

2012 Year 10 Yearly

Section 1 (14 Marks)

1. Find the simple interest charged on \$21 600 at 9% for 18 months. **(1m)**

2. Two dice are thrown. **(2m)**

a) Draw a diagram or table showing the sample space.

b) What is the probability of rolling a total of more than 5?

3. Find the volume of a sphere with radius 7cm. **(1m)**

4. Solve the following equations:

(6m)

a) $4x^2 - 12x - 7 = 0$

b) $x^2 = 6x$

c) $(x+1)^2 = 4x$

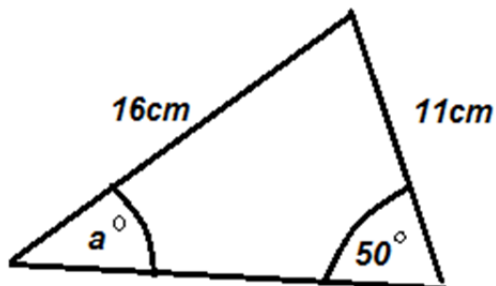
5. Simplify using index laws:

(2m)

$$\sqrt[3]{m^{-9}n^3}$$

6. Find the value of 'a' in the following triangle:

(2m)

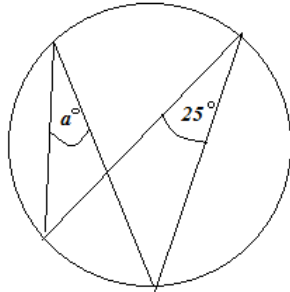


Section 2 (14 Marks)

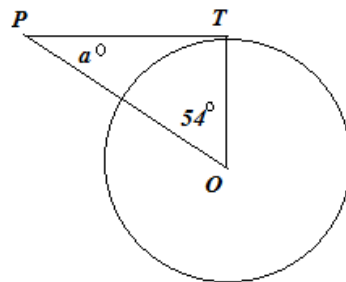
1. Find the value of the variables. Give reasons.

(2m)

a)



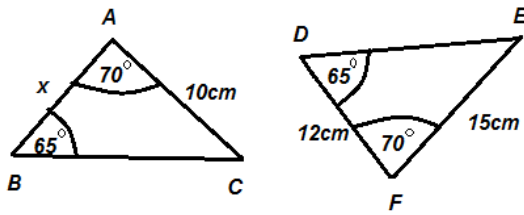
b) PT is a tangent in the following diagram.



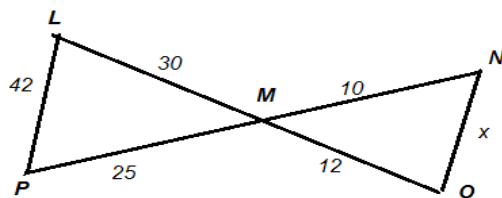
2. Phil invested \$4700 at 8% p.a. compounding monthly for 3 years. Find the value of his investment after this time.

(2m)

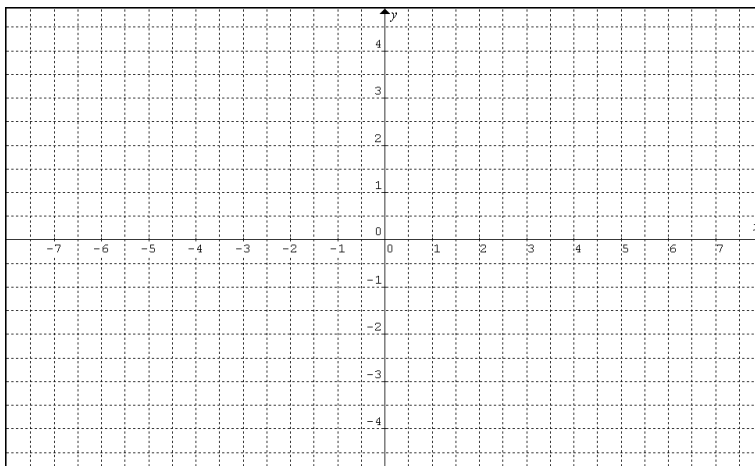
- a) In the following questions, prove that the two triangles are similar and find the value of x (correct to one decimal place where necessary) **(5m)**



b)



3. Sketch the graph of $y = \frac{1}{2}(x+1)^2 - 2$ clearly showing the co-ordinates of the vertex and the X and Y intercepts. **(3m)**



4. Solve by completing the square, giving the solution in simplest surd form:

$$x^2 - 15x + 56 = 0$$

(2m)

Section 3 (14 Marks)

5. Write a polynomial of degree 4 that is monic and has a constant term of 6.

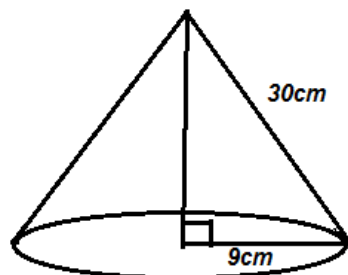
(1m)

6. Find the remainder when $(x^5 - 2x^4 + x^3 + x - 3)$ is divided by $(x + 4)$

(2m)

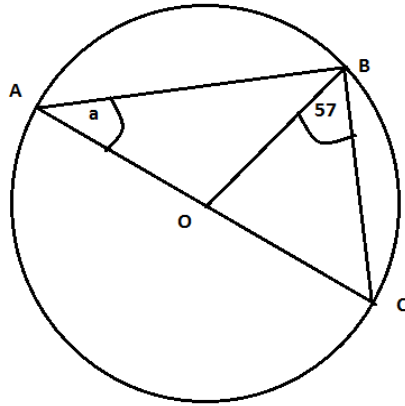
7. Find the volume of this cone:

(2m)



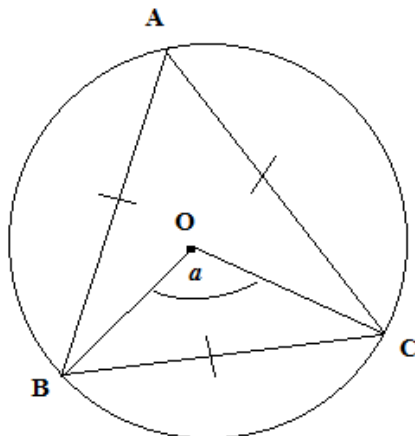
8. Find the value of the pronumeral, giving reasons in full. (The centre of the circle is labelled 'O'.)

(2m)



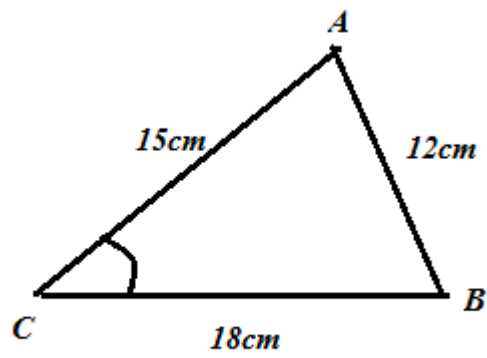
9. Find the value of the pronumeral, giving reasons in full. (The centre of the circle is labelled 'O'.)

(2m)



10. Find the size of angle C :

(2m)



11. Solve this equation :

$$2^{2x+1} - 17(2^x) + 8 = 0$$

(3m)

Section 4 (14 Marks)

1. Solve this equation by using the quadratic formula, giving the solution in simplest surd form: $3x^2 + 2x - 2 = 0$ **(2m)**

2. Solve these equations simultaneously: **(3m)**

$$x^2 + y^2 = 169$$

$$x - y = -7$$

3. In a History test the mean was 61 and the standard deviation was 9. In a Science test the mean was 70 and the standard deviation 10. Elizabeth scored 75 in her history test and Jason scored 75 in his Science test. Who had the better score? Explain.

(1m)

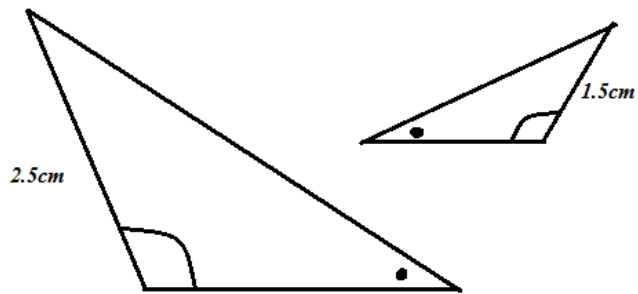
4. How much must I invest now in order to have \$10 000 at the end of 5 years, if interest is 3%p.a. compounding quarterly?

(2m)

5. Which rate will give the better return on an investment: 13% p.a. compounding annually or 12.5% p.a. compounding monthly? Show working.

(2m)

6. For the following pair of similar triangles, state the ratio (in simplest form) of the area of the first triangle to the area of the second triangle. **(2m)**



7. The ratio of the heights of two similar gas cylinders is $2 : 3$. If 4 kg of gas fills the smaller cylinder, how much gas is needed to fill the larger one?

(2m)

Section 5 (15 Marks)

1. Solve the following equations:

(4m)

a) $x^6 - 28x^3 + 27 = 0$

b) $(2x-5)^2 = 2x-5$

2. Find the centre and radius of the circle

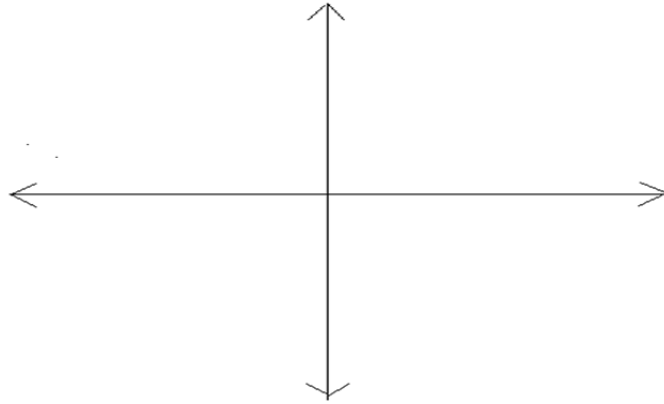
$$x^2 + y^2 - 16x - 2y + 56 = 0$$

(2m)

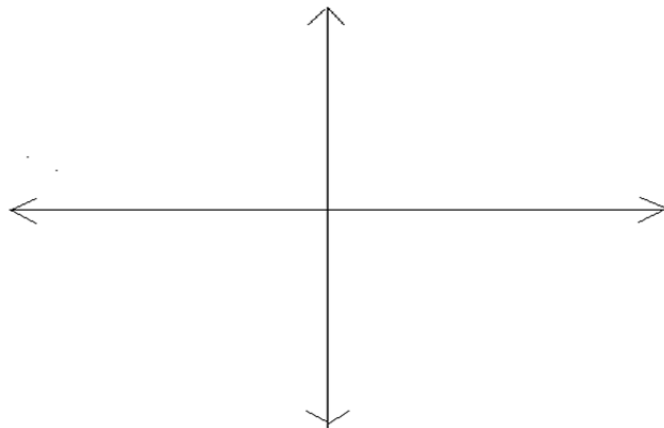
3. Sketch the following curves labelling all x and y intercepts:

(6m)

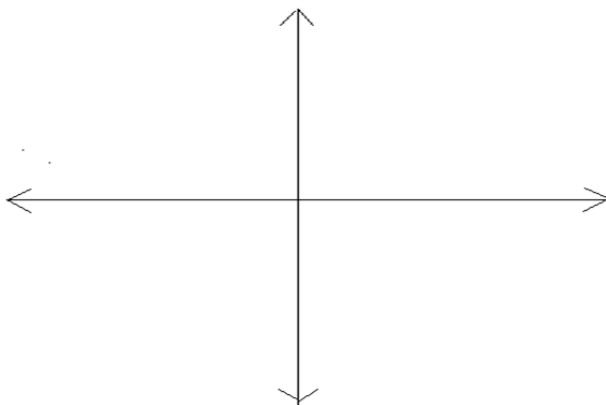
a) $y = (x+3)(x-2)(x-5)$



b) $y = (x-3)^2(x+1)$



c) $y = x(x+2)^3$



4. Factorise fully:

$$P(x) = 2x^3 + 5x^2 - 4x - 12$$

(3m)

Section 6 (14 Marks)

1. Find k , given that $kx^3 + 4x^2 - 4$ is divisible by $x + 2$.

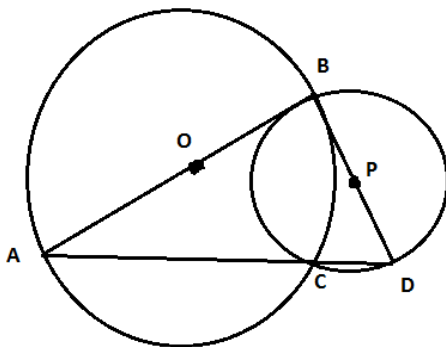
(2m)

2. When $Q(x) = ax^3 + bx^2 + 2x + 3$ is divided by $(x + 1)$, the remainder is 3. When $Q(x)$ is divided by $(x - 1)$ the remainder is 15. Find a and b .

(3m)

3. Two circles intersect at B and C. AB and BD are diameters. Prove that A, C and D are collinear.

(3m)



4. The Department of Primary Industry is interested in the effect of a new fertilizer on the growth of maize plants. After 12 months growth, the heights (in cm) of the plants in 2 plots were measured and found to be as follows:

(3m)

Plot A (New fertilizer)

39 48 50 47 125 46 54 59 58 59

127 48 44 51 53

Plot B (Original Fertilizer)

65 55 59 60 63 57 58 61 62 60

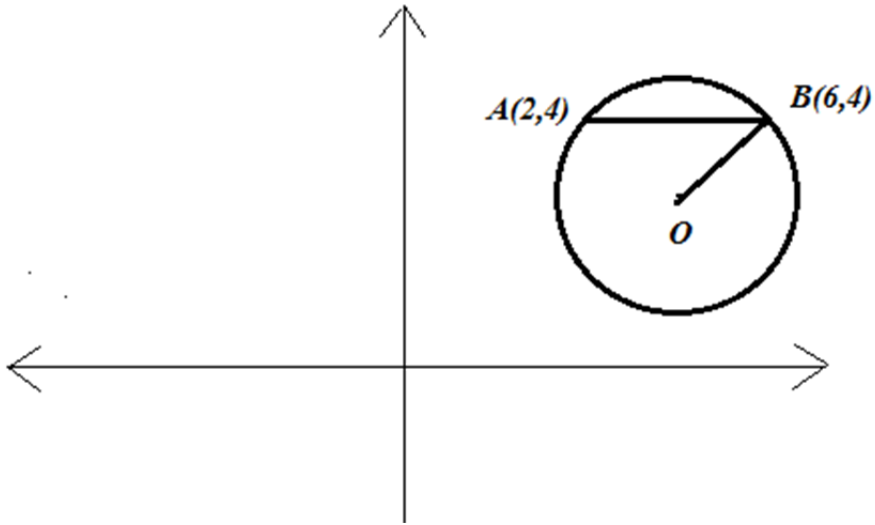
59 63 60 61 57

- a) Calculate the mean and standard deviation of the two samples.

- b) Using these results, compare the effectiveness of the different fertilizers on the growth of maize plants.

5. AB is a chord. Find the equation of the circle, given that $r = \sqrt{5}$.

(3m)



Section 7 (15 Marks)

1. A ship leaves port and heads on a bearing of 145°T travelling at 17km/h . After 8 hours it alters course to a bearing of 253°T and continues at the same speed for another 12 hours. It then receives a report of a cyclone developing in the area. The ship increases speed to 21km/h and heads directly back to port. **(5m)**
 - a) How long will it take to get back to port ?

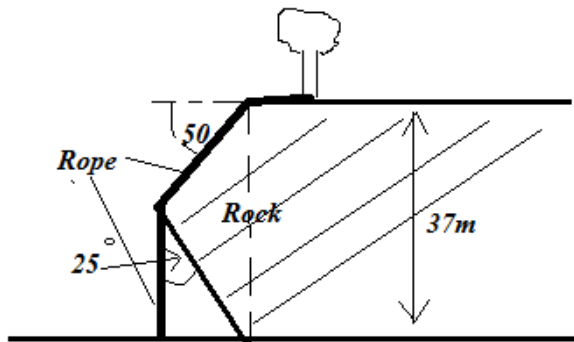
b) On what bearing (to the nearest minute) should it head?

2. Solve: $\sqrt{x+\sqrt{x}} + \sqrt{x-\sqrt{x}} = 3\sqrt{\frac{x}{x+\sqrt{x}}}$

(3m)

3. A cliff is 37m high. The rock slopes outward at an angle of 50° to the horizontal, then cuts back at an angle of 25° to the vertical, meeting the ground directly below the top of the cliff.

NOT TO SCALE



Carol wishes to abseil from the top of the cliff to the ground as shown in the diagram. Her climbing rope is 45m long and she needs 2m to secure it to a tree at the top of the cliff. Will the rope be long enough to allow her to reach the ground?

(3m)

4. A boy plans a boating trip from his home on the edge of a lake to a town that lies on a river that empties into the lake. To make the trip, he travels 20km across the lake (in which there is no current) to the mouth of the river, and then rows a further 20km up the river against a current of 2km/hour. If the journey is completed in 15 hours, at what constant speed (relative to the water) does he travel?

(4m)

YR 10

Section 1 (14 Marks)

1. Find the simple interest charged on \$21 600 at 9% for 18 months.

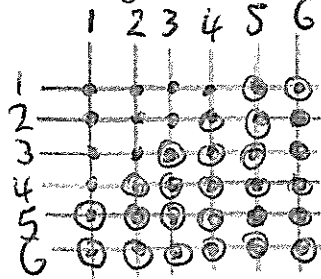
(1m)

$$\begin{aligned}
 I &= PRT \\
 &= 21\,600 \times 0.09 \times 1.5 \\
 &= \$2\,916
 \end{aligned}$$

2. Two dice are thrown.

(2m)

- a) Draw a diagram or table showing the sample space.



- b) What is the probability of rolling a total of more than 5?

$$\begin{aligned}
 1 - \frac{10}{36} &= \frac{26}{36} \\
 &= \frac{13}{18}
 \end{aligned}$$

3. Find the volume of a sphere with radius 7cm.

(1m)

$$\begin{aligned}
 Vol &= \frac{4}{3} \pi r^3 \\
 &= \frac{1372\pi}{3} \text{ cm}^3
 \end{aligned}$$

or

$$\approx 1436.76 \text{ cm}^3$$

4. Solve the following equations:

(6m)

a) $4x^2 - 12x - 7 = 0$

$$\frac{(4x-14)(4x+2)}{4} = 0$$

$$(2x-7)(2x+1) = 0$$

$$x = -\frac{1}{2}, \frac{7}{2}$$

b) $x^2 = 6x$

$$x = 0, 6$$

c) $(x+1)^2 = 4x$

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

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

$$x = 1, 1$$

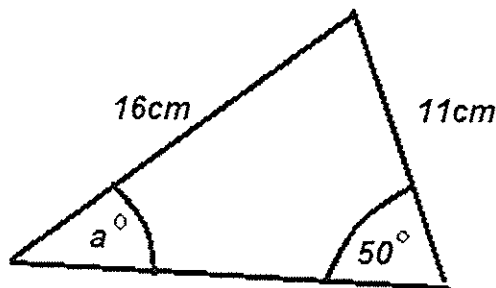
5. Simplify using index laws:

(2m)

$$\sqrt[3]{m^{-9}n^3} = \frac{n}{m^3}$$

6. Find the value of 'a' in the following triangle:

(2m)



$$\frac{\sin a}{11} = \frac{\sin 50}{16}$$

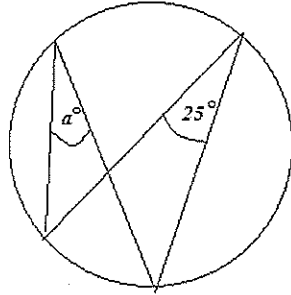
$$a = 31^\circ 47'$$

Section 2 (14 Marks)

1. Find the value of the variables. Give reasons.

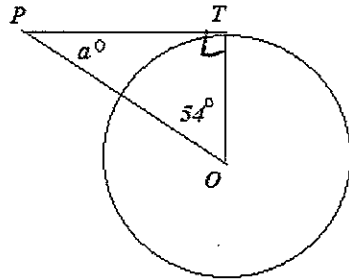
(2m)

a)



$a = 25$ (✓)
 Angles at the circumference standing on the same arc are equal. (✓)

b) PT is a tangent in the following diagram.



$a + 90 + 54 = 180$ angle sum of \triangle after radius and tangent line intersect at 90
 $a = 36$ (✓)

2. Phil invested \$4700 at 8% p.a. compounding monthly for 3 years. Find the value of his investment after this time.

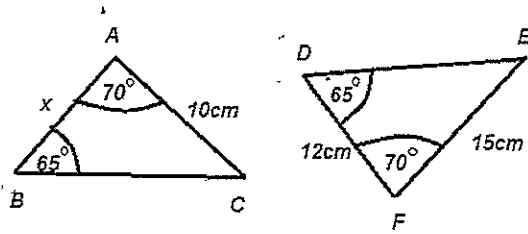
(2m)

compounding monthly $3 \times 12 = 36$ times

$$r = \frac{8}{12} \% = \frac{2}{3} \% \text{ p month}^{-1}$$

$$A = 4700 \left(1 + \frac{2}{3} \frac{1}{100}\right)^{36} = \$5970.11 \quad (2)$$

- a) In the following questions, prove that the two triangles are similar and find the value of x (correct to one decimal place where necessary) (5m)



In $\triangle ABC$ and $\triangle FDE$

$$\hat{BAC} = \hat{DFE} = 70^\circ$$

$$\hat{ABC} = \hat{FDE} = 65^\circ$$

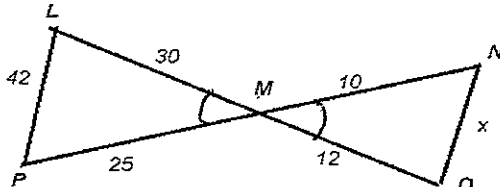
$\therefore \triangle ABC \parallel \triangle FDE$ 2 angle test
 (1/2) (equiangular)

$$\therefore \frac{10}{x} = \frac{15}{12}$$

$$15x = 120$$

$$x = 8$$

b)



In $\triangle MLP$ and $\triangle MNO$

$\hat{LMP} = \hat{NMO}$ (vertically opposite)

and $\frac{30}{12} = \frac{25}{10}$ ratio of sides are equal

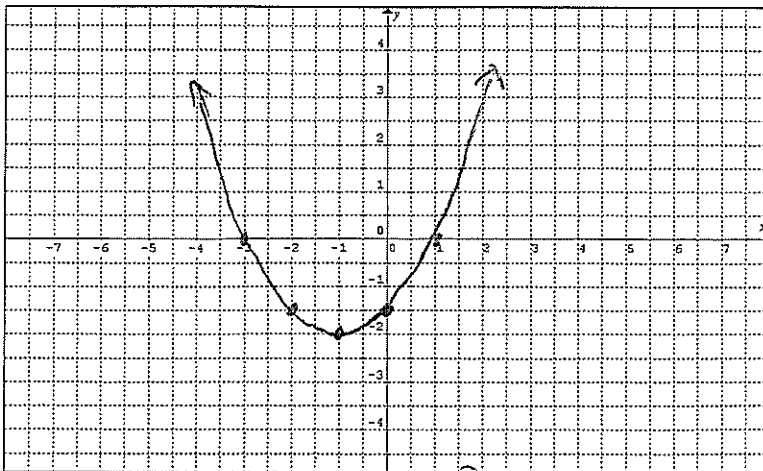
$\therefore \triangle MLP \parallel \triangle MNO$ (ratio of sides and included angle test)
 (1/2)

So

$$\frac{30}{12} = \frac{42}{x}$$

$$x = 16.8$$

3. Sketch the graph of $y = \frac{1}{2}(x+1)^2 - 2$ clearly showing the co-ordinates of the vertex and the X and Y intercepts. (3m)



when $x = -1$, $y = -2$
 when $x = 0$, $y = -1\frac{1}{2}$
 when $x = -2$, $y = -1\frac{1}{2}$
 when $x = -3$, $y = 0$
 when $x = 1$, $y = 0$

(1/2) graph
 (2/2) y intercept $-1\frac{1}{2}$

(1/2) root -3

(2/2) root 1

(1) vertex $(-1, -2)$

misleading

4. Solve by completing the square, giving the solution in simplest surd form:

$$x^2 - 15x + 56 = 0$$

$$x^2 - 15x + \frac{225}{4} = -56 + \frac{225}{4}$$

$$(x - 7\frac{1}{2})^2 = \frac{1}{4}$$

so $(x - 7\frac{1}{2}) = \pm \frac{1}{2}$

$$x = 7\frac{1}{2} \pm \frac{1}{2}$$

$$= 7\frac{1}{2} + \frac{1}{2} = 8 \quad // \quad (2)$$

$$\text{and } 7\frac{1}{2} - \frac{1}{2} = 7 \quad //$$

$$\left(\frac{-15}{2}\right)^2 = \frac{225}{4}$$

(2m)

Yr10 → Ward

4. Solve by completing the square, giving the solution in simplest surd form:

$$x^2 - 15x + 56 = 0$$

(2m)

Section 3 (14 Marks)

5. Write a polynomial of degree 4 that is monic and has a constant term of 6.

(1m)

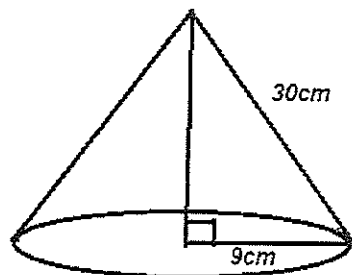
$$x^4 + 6$$

6. Find the remainder when $(x^5 - 2x^4 + x^3 + x - 3)$ is divided by $(x + 4)$ (2m)

$$\begin{aligned} P(-4) &= (-4)^5 - 2(-4)^4 + (-4)^3 + (-4) - 3 \\ &= -1024 - 512 - 64 - 4 - 3 \\ &= -1607 \end{aligned}$$

7. Find the volume of this cone:

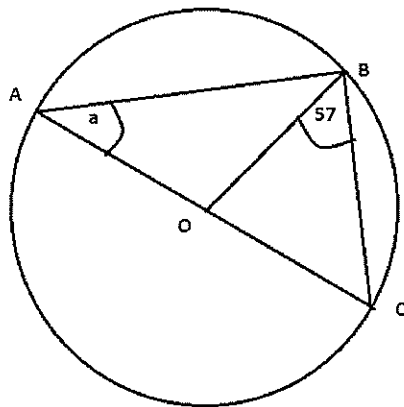
(2m)



$$\begin{aligned} V &= \frac{1}{3} \pi r^2 h & h &= \sqrt{30^2 - 9^2} \\ &= \frac{1}{3} \pi (9)(3\sqrt{91}) & &= \sqrt{819} \\ &= 81\sqrt{91} \pi \text{ units}^3 & &= 3\sqrt{91} \\ &= \underline{\underline{2427.48 \text{ units}^3}} \\ & & & (479594) \end{aligned}$$

8. Find the value of the pronumeral, giving reasons in full. (The centre of the circle is labelled 'O'.)

(2m)



In ΔABC
 $\angle ABC = 90^\circ$ (angle in a semi circle)

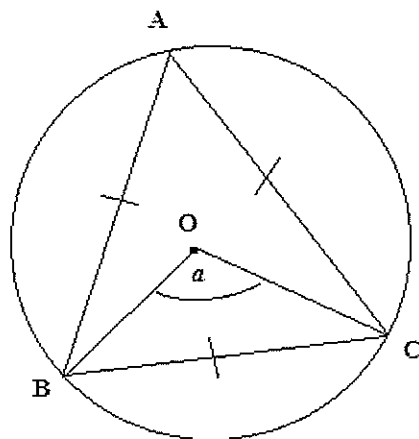
In ΔAOB
 $\angle ABO = 90 - 57$ (complementary)
 $= 33^\circ$

$a = \angle BAO = \angle ABO = 33^\circ$
 (isosceles Δ , = radii)

$a = 33^\circ$

9. Find the value of the pronumeral, giving reasons in full. (The centre of the circle is labelled 'O'.)

(2m)



In ΔBAC
 $\angle BAC = 60^\circ$ (equilateral Δ)

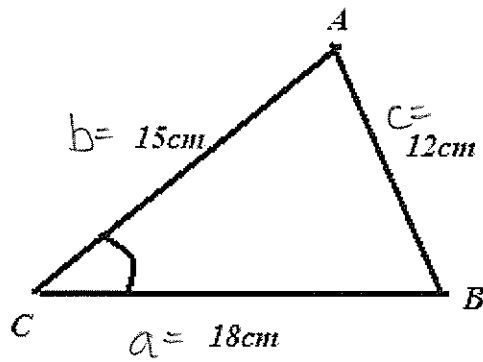
In ΔBOC

$a = \angle BOC = 2 \times 60^\circ$
 (angle at the centre is twice angle at circumference)

$a = 120^\circ$

10. Find the size of angle C :

(2m)



$$\cos C = \frac{a^2 + b^2 - c^2}{2ab}$$

$$= \frac{18^2 + 15^2 - 12^2}{2(18)(15)}$$

$$= \frac{324 + 225 - 144}{540} = \frac{405}{540} \approx 0.75 \Rightarrow 41^\circ 25'$$

11. Solve this equation :

$$2^{2x+1} - 17(2^x) + 8 = 0$$

(3m)

$$2(2^{2x}) - 17(2^x) + 8 = 0$$

$$u = 2^x$$

$$2u^2 - 17u + 8 = 0$$

$$(2u-1)(u-8) = 0$$

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

$$x = -1$$

$$u = 8 = 2^x$$

$$x = 3$$

Section 4 (14 Marks)

1. Solve this equation by using the quadratic formula, giving the solution in simplest surd form: $3x^2 + 2x - 2 = 0$ (2m)

$$\begin{aligned}x &= \frac{-2 \pm \sqrt{2^2 - 4 \times 3 \times -2}}{2 \times 3} \\&= \frac{-2 \pm \sqrt{28}}{6} \\&= \frac{-1 \pm \sqrt{7}}{3}\end{aligned}$$

2. Solve these equations simultaneously: (3m)

$$x^2 + y^2 = 169$$

$$x - y = -7$$

$$x = y - 7$$

$$y^2 - 14y + 49 + y^2 = 169$$

$$2y^2 - 14y - 120 = 0$$

$$y^2 - 7y - 60 = 0$$

$$(y - 12)(y + 5) = 0$$

$$y = 12, -5$$

$$x = 5, -12$$

3. In a History test the mean was 61 and the standard deviation was 9. In a Science test the mean was 70 and the standard deviation 10. Elizabeth scored 75 in her history test and Jason scored 75 in his Science test. Who had the better score? Explain.

ELIZABETH as score 1.6 SD above the mean ^(1m)
Jason was only ≈ 0.5 SD " " "

4. How much must I invest now in order to have \$10 000 at the end of 5 years, if interest is 3% p.a. compounding quarterly? (2m)

$$10000 = P \left(1 + \frac{3}{400}\right)^{20}$$
$$P = 10000 \left(1 + \frac{3}{400}\right)^{-20}$$
$$= \$8611.90$$

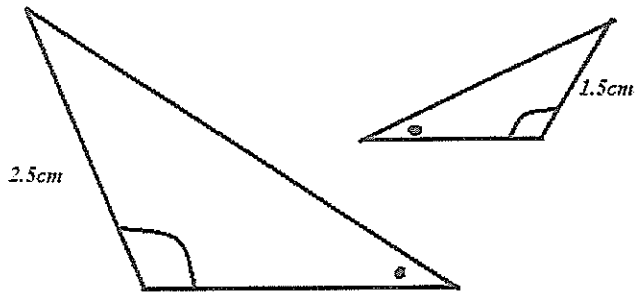
5. Which rate will give the better return on an investment: 13% p.a. compounding annually or 12.5% p.a. compounding monthly? Show working.

After 1 year @ 13% p.a. $A = P(1.13)^1 = 1.13P$ (2m)

After 1 year @ 12.5% monthly $A = P\left(1 + \frac{12.5}{1200}\right)^{12} = 1.132P$

12.5% compounded monthly is better

6. For the following pair of similar triangles, state the ratio (in simplest form) of the area of the first triangle to the area of the second triangle. (2m)



ratio of sides 2.5 to 1.5
5 : 3
ratio of area $5^2 : 3^2$
= 25 : 9

7. The ratio of the heights of two similar gas cylinders is 2 : 3. If 4 kg of gas fills the smaller cylinder, how much gas is needed to fill the larger one? (2m)

ratio heights 2 : 3
ratio volumes $2^3 : 3^3 = 8 : 27$
Small 4 kg of gas / kg need $\frac{27}{8}$ kg
13.5 kg

Section 5 (15 Marks)

1. Solve the following equations:

(4m)

a) $x^6 - 28x^3 + 27 = 0$

$$(x^3 - 27)(x^3 - 1) = 0$$

$$x^3 = 27, \quad x^3 = 1$$

$$x = 3, \quad x = 1$$

(2)

b) $(2x-5)^2 = 2x-5$

$$(2x-5)^2 - (2x-5) = 0$$

$$(2x-5)(2x-6) = 0$$

$$x = \frac{5}{2}, \quad 3$$

$$4x^2 - 20x + 25 = 2x - 5$$

$$4x^2 - 22x + 30 = 0$$

$$2x^2 - 11x + 15 = 0$$

$$(2x-5)(x-3) = 0$$

$$x = \frac{5}{2}, \quad 3$$

(2)

2. Find the centre and radius of the circle

$$x^2 + y^2 - 16x - 2y + 56 = 0$$

(2m)

$$x^2 - 16x + y^2 - 2y = -56$$

$$x^2 - 16x + (-8)^2 + y^2 - 2y + (-1)^2 = -56 + 64 + 1$$

$$(x-8)^2 + (y-1)^2 = 9$$

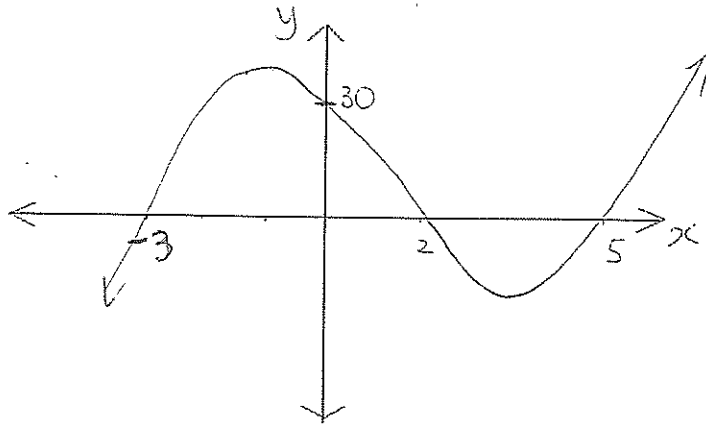
$$\therefore \text{Centre } (8, 1) \text{ and radius } 3$$

(2)

3. Sketch the following curves labelling all x and y intercepts:

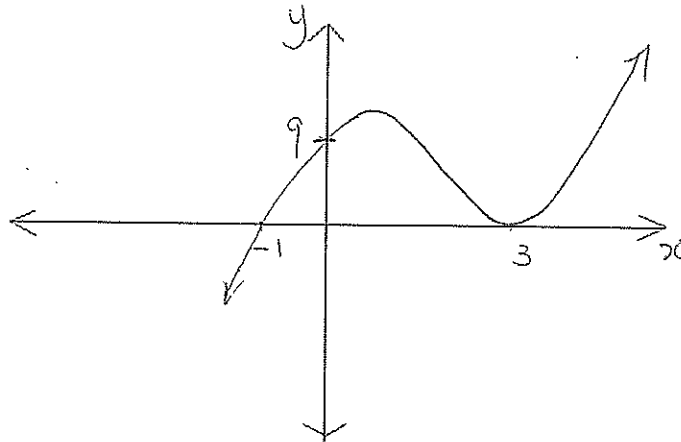
(6m)

a) $y = (x+3)(x-2)(x-5)$



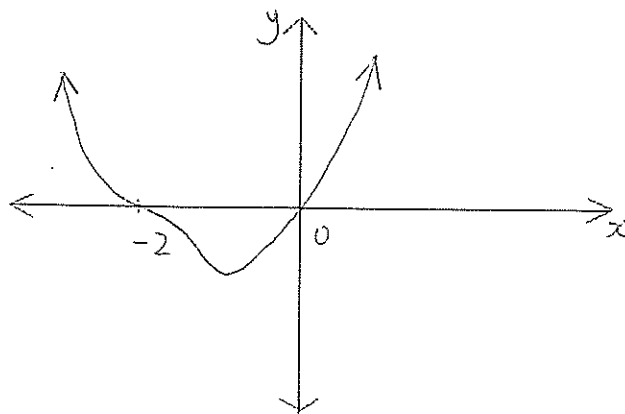
(2)

b) $y = (x-3)^2(x+1)$



(2)

c) $y = x(x+2)^3$



(2)

4. Factorise fully:

$$P(x) = 2x^3 + 5x^2 - 4x - 12$$

(3m)

$$P(-2) = 2(-2)^3 + 5(-2)^2 - 4(-2) - 12$$

$$P(-2) = 0$$

(1)

$\therefore x = -2$ is a root.

$$\begin{array}{r} 2x^2 + x - 6 \\ x+2 \overline{) 2x^3 + 5x^2 - 4x - 12} \\ \underline{2x^3 + 4x^2} \\ x^2 - 4x - 12 \\ \underline{x^2 + 2x} \\ -6x - 12 \\ \underline{-6x - 12} \\ 0 \end{array}$$

(1)

$$\begin{aligned} \therefore P(x) &= (x+2)(2x^2 + x - 6) \\ &= (x+2)(2x-3)(x+2) \end{aligned}$$

$$P(x) = (x+2)^2(2x-3)$$

(1)

2012 Year 10 Yearly Examination:
Solutions— Section 6

1. Find k , given that $kx^3 + 4x^2 - 4$ is divisible by $x + 2$.

2

Solution: $P(x) = kx^3 + 4x^2 - 4$
 $P(-2) = -8k + 16 - 4 = 0$,
 $-8k = -12$,
 $k = \frac{3}{2}$.

2. When $Q(x) = ax^3 + bx^2 + 2x + 3$ is divided by $(x + 1)$, the remainder is 3.
 When $Q(x)$ is divided by $(x - 1)$, the remainder is 15. Find a and b .

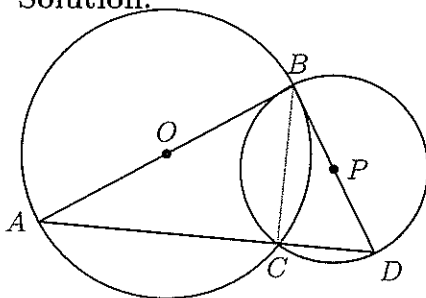
3

Solution: $Q(-1) = -a + b - 2 + 3 = 3$,
 $Q(1) = a + b + 2 + 3 = 15$,
i.e. $-a + b = 2$ 1
 $a + b = 10$ 2
 1 + 2 : $2b = 12$,
 $b = 6$.
 Subst. in 2 : $a + 6 = 10$,
 $a = 4$.

3. Two circles intersect at B and C . AB and BD are diameters.
 Prove that A , C and D are collinear.

3

Solution:



Draw BC ,
 $\widehat{ACB} = 90^\circ$ (\angle in a semicircle)
 $\widehat{BCD} = 90^\circ$ (\angle in a semicircle)
 $\therefore \widehat{ACD} = 180^\circ$.
i.e. A , C and D are collinear.

4. The Department of Primary Industry is interested in the effect of a new fertilizer on the growth of maize plants. After 12 months growth, the heights (in cm) of the plants in two plots were measured and found to be as follows:

Plot A (New Fertilizer)

39 48 50 47 125 46 54 59 58 59
127 48 44 51 53

Plot B (Original Fertilizer)

65 55 59 60 63 57 58 61 62 60
59 63 60 61 57

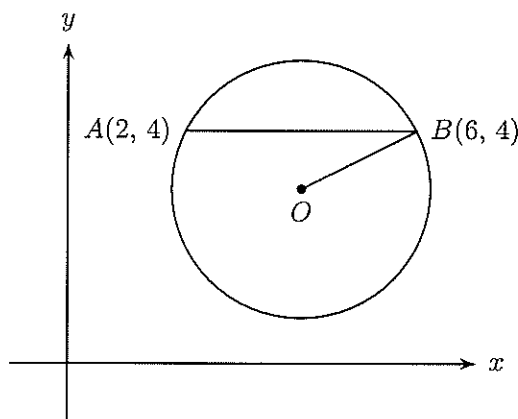
- (a) Calculate the mean and standard deviation of the two samples.

Solution:	Plot	\bar{x}	σ
	A	60.533	26.245
	B	60	2.556

- (b) Using these results, compare the effectiveness of the different fertilizers on the growth of maize plants.

Solution: The new fertilizer gave more varied results than the old (*i.e.* much higher highs but also lower lows) and had less than 1% overall improvement.

5. AB is a chord. Find the equation of the circle, given that $r = \sqrt{5}$.



Solution:

$$h^2 + 2^2 = 5,$$

$$h = 1.$$

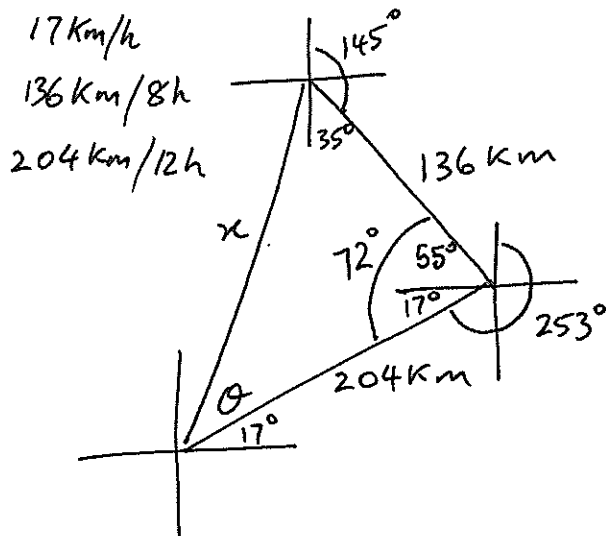
\therefore Centre $(4, 3)$.

Circle $(x - 4)^2 + (y - 3)^2 = 5,$
 $x^2 - 8x + 16 + y^2 - 6y + 9 = 5,$
 $x^2 - 8x + y^2 - 6y + 20 = 0.$

Section 7 (15 Marks)

1. A ship leaves port and heads on a bearing of $145^\circ T$ travelling at 17 km/h . After 8 hours it alters course to a bearing of $253^\circ T$ and continues at the same speed for another 12 hours. It then receives a report of a cyclone developing in the area. The ship increases speed to 21 km/h and heads directly back to port. (5m)

a) How long will it take to get back to port ?



$$x^2 = 136^2 + 204^2 - 2(136)(204)\cos 72^\circ$$

$$= 4296.5.265 \dots$$

$$x = 207.28 \text{ km}$$

$$t = \frac{207.28}{21}$$

$$= 9 \text{ hours } 52 \text{ minutes } 13.82 \text{ seconds}$$

b) On what bearing (to the nearest minute) should it head?

$$\frac{\sin \theta}{136} = \frac{\sin 72^\circ}{207.28}$$

$$\sin \theta = \frac{136 \sin 72^\circ}{207.28}$$

$$\theta = 38^\circ 37'$$

$$90 - (38^\circ 37' + 17^\circ)$$

$$= 34^\circ 23'$$

\therefore bearing is $034^\circ 23' T$

2. Solve: $\sqrt{x+\sqrt{x}} + \sqrt{x-\sqrt{x}} = 3\sqrt{\frac{x}{x+\sqrt{x}}}$

(3m)

$$\sqrt{x+\sqrt{x}} + \sqrt{x-\sqrt{x}} = \frac{3\sqrt{x}}{\sqrt{x+\sqrt{x}}}$$

$$x+\sqrt{x} + \sqrt{x-\sqrt{x}} \cdot \sqrt{x+\sqrt{x}} = 3\sqrt{x}$$

$$x+\sqrt{x} + \sqrt{x^2-x} = 3\sqrt{x}$$

$$\sqrt{x^2-x} = 2\sqrt{x} - x$$

$$\cancel{x^2} - x = 4x - 4x\sqrt{x} + \cancel{x^2}$$

$$4x\sqrt{x} = 5x$$

$$16x^3 = 25x^2$$

$$16x^3 - 25x^2 = 0$$

$$x^2(16x - 25) = 0$$

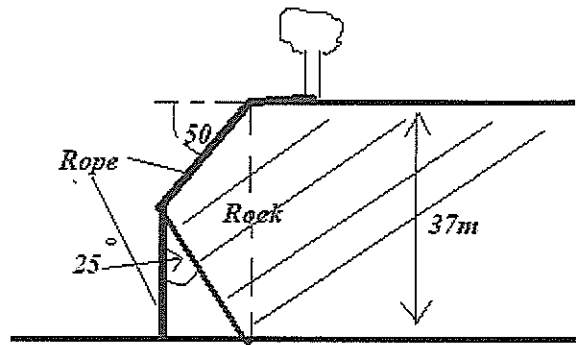
$$x = 0, \frac{25}{16}$$

since $x \neq 0$

$$x = \frac{25}{16}$$

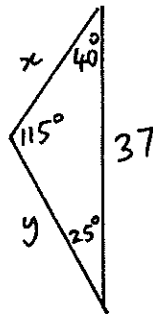
3. A cliff is 37m high. The rock slopes outward at an angle of 50° to the horizontal, then cuts back at an angle of 25° to the vertical, meeting the ground directly below the top of the cliff.

NOT TO SCALE



Carol wishes to abseil from the top of the cliff to the ground as shown in the diagram. Her climbing rope is 45m long and she needs 2m to secure it to a tree at the top of the cliff. Will the rope be long enough to allow her to reach the ground?

(3m)



$$\frac{x}{\sin 25^\circ} = \frac{37}{\sin 115^\circ}$$

$$x = \frac{37 \sin 25^\circ}{\sin 115^\circ}$$

$$x = 17.25 \dots$$

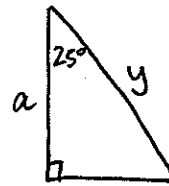
$$\frac{y}{\sin 40^\circ} = \frac{37}{\sin 115^\circ}$$

$$y = \frac{37 \sin 40^\circ}{\sin 115^\circ}$$

$$y = 26.24 \dots$$

$$17.25 + 26.24 + 2 = 45.49$$

which is less than 45
 \therefore the rope is long enough.



$$\cos 25^\circ = \frac{a}{y}$$

$$a = y \cos 25^\circ$$

$$a = 23.78 \dots$$

4. A boy plans a boating trip from his home on the edge of a lake to a town that lies on a river that empties into the lake. To make the trip, he travels 20km across the lake (in which there is no current) to the mouth of the river, and then rows a further 20km up the river against a current of 2km/hour. If the journey is completed in 15 hours, at what constant speed (relative to the water) does he travel?

(4m)

let boy travel at x km/h

$$\frac{20}{x} + \frac{20}{x-2} = 15$$

$$20(x-2) + 20x = 15x(x-2)$$

$$20x - 40 + 20x = 15x^2 - 30x$$

$$15x^2 - 70x + 40 = 0$$

$$3x^2 - 14x + 8 = 0$$

$$\frac{(3x-12)(3x-2)}{3} = 0$$

$$(x-4)(3x-2) = 0$$

$$x = 4, \frac{2}{3}$$

Note: $x > 2$

$$\therefore x = 4 \text{ km/h}$$

$$\begin{array}{r|l} x & 24 \\ + & -14 \\ \hline & -12 \\ & -2 \end{array}$$