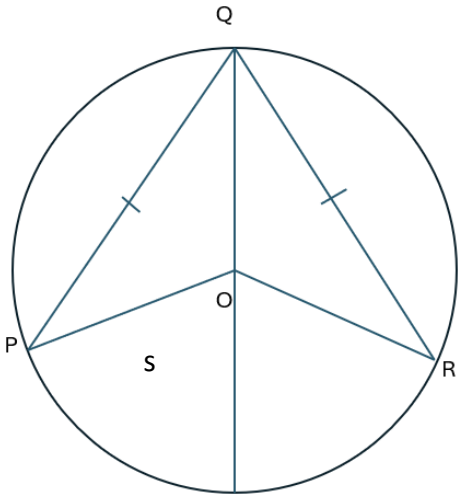
b) Consider triangle ABC, with altitude BD. It is known that $DC = 2AB$.



NOT TO SCALE

Prove that $tanC = ¼$ **3**

c) Below is a circle centre *O*, with points *P*, *Q* and *R* on the circumference. Chord *PQ* and *QR* are equal.



i. Prove that triangle POQ is congruent to triangle ROQ. **3**

ii. Hence, prove that $\angle POR = 2\angle PQR$ **2**

END OF TEST

FINAL

Suggested solutions STHS J.A.

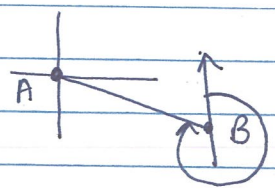
Year 9 2024

Yearly.

Summary	
1.	C
2.	D
3.	D
4.	C
5.	B
6.	D
7.	B
8.	C
9.	A
10.	C

1. 2.6×10^{21} (C) calculator

2. $3(k-1)(k+1) - 2(2k-1)$
$= 3k^2 - 3 - 4k + 2$
$= 3k^2 - 4k - 1$ (D)

3. 

$180° + 120° = 300°T$ (D)

4. $(2x^{-3/2})^2 = 4x^{-3}$
$= \frac{4}{x^3}$ (C)

5. $(x-4)(x+4)$ is (B)

6. $y = 3 - \frac{1}{2}x$ (D)

7. $25m^2 - 30m + 9 = (5m-3)^2$ (B)

8.

	ESS	Doesn't		
Male	88	176	264	$156 + 176 = 332$
Female	68	153	221	
	156	329	485	Prob $= \frac{332}{485} \doteq 68\%$ (C)

9. $\frac{\frac{1}{2} \times 0.1}{50.2} \times 100 = 0.1\%$ (A)

10.

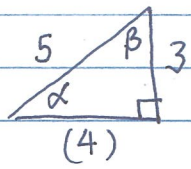
x	1	3	5	7
cf	2	6	12	20
freq	2	4	6	8

$\therefore \bar{x} = (1\times2 + 3\times4 + 5\times6 + 7\times8) \div 20$
$= 5$ (C)

$(\frac{1}{5}m+3)^2$

Question 11

a. $(-4) - 3(-4)^2 + 12 = -40$ (1)

b. 

$\therefore \frac{3}{4}$ is $\tan\alpha$ or $\tan C$ (2)

c. $2\sqrt{24} - \sqrt{150} = 2 \times 2\sqrt{6} - 5\sqrt{6}$

$= -\sqrt{6} \quad \therefore a = -1$ (1)

d. $\frac{2x}{3} + 2 = -x$

$2x + 6 = -3x$

$5x = -6$

$x = \frac{-6}{5}$ (2)

e) $V = \frac{4}{3}\pi r^3 \quad r = \frac{1}{2} \times 12$

$= \frac{4}{3} \times \pi \times 6^3 \quad = 6$

$= 904.778....$

$\doteq 905 \text{ cm}^3$ (3 sig fig)

*(2) rounding

f) $y = mx + c \quad c = 4 \quad m = \frac{4}{2}$ (2)

given Line (1)
↳ $y = 2x + 4$ through the origin (1)

$\therefore$ new line $y = 2x$

g) $\frac{3\sqrt{2}}{\sqrt{6}} \times \frac{\sqrt{6}}{\sqrt{6}} = \frac{3\sqrt{12}}{6}$ (2)

$= \frac{3 \times 2\sqrt{3}}{6}$

$= \sqrt{3}$

Question 12

a) i. $36 - a^2 = (6-a)(6+a)$

ii. $a^2 - 11a + 30 = (a-5)(a-6)$

iii. $\frac{2a(a+6)}{a(a-5)} \times \frac{(a-5)(a-6)}{(6-a)(6+a)}$

$= \frac{2\cancel{a}(a+6)}{\cancel{a}(a-5)} \times \frac{(a-5)(a-6)}{(6-a)(6+a)}$

$= \frac{2(a-6)}{6-a}$

$= -1 \times 2$

$= -2$

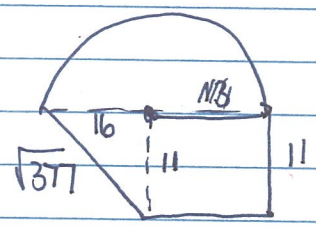
b) $\frac{3-2x}{7} > -2$

$\frac{-2x}{7} > -5$

$2x < 35$

$x < 35/2$

c) $r = 14.5$



i) $P = \sqrt{377} + 13 + 11 + \frac{1}{2}(\pi \times 29)$

$= 88.9695....$

$= 88.97\text{m}$

ii) $A = \frac{1}{2}(\pi \times 14.5^2) + \frac{1}{2}(11)(29+13)$

$= 561.2599....$

$= 561.3\ m^2$

accept both.

iii) $V = 561.2599 \times 0.008$

$= 4.4900\ m^3 \Rightarrow 4.49 \times 100^3 = 4490079\ cm^3$

(note $4490400\ cm^3$ if using parti)

Question 13

a) $3(a) + (4a) - 21 = 0$

$7a = 21$

$a = 3.$

b) $a^{-1} + b^{-1} = \frac{1}{a} + \frac{1}{b}$

$= \frac{b+a}{ab}$

c) $\cos 50° = \sin\theta$ $\quad \theta + 50° = 90°$

$\theta = 40°$

d) $(2\sqrt{2}+3)^2 = 8 + 12\sqrt{2} + 9$

$= 17 + 12\sqrt{2}$

e) $V = \pi r^2 h$

$\pi \times 5^2 \times h = 628$

$h = \frac{628}{25\pi}$

$\therefore SA = 2\pi r^2 + 2\pi rh$

$= 2\pi \times 5^2 + 2\pi \times 5 \times \frac{628}{25\pi}$

$= 50\pi + \frac{1256}{5}$

$= 408.2796...$

$\approx 408 \text{ cm}^2$

f) $(3-2x)(3+2x) - (2x+3)^2$

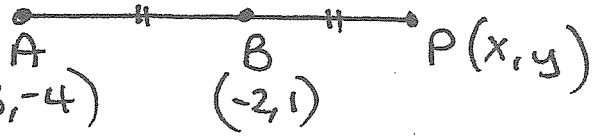
$9 - 4x^2 - (4x^2 + 12x + 9)$

$= 9 - 4x^2 - 4x^2 - 12x - 9$

$= -8x^2 - 12x$

Question 14

a) $A(3,-4)$ and $(-2,1)=B$



i. $\frac{3+x}{2} = -2$ $\quad \frac{-4+y}{2} = 1$

$x = -7$ $\quad -4+y = 2$

$y = 6$ $\quad \therefore P(-7,6)$

ii. AB dist $\sqrt{(-2-3)^2 + (1--4)^2}$

$= \sqrt{50}$

$= 5\sqrt{2}$

iii. $m_{AP} = \frac{6--4}{-7-3}$

$= -1$

iv. $m_{AB} = \frac{1--4}{-2-3}$ $\quad m_{\perp} = 1$ $\quad P(-7,6)$

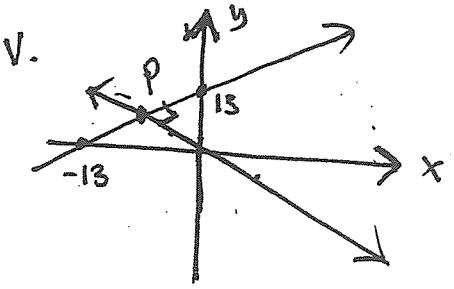
$= -1$

$\therefore \quad y-6 = 1(x+7)$

$y = x + 13$

$x - y + 13 = 0$

v.



b) $h = \frac{rs+t}{4r}$

$4hr = rs + t$

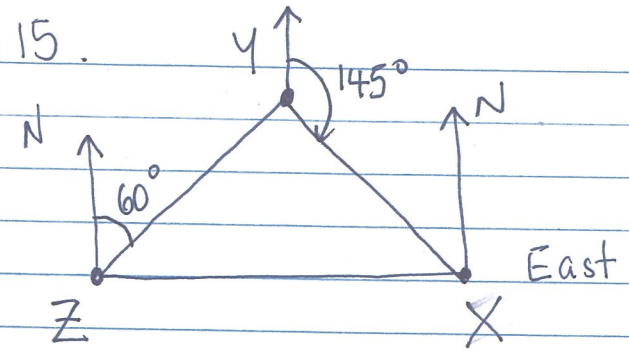
$4hr - rs = t$

$r(4h-s) = t$

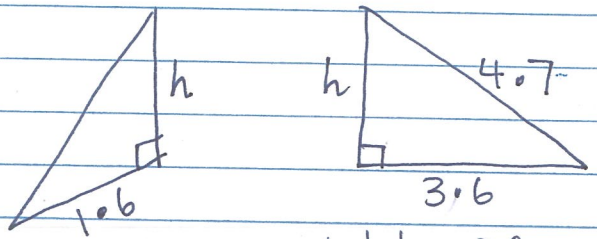
$r = \frac{t}{4h-s}$.

Question 15.

a)



b)



Let $h = DC$

$4.7^2 = h^2 + 3.6^2$

$h^2 = 9.13$

$h = \sqrt{9.13} = 3.02588\ldots$

NOW $DB^2 = h^2 + 1.6^2$

$= 9.13 + 1.6^2$

$= 11.69$

$DB = \sqrt{11.69} = 3.42$

$SA = 2 \times \frac{1}{2} \times 4.7 \times 3.2 + 2 \times \frac{1}{2} \times \sqrt{11.69} \times 7.2$

$= 39.657\ldots$

$\approx 39.7\ m^2$

ii) $V = \frac{1}{3} \times 3.2 \times 7.2 \times \sqrt{9.13}$

$= 23.2058\ldots$

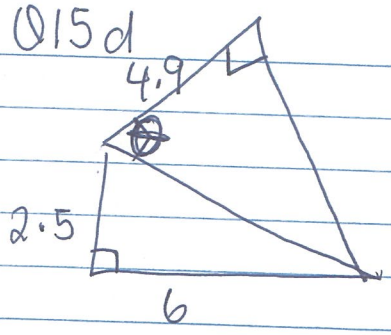
$\approx \underline{23\ m^3}$ (nearest m^3).

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

$= \frac{2x-6}{(x+3)(x-3)(x-1)} = \frac{2(x-3)}{(x+3)(x-3)(x-1)}$

$= \frac{2}{(x+3)(x-1)}$

Q15 d



$$\cos\theta = \frac{4.9}{\sqrt{2.5^2+6^2}}$$

$$\cos\theta = 0.7169$$

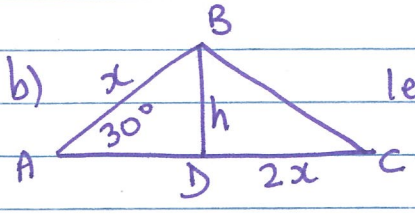
$$\theta = 41^\circ 5'$$

Question 16

a) $4x^2-4x+1-y^2 = (2x-1)^2-y^2$

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

b)



let $AB=x$, $BD=h$ $\therefore DC=2x$

In ΔABD $\sin 30° = h/x$

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

$x = 2h$ $\therefore h = \frac{x}{2}$

In ΔBDC

$\tan C = \frac{h}{2x}$

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

$\therefore \tan C = 1/4$

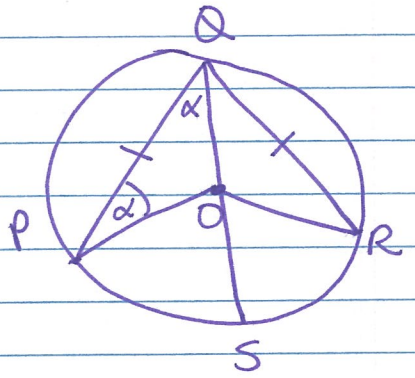
c) i. In ΔPOQ and ΔROQ

✓ $PO = OR$ radii

✓ OQ is common

$PQ = QR$ (given)

✓ $\therefore \Delta POQ \equiv \Delta ROQ$ (SSS)



ii. let $\angle OPQ = \alpha$

$\therefore \angle ORQ = \alpha$ (corresponding angles in congruent triangles)

also

$\angle OQP = \angle QPO$ (equal angles opposite equal sides as $OQ=OP=OR$ radii)

and

$\angle OQR = \angle OQP$ (corresponding angles in congruent triangles)

$= \alpha$

$\therefore \angle PQR = 2\alpha$ (sum of adjacent angles)

$\angle POS = \angle OQP + \angle OPQ$ (exterior angle of triangle POQ)

$= 2\alpha$

and $\angle SOR = \angle ORQ + \angle OQR$ (exterior angle of triangle ORQ)

$= 2\alpha$

$\therefore \angle POR = \angle POS + \angle SOR$

$= 4\alpha$ (sum of adjacent angles)

$\therefore \angle POR = 2(2\alpha)$

$= 2(\angle PQR)$ as required.

(2) = good proof with good reasons

(1) = attempt with some steps correct.