Girraween High School

2023 Year 10 Mathematics

Yearly Exam

General Instructions

- Time allowed: 2 hours plus 5 minutes reading time
- Write using black pen.
- Answer in the spaces provided.
- NESA approved calculators may be used.
- Marks may be deducted for poorly arranged work.
- Show all necessary working out.

Teacher

❒ Ms Kularajendran

❒ Mr Hurley

❒ Ms Sreedevi

❒ Ms Li

❒ Ms Bonala

Name _____

Question	NA	MG	SP	Total
Non Calculator	**/20**			
Multiple Choice	**/11**	**/4**	**/5**	**/20**
Short Answer	**/7**	**/4**	**/4**	**/15**
Q1	**/19**			**/19**
Q2	**/18**			**/18**
Q3		**/16**		**/16**
Q4			**/19**	**/19**
Total	**/75**	**/24**	**/28**	**/107**

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2023 Year 10 Yearly Exam

Multiple Choice Answer Sheet

Name _____

Select the alternative A, B, C or D that best answers the question.

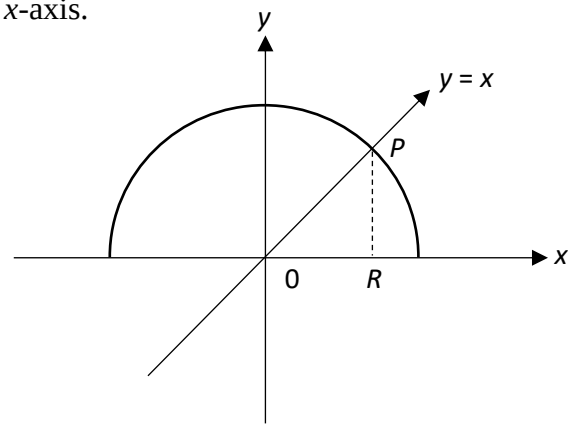
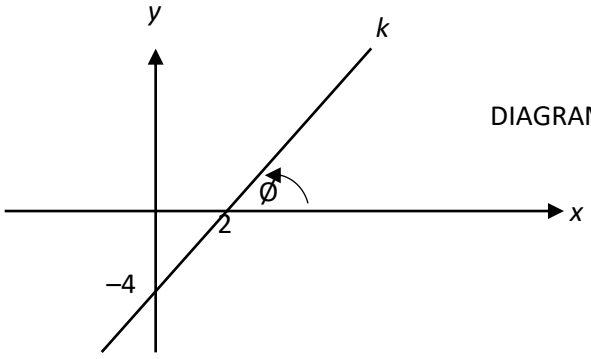
					NA	MG	SP
1.	A ○	B ○	C ○	D ○			
2.	A ○	B ○	C ○	D ○			
3.	A ○	B ○	C ○	D ○			
4.	A ○	B ○	C ○	D ○			
5.	A ○	B ○	C ○	D ○			
6.	A ○	B ○	C ○	D ○			
7.	A ○	B ○	C ○	D ○			
8.	A ○	B ○	C ○	D ○			
9.	A ○	B ○	C ○	D ○			
10.	A ○	B ○	C ○	D ○			
11.	A ○	B ○	C ○	D ○			
12.	A ○	B ○	C ○	D ○			
13.	A ○	B ○	C ○	D ○			
14.	A ○	B ○	C ○	D ○			
15.	A ○	B ○	C ○	D ○			
16.	A ○	B ○	C ○	D ○			
17.	A ○	B ○	C ○	D ○			
18.	A ○	B ○	C ○	D ○			
19.	A ○	B ○	C ○	D ○			
20.	A ○	B ○	C ○	D ○			
					/11	/4	/5

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2023 Year 10 Mathematics Yearly Exam

Multiple Choice Questions

- **Select your answer on the Multiple Choice Answer Sheet provided.**
- **All Questions are worth 1 mark.**

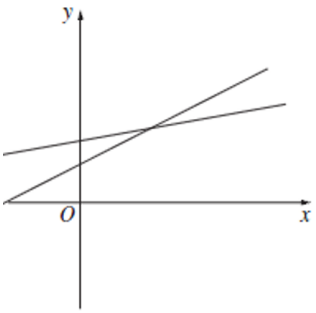
	Questions
1)	Which of these equations is equivalent to $y = \frac{x}{5} - 3$? A) $x + 5y - 3 = 0$ B) $5x - y + 3 = 0$ C) $x - 5y - 15 = 0$ D) $x - 5y + 15 = 0$
2)	The diagram shows the line $y = x$ intersecting the semicircle with centre (0, 0) and radius 2, at the point P. R is the foot of the perpendicular from P to the x-axis. What is the area of triangle OPR? A) 1 B) $\sqrt{2}$ C) $2\sqrt{2}$ D) 4 
3)	To the nearest degree, what is the size of angle Ø shown in this diagram? A) 26° B) 27° C) 63° D) 64°  DIAGRAM NOT TO SCALE

4)	Solve $2x^2 - 5x - 1 = 0$ A) $x = \frac{5 \pm \sqrt{17}}{4}$ B) $x = \frac{-5 \pm \sqrt{17}}{4}$ C) $x = \frac{5 \pm \sqrt{33}}{4}$ D) $x = \frac{-5 \pm \sqrt{33}}{4}$
5)	Consider the function $f(x) = x^3$. The function $g(x) = (x - 4)^3$ can best be described graphically as: A) $f(x)$ moved up 4 units. B) $f(x)$ moved down 4 units. C) $f(x)$ moved to the right by 4 units. D) $f(x)$ moved to the left by 4 units.
6)	Which of the following is equivalent to $5^n - 5^{n-1}$? A) 5 B) 5^{n-1} C) $4(5^n - 1)$ D) $4(5^{n-1})$
7)	Which of the following is equivalent to $w - w^{-1}$? A) $\frac{w^2 - 1}{w}$ B) $\frac{w^2 - 2}{w}$ C) $w^2 - 2$ D) 1

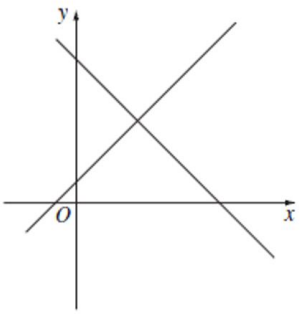
8) David drew a correct diagram that gave the solution to the simultaneous equations $y = 2x - 5$ and $y = x + 6$.

Which diagram did he draw?

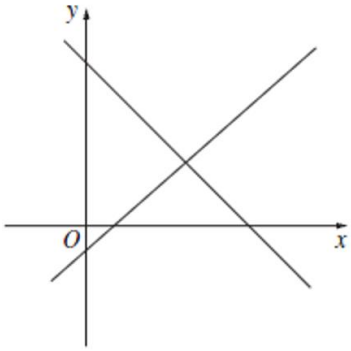
A)



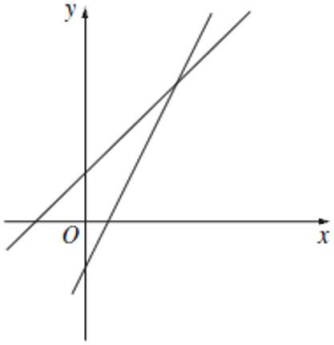
B)



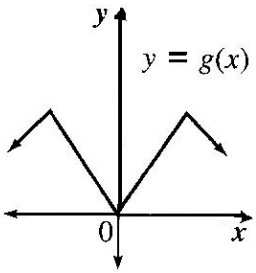
C)



D)

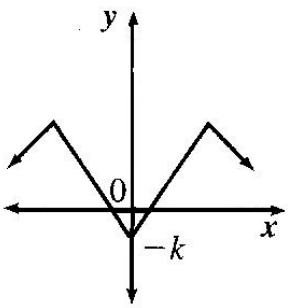


9) This graph represents the function $y = g(x)$.

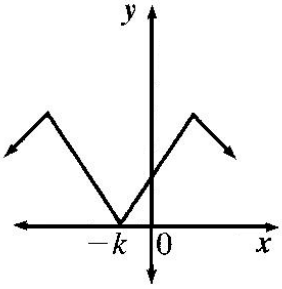


Which graph best represents the equation $y = g(x) - k$, where $k > 0$.

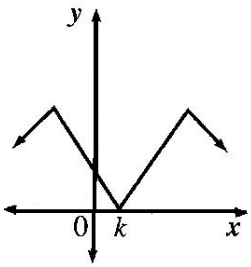
A)



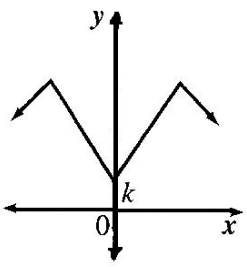
B)



C)



D)



10) If an electrical current varies inversely with resistance, what is the effect on the current when the resistance is doubled?

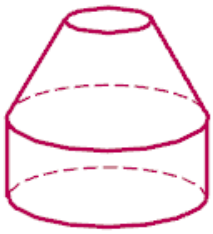
A) The current is doubled.

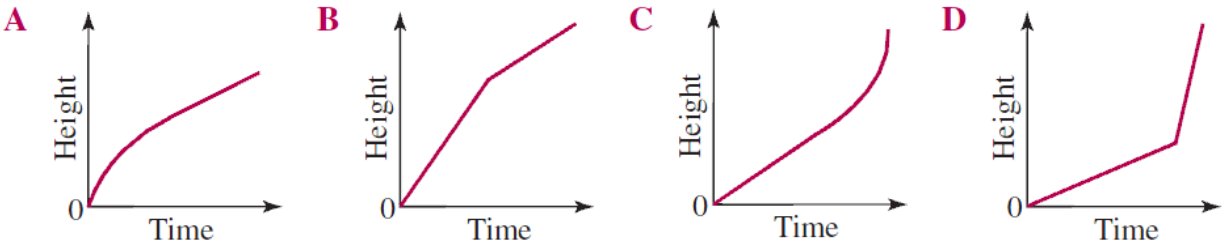
B) The current is exactly the same.

C) The current is halved.

D) The current is squared.

11) The container below is to be filled with water at a uniform rate. Select the graph that best shows the change in the height of the water against time.





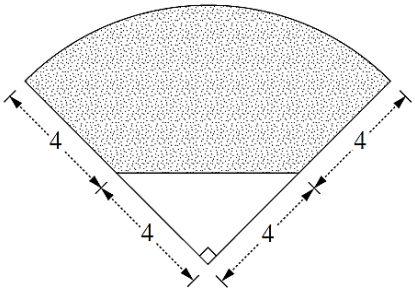
12) What is the area of the shaded part of this quadrant, to the nearest square centimetre?

A) $34cm^2$

B) $42cm^2$

C) $50cm^2$

D) $193cm^2$



NOT TO SCALE

All measurements are in centimetres.

13) The volume of a sphere is 36π cm^3. What is the surface area (cm^2) of the sphere?

A) 36π

B) 42π

C) 48π

D) 72π

14) An equilateral triangle has a side length of 8 cm.
What is the area (cm^2) of the triangle?

A) $8\sqrt{3}$

B) $16\sqrt{3}$

C) 32

D) $32\sqrt{3}$

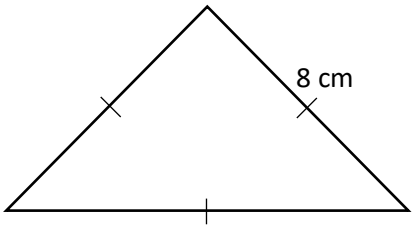


DIAGRAM NOT TO SCALE

15) The height of the cone is twice the length of its diameter.

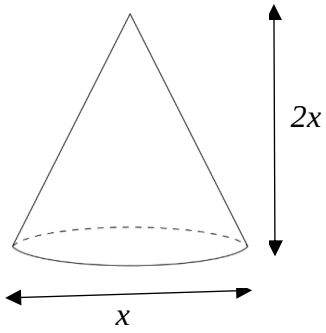
Which expression gives the volume of the cone?

A) $V = \frac{\pi x^3}{12}$

B) $V = \frac{2\pi x^3}{3}$

C) $V = \frac{\pi x^3}{6}$

D) $V = \frac{2\pi x^4}{3}$



16) The height of each student in a class was measured and it was found that the mean height was 160cm. Two students were absent. When their heights were included in the data for the class, the mean height did not change.
Which of the following heights are possible for the two absent students?

A) 155 cm and 162 cm

B) 152 cm and 167 cm

C) 149 cm and 171 cm

D) 143 cm and 178 cm

17) The frequency histogram shows the number of goals scored by a football team in each game in a season.

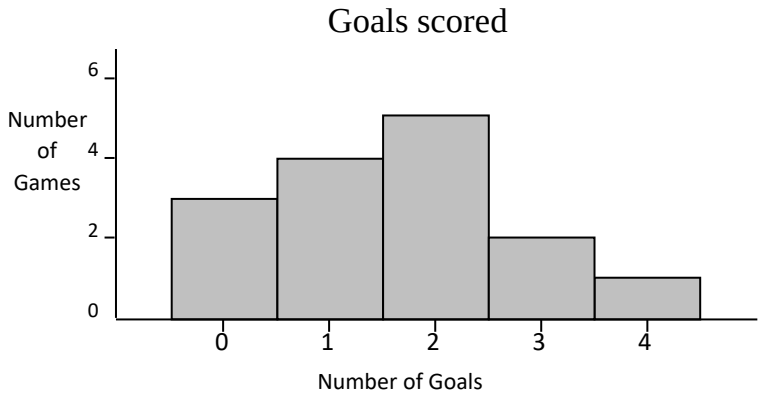
What is the mean number of goals?

A) 1

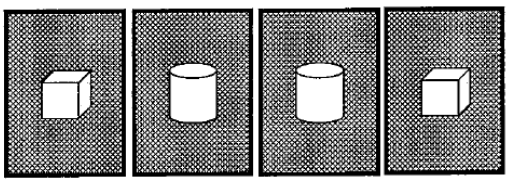
B) 1.6

C) 2

D) 2.6



18) There are 20 cards in a game of shape recognition for young children.
5 cards have a picture of a cube, 5 have cylinders, 5 have pyramids and 5 have cones.
Sally has been given the following four cards at random from the set of 20 and these cards are kept out on the table.



What is the probability that Sally's next (5th) card randomly drawn from the set, will give her "three of a kind"?

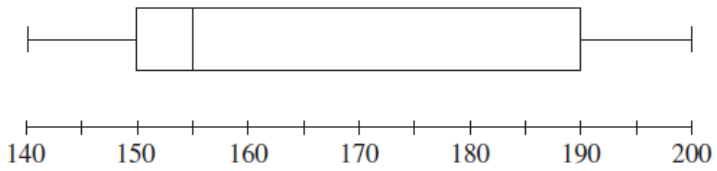
A) $\frac{2}{3}$

B) $\frac{4}{5}$

C) $\frac{1}{8}$

D) $\frac{3}{8}$

19) A set of data is displayed in this box-and-whisker plot.



What is the interquartile range?

A) 40

B) 155

C) 190

D) 150

20) A bag contains red, green, yellow and blue balls.
The table shows the probability of choosing a red, green or blue ball from the bag.
If there are 12 yellow balls in the bag, how many balls are in the bag altogether?

Colour	*Probability*
Red	$\frac{1}{3}$
Green	$\frac{1}{4}$
Yellow	?
Blue	$\frac{1}{6}$

A) 16

B) 36

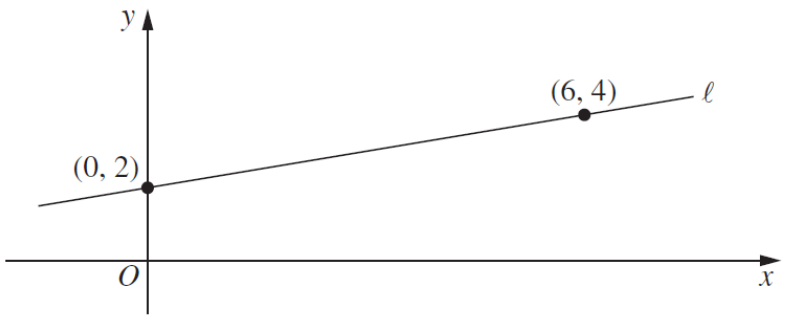
C) 48

D) 60

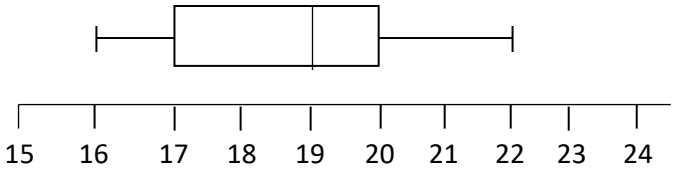
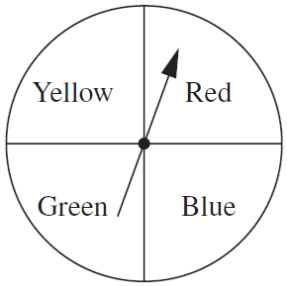
End of Multiple Choice questions.

Short Answer Questions **(15 marks)**

- **Write you answer in the space provided.**
- **All Questions are worth 1 mark.**

	Questions	Answers
1)	Evaluate $\log_2 \frac{1}{32}$.	
2)	If the lines with equations $2x - 4y + 1 = 0$ and $y = 2mx$ are perpendicular, what is the value of m?	
3)	Expand and simplify $(3\sqrt{7} - 2)^2$	
4)	The stopping distance d (metres) for a vehicle travelling at a speed s (kilometres per hour) can also be given by the formula: $$d = \frac{s}{10}\left(\frac{s}{20} + 2\right)$$ Use this formula to calculate the stopping distance of a car travelling at 40km/h in a school zone.	
5)	What is the equation of the line l ? 	

	Questions	Answers
6)	Solve $6x(x-3)=0$	
7)	Solve $2^x = 7$. Give your answer to 1 decimal place.	
8)	The Great Pyramid of Egypt has a square base of side 230 m. Its perpendicular height is 135 m. What is the volume of the pyramid?	
9)	Find the value of x if: $\cos(30°) = \sin(x)$, where $0 < x < 90^o$.	
10)	Solve $\tan\theta = -\frac{1}{\sqrt{3}}$ for $0 \leq \theta \leq 360^o$	
11)	An astronomical unit (*AU*) is the mean distance from the centre of the Earth to the centre of the Sun. 1 *AU* = 149 597 870 *km* The dwarf planet Pluto is approximately 39.79 *AU* from the Sun. Express this distance in *km*. *Answer in scientific notation correct to 2 significant figures.*	

	Questions	Answers
12)	The following box-and-whisker plot shows the number of hours spent doing gardening by a group of 60 people. How many people gardened for more than 20 hours?  	
13)	Find the median from the table below. *Score* / *Frequency* 12 — 13 14 — 6 16 — 2 18 — 12 **Total** — 33	
14)	A group of 12 students sat a Science exam. The marks obtained in the Science exam are as follows: *Science*: 42, 60, 74, 76, 58, 64, 80, 39, 78, 84, 53, 57 Calculate the standard deviation of the Science exam. (Answer correct to 2 decimal places)	
15)	The arrow is spun and will point to one of the four colours when it stops. If the arrow is spun twice, what is the probability that it points to the same colour both times it stops?  	

Examination continues next page…

Extended Response Questions

Show all working where necessary.

Question 1 (19 marks)

a) Factorise fully $3y^4 - 12y^2$ **2**

b)

i) By completing the square, show that $x^2 + y^2 + 6x - 4y - 12 = 0$ is equivalent to $(x + 3)^2 + (y - 2)^2 = 25$ **1**

ii) State the centre and radius of the circle. **2**

Centre _____ radius _____

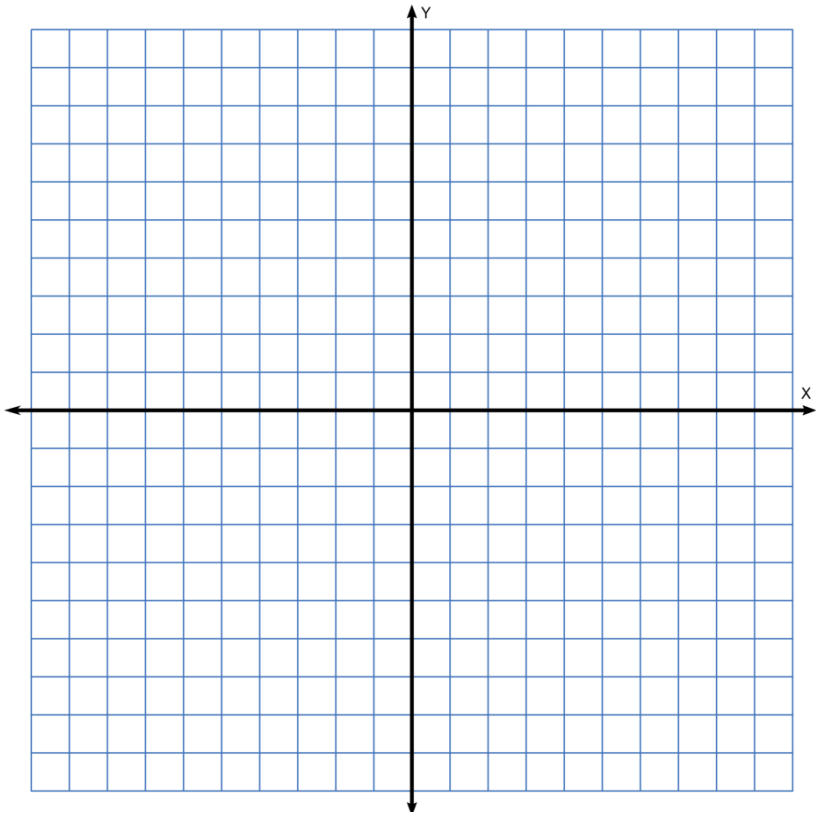
iii) State its domain. **1**

Examination continues next page…

c) Solve for x: $\log_2(x-2) + \log_2 x = 3$ **3**

Examination continues next page…

d) Sketch the curve $f(x) = 2^x + 3$ on the axes below. Show any important features. **2**



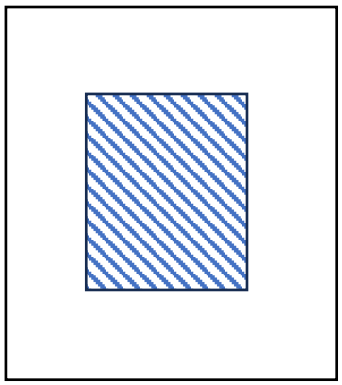
e) State the domain and range of $y = \log_2(x - 3) + 5$ **2**

Domain _____

Range _____

f) A rectangular photograph, $18cm$ long and $12cm$ wide, is surrounded by a frame of uniform width, whose area is equal to the area of the photograph.

i) If x is the width of the frame, show that the **area of the frame** can be represented by the expression: $(18 + 2x)(12 + 2x) - 216$. **1**



Not to scale

ii) Hence, find the width of the frame. **2**

g) Consider the equation $P = \frac{125ka^t}{k+2a^t}$ where $t \geq 0$ **3**

Given $P = 400$, $k = 8$, $a = 1.2$, solve for t.

Question 2 (18 marks)

a) If $f(x) = x^2 + 1$

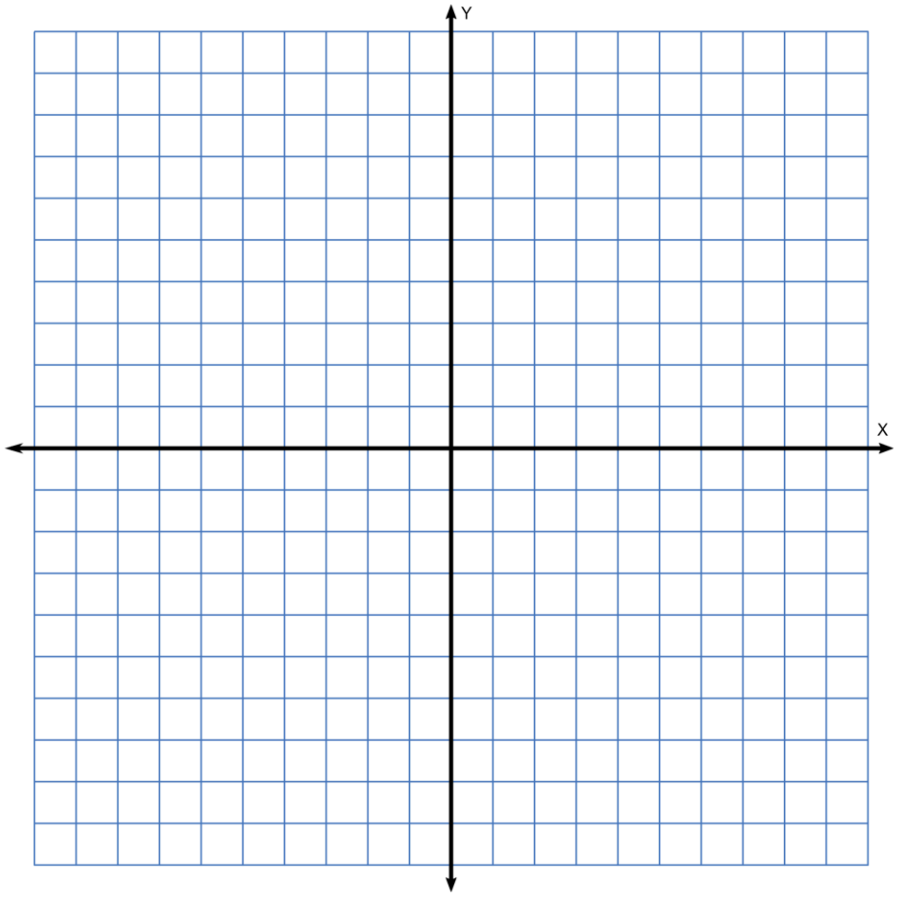
i) Evaluate $f(-3)$ **1**

ii) Find an expression for $\frac{f(x+h)-f(x)}{h}$ in simplest form. **3**

b) The quadratic function $y = 3x^2 + bx + c$ has a minimum value of -16 when $x = 3$. Find values for b and c. **2**

c) Consider the function of $f(x) = 2 - \frac{1}{x-1}$

i) Sketch the function $f(x) = 2 - \frac{1}{x-1}$ on the axes below. Show all asymptotes and intercepts. **3**



ii) Find the inverse function of $f(x) = 2 - \frac{1}{x-1}$ **2**

Examination continues next page…

d) Solve simultaneously, to find the points of intersection of $x^2 + y^2 = 5$ and $y = x + 1$. **3**

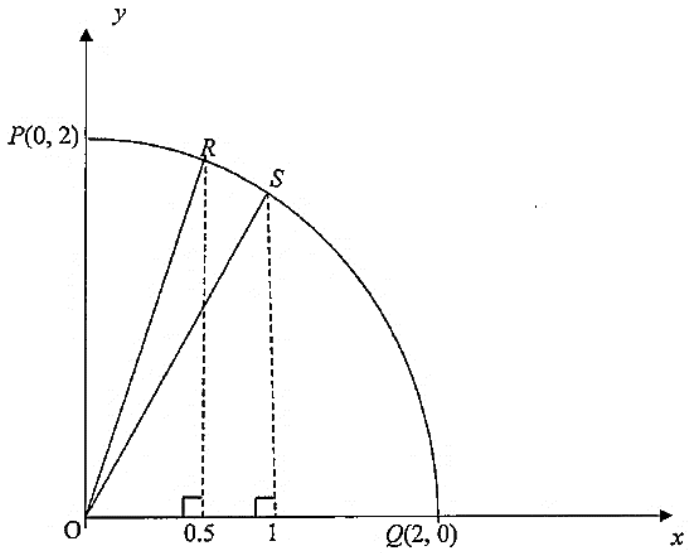
e) Given $p = \log_a 4$ and $q = \log_a 5$, express each of the following logarithms in terms of p and q.

i) $\log_a 100$ **2**

ii) $\log_a 0.4$ **2**

Question 3 (16 marks)

a) The diagram shows an arc PQ, part of the circumference of a circle (centre O), drawn on the co-ordinate axes.
The points R and S are also on the circumference of the circle, and have horizontal distances from the origin, as shown.



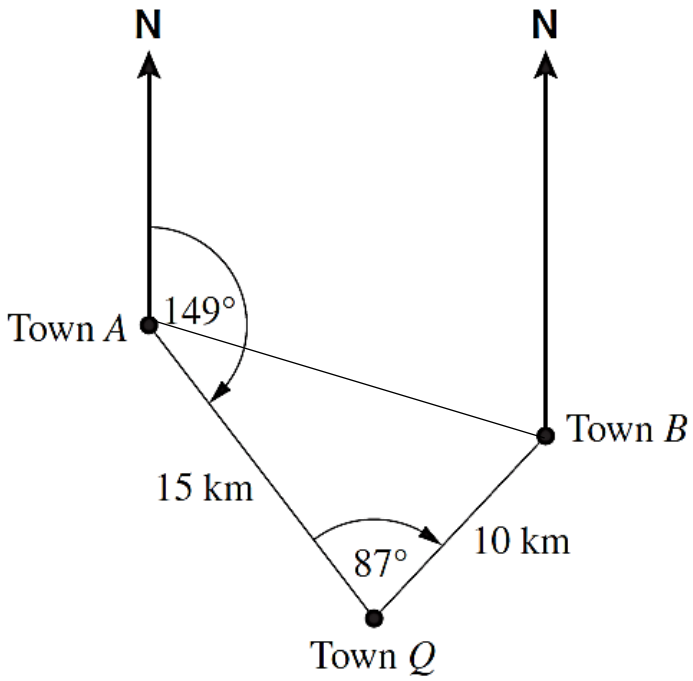
i) What is the length of OS? **1**

ii) Calculate the size of $\angle SOQ$. **1**

iii) Show that the value of $\angle ROS = 15.5^o$ (1 decimal place) **2**

iv) Calculate the arc length (to 2 decimal places) between R and S. **1**

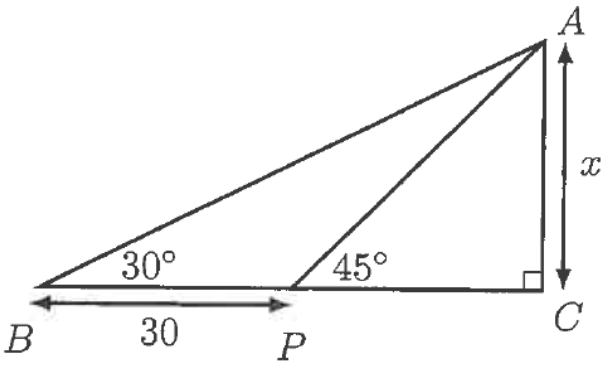
b) The diagram shows information about the locations of towns *A*, *B* and *Q*.



i) Amy walks to Town *B* from Town *A* and then to Town *Q*. **2**
Find the distance from Town *A* to Town *B*. Give your answer to the nearest km.

ii) Calculate the bearing of Town *Q* from Town *B*. **1**

c) Ayana finds that the angle of elevation of the top of a pole A, from B is 30^o, but when she walks 30 metres towards a point P, the angle of elevation is 45^o.

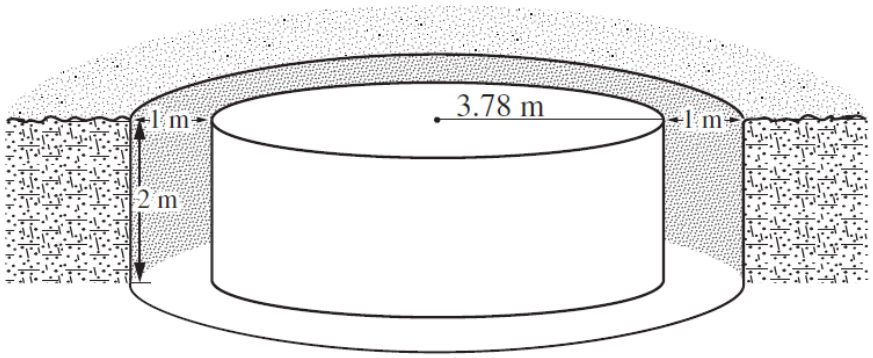


i) Show that $AP = \frac{30 \sin 30^o}{\sin 15^o}$ **2**

ii) Hence, calculate the height of the pole correct to the nearest metre. **2**

d) A cylindrical water tank, of height 2 m, is placed in the ground at a school.

The radius of the tank is 3.78 metres. The hole is 2 metres deep. When the tank is placed in the hole there is a gap of 1 metre all the way around the side of the tank.



i) When digging the hole for the water tank, what volume of soil was removed? **2**
Give your answer to the nearest cubic metre.

ii) Water is to be collected in the tank from the roof of the school hall, which has an area of $400m^2$. During a storm, 20mm of rain falls on the roof and is collected in the tank. **2**
How many litres of water were collected?

Question 4 (19 marks)

a) A new test has been developed for determining whether or not people are carriers of the Noether virus.

Two hundred people are tested. A two-way table is being used to record the results.

	Positive	*Negative*
Carrier	74	12
Not a carrier	16	***A***

i) What is the value of ***A***? **1**

ii) A person selected from the tested group is a carrier of the virus. What is the **probability** that the test results would show this? **1**

iii) For **how many** of the people tested were their test results inaccurate? **1**

Examination continues next page…

b) Jason travels to work by car on all five days of this working week, leaving home at 7am each day. He compares his travel times using roads without tolls and roads with tolls over a period of 12 working weeks.

He records his travel times (in minutes) in a back to back stem and leaf plot.

Travel time (minutes)

Without tolls		*With tolls*
9	3	5 8 9 9
9 9 8 7 7 6 5 5 4 4 3 2 0	4	0 1 2 6 7 7 8 8 8 9
9 8 7 5 4 3 3 3 2 2 2 2 1 1 0	5	2 4 4 5 6 8 9
1	6	1 3 5 7
	7	0 2 8
	8	2
	9	0

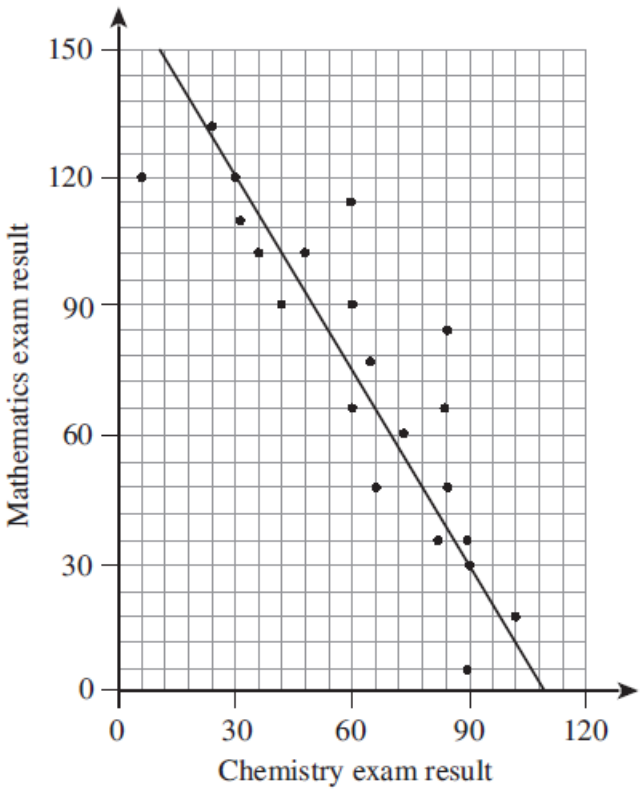
i) What is the modal travel time when he uses roads without tolls? **1**

ii) What is the median travel time with he uses roads without tolls? **1**

iii) Describe the **shape/skewness** of **each** distribution: 'Without tolls' and 'Tolls'. **2**

Examination continues next page…

c) The Mathematics and Chemistry exam results for a group of students are recorded in the scatterplot. A line of best fit was drawn as shown.



i) Calculate the gradient of the line of best fit. **1**

ii) Describe the strength and direction of the correlation between the Mathematics and Chemistry exam results using the words below: *(Circle your answer for α and β)* **2**

α) strong or weak

β) positive or negative

d) The coach of a football team notices that the team has a probability of $\frac{2}{3}$ of winning if it is rainy (R) and if the weather is dry (D), the probability of the team winning is $\frac{1}{5}$. The probability of rainy weather is $\frac{1}{4}$.

i) Draw a probability tree diagram of this scenario and list the outcomes. **2**

ii) Find the probability that the team will win. **2**

iii) Given that the team has won a game, calculate the probability that it rained on the day of the match. **2**

Examination continues next page…

e) A bag has x discs of the same size, of which 6 are blue and the rest are white.
Two discs are randomly selected from the bag, **without replacement**.

i) Find the probability (in terms of x), of choosing two white discs. **1**
(You may draw a tree diagram to help you)

ii) Show that the probability of selecting at least one blue disc can be given by: $\frac{6(2x-7)}{x^2-x}$ **2**

End of examination.

Extra working space

Any solutions you want marked must be clearly labelled with the question number.

Girraween High School

2023 Year 10 Mathematics

Yearly Exam

General Instructions

- Time allowed: 2 hours plus 5 minutes reading time
- Write using black pen.
- Answer in the spaces provided.
- NESA approved calculators may be used.
- Marks may be deducted for poorly arranged work.
- Show all necessary working out.

Teacher

- ☐ Ms Kularajendran
- ☐ Mr Hurley
- ☐ Ms Sreedevi
- ☐ Ms Li
- ☐ Ms Bonala

Name Solutions

Question	NA	MG	SP	Total
Non Calculator	/20			
Multiple Choice	/11	/4	/5	/20
Short Answer	/7	/4	/4	/15
Q1	/18			/18
Q2	/18			/18
Q3		/16		/16
Q4			/19	/19
Total	/74	/24	/28	/106

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2023 Year 10 Yearly Exam

Multiple Choice Answer Sheet

Name _____

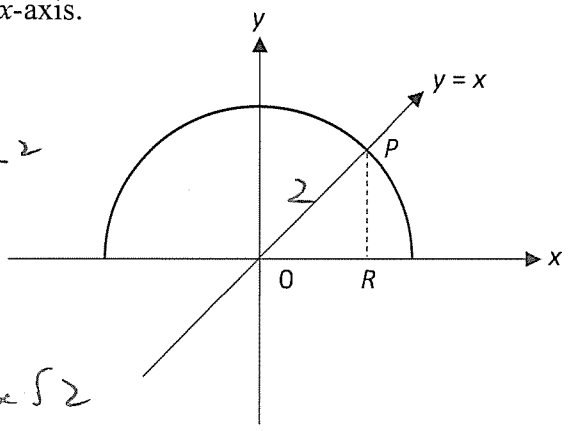
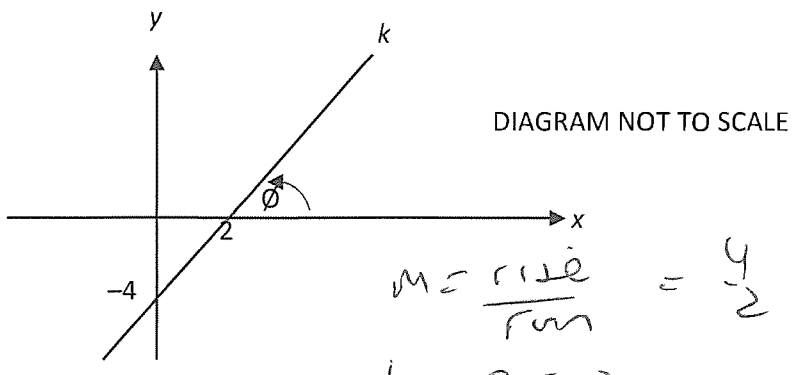
Select the alternative A, B, C or D that best answers the question.

					NA	MG	SP
1.	A ○	B ○	C ●	D ○			
2.	A ●	B ○	C ○	D ○			
3.	A ○	B ○	C ●	D ○			
4.	A ○	B ○	C ●	D ○			
5.	A ○	B ○	C ●	D ○			
6.	A ○	B ○	C ○	D ●			
7.	A ●	B ○	C ○	D ○			
8.	A ○	B ○	C ○	D ●			
9.	A ●	B ○	C ○	D ○			
10.	A ○	B ○	C ●	D ○			
11.	A ○	B ○	C ●	D ○			
12.	A ○	B ●	C ○	D ○			
13.	A ●	B ○	C ○	D ○			
14.	A ○	B ●	C ○	D ○			
15.	A ○	B ○	C ●	D ○			
16.	A ○	B ○	C ●	D ○			
17.	A ○	B ●	C ○	D ○			
18.	A ○	B ○	C ○	D ●			
19.	A ●	B ○	C ○	D ○			
20.	A ○	B ○	C ●	D ○			
					/11	/4	/5

2023 Year 10 Mathematics Yearly Exam

Multiple Choice Questions

- **Select your answer on the Multiple Choice Answer Sheet provided.**
- **All Questions are worth 1 mark.**

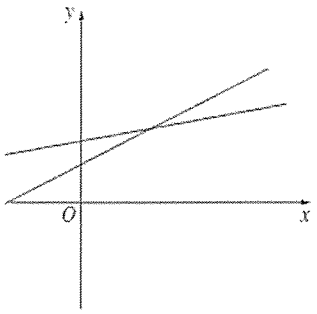
	Questions
1)	Which of these equations is equivalent to $y = \frac{x}{5} - 3$? A) $x + 5y - 3 = 0$ B) $5x - y + 3 = 0$ C) $x - 5y - 15 = 0$ D) $x - 5y + 15 = 0$ $5y = x - 15$ $x - 5y - 15 = 0$
2)	The diagram shows the line $y = x$ intersecting the semicircle with centre (0, 0) and radius 2, at the point P. R is the foot of the perpendicular from P to the x-axis. What is the area of triangle OPR? A) 1 B) $\sqrt{2}$ C) $2\sqrt{2}$ D) 4 $x^2 + x^2 = 2^2$ $x^2 = 2$ $x = \sqrt{2}$ $A = \frac{1}{2} \sqrt{2} \times \sqrt{2}$ 
3)	To the nearest degree, what is the size of angle Ø shown in this diagram? A) 26° B) 27° C) 63° D) 64°  DIAGRAM NOT TO SCALE $m = \frac{\text{rise}}{\text{run}} = \frac{4}{2}$ $\tan\theta = 2$ $\theta = 63°$

4)	Solve $2x^2 - 5x - 1 = 0$ A) $x = \frac{5 \pm \sqrt{17}}{4}$ B) $x = \frac{-5 \pm \sqrt{17}}{4}$ C) $x = \frac{5 \pm \sqrt{33}}{4}$ D) $x = \frac{-5 \pm \sqrt{33}}{4}$
5)	Consider the function $f(x) = x^3$. The function $g(x) = (x-4)^3$ can best be described graphically as: A) $f(x)$ moved up 4 units. B) $f(x)$ moved down 4 units. C) $f(x)$ moved to the right by 4 units. D) $f(x)$ moved to the left by 4 units.
6)	Which of the following is equivalent to $5^n - 5^{n-1}$? A) 5 B) 5^{n-1} C) $4(5^n - 1)$ D) $4(5^{n-1})$
7)	Which of the following is equivalent to $w - w^{-1}$? A) $\frac{w^2-1}{w}$ B) $\frac{w^2-2}{w}$ C) $w^2 - 2$ D) 1

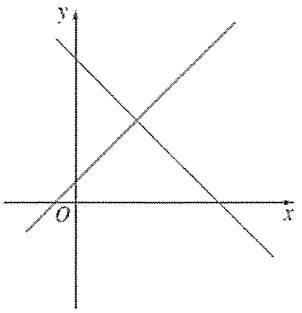
8) David drew a correct diagram that gave the solution to the simultaneous equations $y = 2x - 5$ and $y = x + 6$.

Which diagram did he draw?

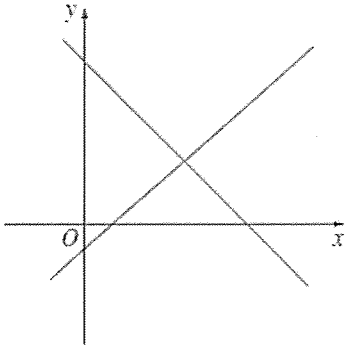
A)



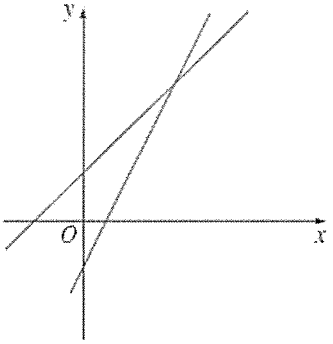
B)



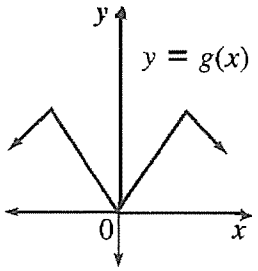
C)



D)

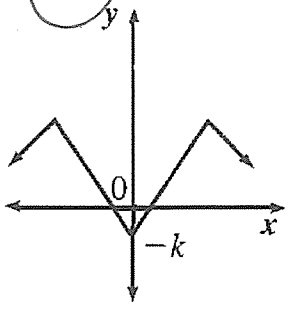


9) This graph represents the function $y = g(x)$.

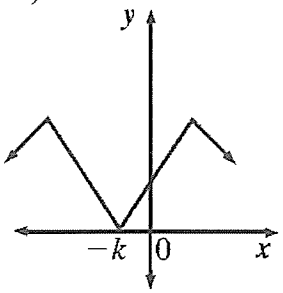


Which graph best represents the equation $y = g(x) - k$, where $k > 0$.

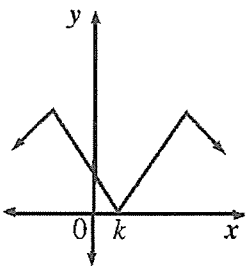
A)



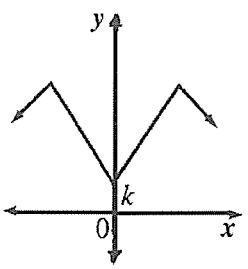
B)



C)



D)



10) If an electrical current varies inversely with resistance, what is the effect on the current when the resistance is doubled?

A) The current is doubled.

B) The current is exactly the same.

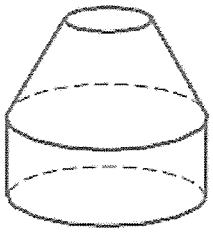
C) The current is halved.

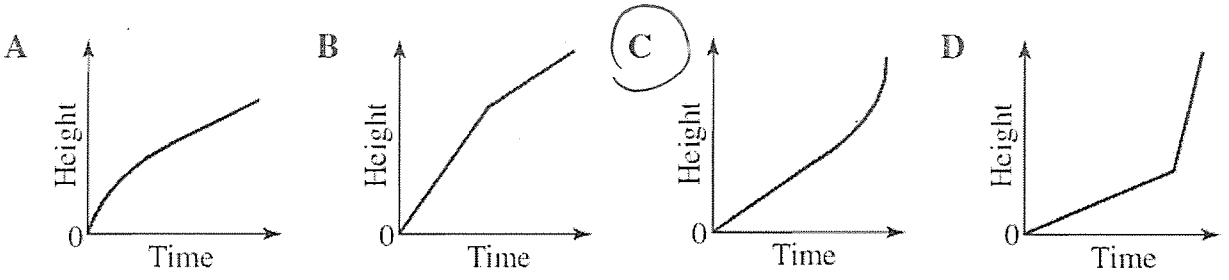
D) The current is squared.

Current $\propto \frac{k}{R}$

$\propto \frac{k}{2R}$

11) The container below is to be filled with water at a uniform rate. Select the graph that best shows the change in the height of the water against time.





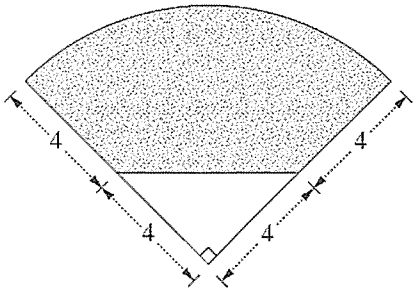
12) What is the area of the shaded part of this quadrant, to the nearest square centimetre?

A) $34cm^2$

B) $42cm^2$

C) $50cm^2$

D) $193cm^2$



NOT TO SCALE

All measurements are in centimetres.

$A = \frac{1}{4}\pi 8^2 - \frac{1}{2}.4.4$

13) The volume of a sphere is 36π cm^3. What is the surface area (cm^2) of the sphere?

A) 36π

B) 42π

C) 48π

D) 72π

$V = 36\pi = \frac{4}{3}\pi r^3$

$27 = r^3$

$r = 3$

$SA = 4\pi r^2$

$= 4\pi 3^2$

$= 36\pi$

14) An equilateral triangle has a side length of 8 cm.
What is the area (cm^2) of the triangle?

$A = \frac{1}{2} \times 8 \times 8 \sin 60$

$= 32 \times \frac{\sqrt{3}}{2}$

A) $8\sqrt{3}$

B) $16\sqrt{3}$

C) 32

D) $32\sqrt{3}$

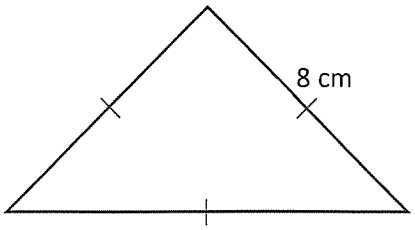


DIAGRAM NOT TO SCALE

15) The height of the cone is twice the length of its diameter.

Which expression gives the volume of the cone?

A) $V = \frac{\pi x^3}{12}$

B) $V = \frac{2\pi x^3}{3}$

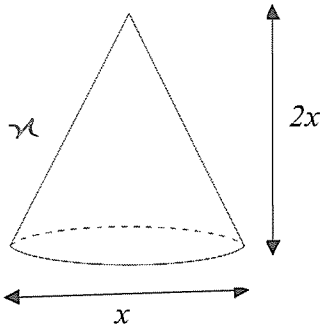
C) $V = \frac{\pi x^3}{6}$

D) $V = \frac{2\pi x^4}{3}$

$V = \frac{1}{3} \pi r^2 h$

$= \frac{1}{3} \pi \left(\frac{x}{2}\right)^2 2x$

$= \frac{1}{6} \pi x^3$



16) The height of each student in a class was measured and it was found that the mean height was 160cm. Two students were absent. When their heights were included in the data for the class, the mean height did not change.
Which of the following heights are possible for the two absent students?

$\frac{149 + 171}{2} = 160$

A) 155 cm and 162 cm

B) 152 cm and 167 cm

C) 149 cm and 171 cm

D) 143 cm and 178 cm

17) The frequency histogram shows the number of goals scored by a football team in each game in a season.

What is the mean number of goals?

$\bar{x} = \frac{24}{15}$

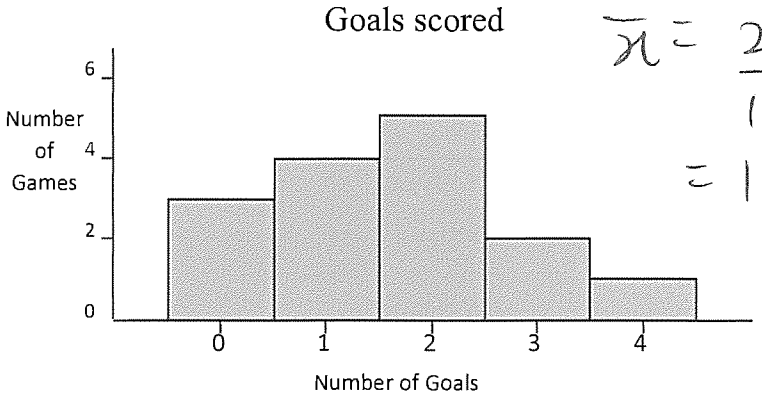
$= 1.6$

A) 1

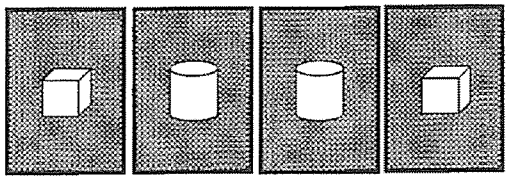
B) 1.6

C) 2

D) 2.6



18) There are 20 cards in a game of shape recognition for young children.
5 cards have a picture of a cube, 5 have cylinders, 5 have pyramids and 5 have cones.
Sally has been given the following four cards at random from the set of 20 and these cards are kept out on the table.



What is the probability that Sally's next (5th) card randomly drawn from the set, will give her "three of a kind"?

A) $\frac{2}{3}$

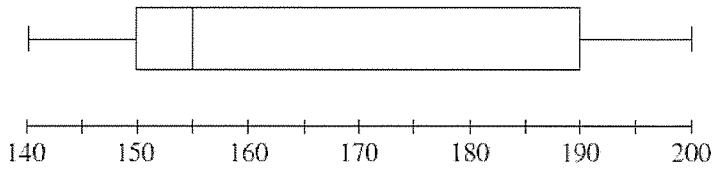
B) $\frac{4}{5}$

C) $\frac{1}{8}$

D) $\frac{3}{8}$

P(cube or cylinder)
$= \frac{3}{16} + \frac{3}{16}$
$= \frac{6}{16}$

19) A set of data is displayed in this box-and-whisker plot.



What is the interquartile range?

A) 40

B) 155

C) 190

D) 150

20) A bag contains red, green, yellow and blue balls.
The table shows the probability of choosing a red, green or blue ball from the bag.
If there are 12 yellow balls in the bag, how many balls are in the bag altogether?

Colour	*Probability*
Red	$\frac{1}{3}$
Green	$\frac{1}{4}$
Yellow	?
Blue	$\frac{1}{6}$

A) 16

B) 36

C) 48

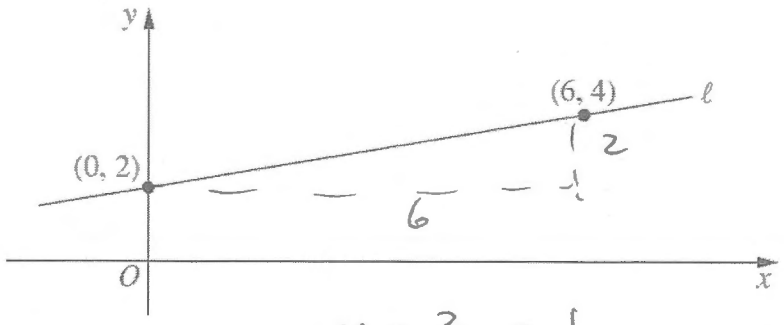
D) 60

P(yellow)
$= 1 - \frac{1}{3} - \frac{1}{4} - \frac{1}{6}$
$= \frac{1}{4}$
$\frac{1}{4} \times n = 12$
$n = 48$

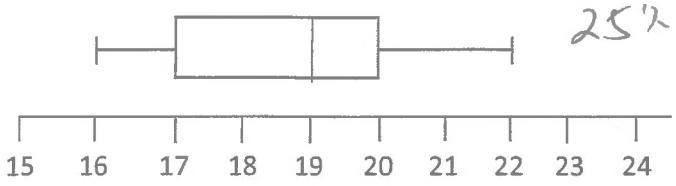
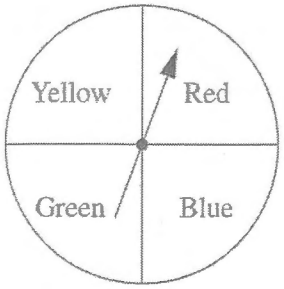
End of Multiple Choice questions.

Short Answer Questions **(15 marks)**

- **Write you answer in the space provided.**
- **All Questions are worth 1 mark.**

	Questions	Answers
1)	Evaluate $\log_2 \frac{1}{32}$. $\log_2 2^{-5}$	-5
2)	If the lines with equations $2x - 4y + 1 = 0$ and $y = 2mx$ are perpendicular, what is the value of m? $m = \frac{1}{2}$ $m_N = -2 = 2m$ $m = -1$	$m = -1$ students to revise gradients of parallel & ⊥ lines and the relationship
3)	Expand and simplify $(3\sqrt{7} - 2)^2$ $= 9 \times 7 - 12\sqrt{7} + 4$	$67 - 12\sqrt{7}$
4)	The stopping distance d (metres) for a vehicle travelling at a speed s (kilometres per hour) can also be given by the formula: $d = \frac{s}{10}\left(\frac{s}{20} + 2\right)$ $d = \frac{40}{10}\left(\frac{40}{20} + 2\right)$ Use this formula to calculate the stopping distance of a car travelling at $40km/h$ in a school zone.	16 m
5)	What is the equation of the line l ?  $m = \frac{2}{6} = \frac{1}{3}$	$y = \frac{1}{3}x + 2$

	Questions	Answers
6)	Solve $6x(x-3)=0$	$x = 0, 3$
7)	Solve $2^x = 7$. Give your answer to 1 decimal place. $\log_{10} 2^x = \log_{10} 7$ $x = \frac{\log_{10} 7}{\log_{10} 2}$	$x = 2.8$ (1dp)
8)	The Great Pyramid of Egypt has a square base of side 230 m. Its perpendicular height is 135 m. What is the volume of the pyramid? $V = \frac{1}{3}Ah$ $= \frac{1}{3}(230)^2 \times 135$	$V = 2,380,500 m^3$
9)	Find the value of x if: $\cos(30°) = \sin(x)$, where $0 < x < 90°$.	$x = 60$
10)	Solve $\tan\theta = -\frac{1}{\sqrt{3}}$ for $0 \leq \theta \leq 360°$ related angle $= 30°$	$\theta = 150°, 330°$ Most students missed the second angle. Revision needed.
11)	An astronomical unit (AU) is the mean distance from the centre of the Earth to the centre of the Sun. 1 AU = 149 597 870 km The dwarf planet Pluto is approximately 39.79 AU from the Sun. Express this distance in km. *Answer in scientific notation correct to 2 significant figures.* $39.79 \times 149\,597\,870$	6.0×10^9 km Revise

	Questions	Answers
12)	The following box-and-whisker plot shows the number of hours spent doing gardening by a group of 60 people. How many people gardened for more than 20 hours?  25% × 60	15
13)	Find the median from the table below. 17th score *Score* / *Frequency* 12 — 13 14 — 6 16 — 2 18 — 12 **Total** — 33	14
14)	A group of 12 students sat a Science exam. The marks obtained in the Science exam are as follows: *Science*: 42, 60, 74, 76, 58, 64, 80, 39, 78, 84, 53, 57 Calculate the standard deviation of the Science exam. (Answer correct to 2 decimal places)	14.22 (2dp)
15)	The arrow is spun and will point to one of the four colours when it stops. If the arrow is spun twice, what is the probability that it points to the same colour both times it stops?  $\frac{1}{4} \times \frac{1}{4} \times 4$	$\frac{1}{4}$ Most students got this wrong common wrong answer was $\frac{1}{16}$

Examination continues next page…

Extended Response Questions

Show all working where necessary.

Question 1 (19 marks)

a) Factorise fully $3y^4 - 12y^2$ **2**

$3y^2(y^2-4)$

$3y^2(y-2)(y+2)$

done well
some students left the answer as $3y^2(y^2-4)$

---

b)

i) By completing the square, show that $x^2 + y^2 + 6x - 4y - 12 = 0$ is equivalent to $(x+3)^2 + (y-2)^2 = 25$ **1**

$(x^2+6x+9) + (y^2-4y+4) = 12+4+9$

$(x+3)^2 + (y-2)^2 = 25$

done well

ii) State the centre and radius of the circle. **2**

Centre $(-3, 2)$ radius 5

done well

iii) State its domain. **1**

$-8 \leq x \leq 2$

need improvement

c) Solve for x: $\log_2(x-2)+\log_2 x = 3$ **3**

$\log_2 (x-2) \times x = 3$

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

$x^2 - 2x - 8 = 0$

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

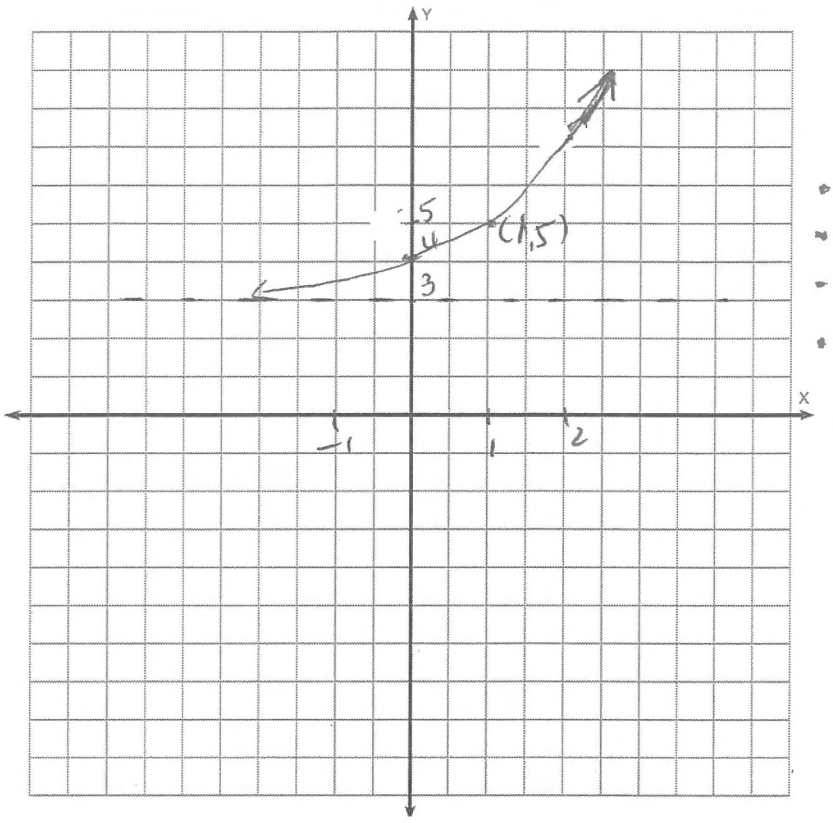
$x = -2, 4$

but $x > 2$ ⇒ Mostly not stated. ∴ lost 1 mark.

$\therefore x = 4$

Examination continues next page…

d) Sketch the curve $f(x) = 2^x + 3$ on the axes below. Show any important features. **2**



- shape
- asymptote
- intercept
- point

done well

e) State the domain and range of $y = \log_2(x - 3) + 5$ **2**

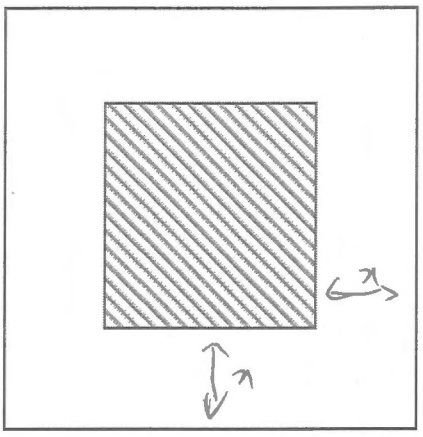
Domain $x > 3$

done well.

Range all real y

f) A rectangular photograph, $18cm$ long and $12cm$ wide, is surrounded by a frame of uniform width, whose area is equal to the area of the photograph.

i) If x is the width of the frame, show that the **area of the frame** can be represented by the expression: $(18 + 2x)(12 + 2x) - 216$. **1**



Not to scale

Area of photo $= 18 \times 12$
$= 216$

width of frame $= 12 + 2x$
length of frame $= 18 + 2x$

Area of frame
$= (12 + 2x)(18 + 2x) - 216$

done poorly.

ii) Hence, find the width of the frame. **2**

$(18 + 2x)(12 + 2x) - 216 = 216$

$216 + 36x + 24x + 4x^2 - 432 = 0$

$4x^2 + 60x - 216 = 0$

$x^2 + 15x - 54 = 0$

$(x - 3)(x + 18) = 0$

$x = 3, -18$

but $x > 0$

$\therefore x = 3$

very poorly done. did not read the question properly.

g) Consider the equation $P = \frac{125ka^t}{k+2a^t}$ where $t \geq 0$

Given $P = 400$, $k = 8$, $a = 1.2$, solve for t.

$$400 = \frac{125 \times 8 \times 1.2^t}{8 + 2 \times 1.2^t}$$

done well upto this step

$$400 = \frac{1000 \times 1.2^t}{8 + 2 \times 1.2^t}$$

$$4 = \frac{10 \times 1.2^t}{2(4 + 1.2^t)}$$

$$4 = \frac{5 \times 1.2^t}{4 + 1.2^t}$$

lot of ~~ade~~ algebraic mistakes

$$4(4 + 1.2^t) = 5 \times 1.2^t$$

$$16 + 4 \times 1.2^t = 5 \times 1.2^t$$

$$16 = 1.2^t$$

$$\log_{10} 16 = \log_{10} 1.2^t$$

$$t = \frac{\log_{10} 16}{\log_{10} 1.2}$$

or $t \doteq 15.2$ (1 dp)

Feedback.

Question 2 (18 marks)

a) If $f(x) = x^2 + 1$

i) Evaluate $f(-3)$ 1

$f(-3) = (-3)^2 + 1$

$= 10$ Well done.

ii) Find an expression for $\frac{f(x+h)-f(x)}{h}$ in simplest form. 3

$\frac{f(x+h) - f(x)}{h} = \frac{(x+h)^2 + 1 - (x^2+1)}{h}$

$= \frac{x^2 + 2xh + h^2 + 1 - x^2 - 1}{h}$ VERY poorly done!

$= \frac{2xh + h^2}{h}$ (1) Some students didn't substitute $f(x) = x^2+1$ in the question.

$= \frac{h(2x + h)}{h}$ (2) MANY students DID NOT EXPAND $(x+h)^2$ CORRECTLY! THIS WAS A BASIC MISQUOTED FORMULA!

$= 2x + h$

(3) Some students forgot there was a BRACKET $[-(x^2+1)]$ when substituting.

b) The quadratic function $y = 3x^2 + bx + c$ has a minimum value of -16 when $x = 3$. 2
Find values for b and c.

$x = \frac{-b}{2a}$ $3 = \frac{-b}{2(3)}$ VERY poorly done!

$\therefore b = -18$ People forgot the x co-ordinate of the turning point was $-\frac{b}{2a} = 3$

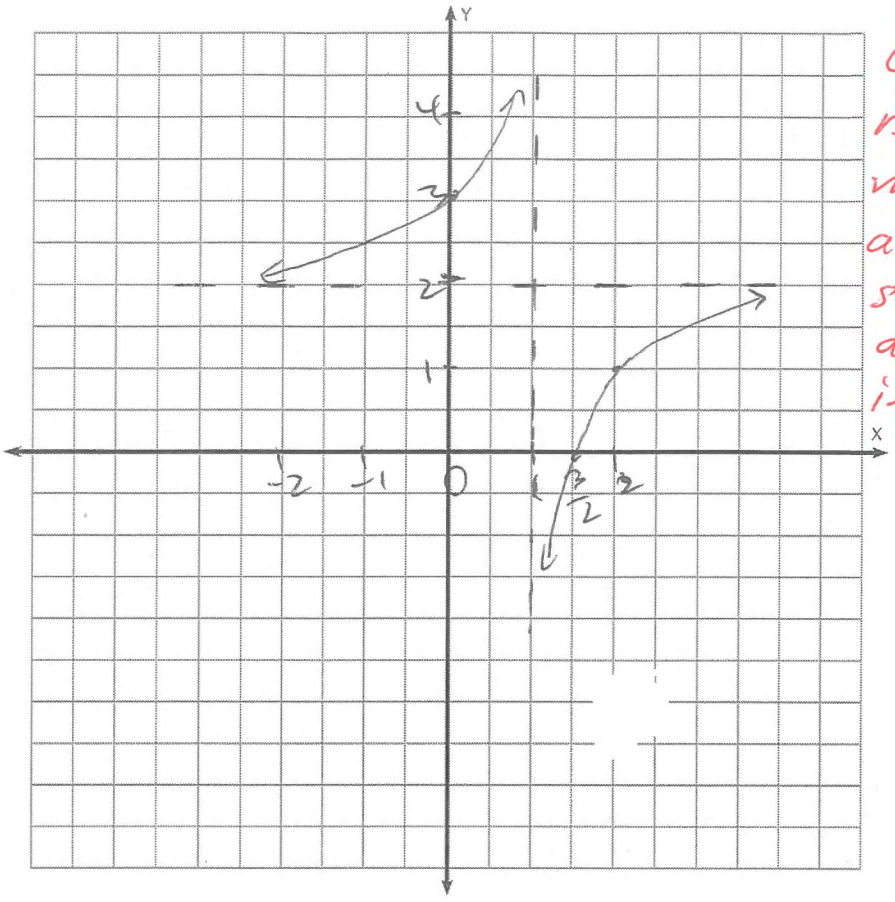
Subs $(3, -16)$ $-16 = 3(3)^2 - 18(3) + c$

$c = 11$ The few people who realised this got the whole answer.

Could also do $y = 3(x-3)^2 - 16$ & expand.
Students who did this got the correct answer.

c) Consider the function of $f(x) = 2 - \frac{1}{x-1}$

i) Sketch the function $f(x) = 2 - \frac{1}{x-1}$ on the axes below. Show all asymptotes and intercepts. **3**



Generally reasonably well done, although some students didn't label intercepts clearly.

ii) Find the inverse function of $f(x) = 2 - \frac{1}{x-1}$ **2**

$x = 2 - \frac{1}{y-1}$ ← Most students got to here,

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

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

$y = \frac{1}{2-x} + 1$

or $y = 1 - \frac{1}{x-2}$

but then many students made errors when making y the subject.

Examination continues next page…

d) Solve simultaneously, to find the points of intersection of $x^2 + y^2 = 5$ and $y = x + 1$. **3**

$x^2 + y^2 = 5$ (1)

$y = x + 1$ (2)

subs (2) into (1)

$x^2 + (x+1)^2 = 5$

$x^2 + x^2 + 2x + 1 = 5$

$2x^2 - 2x - 4 = 0$

$x^2 - x - 2 = 0$

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

$x = 2$ $\quad x = -1$

$y = 3$ $\quad y = 0$

$(2, 3)$ $\quad (-1, 0)$

Many students started correctly but then BASIC MISQUOTED FORMULAS were a problem: $(x+1)^2 = x^2 + 2x + 1$ NOT $x^2 + 1$. Also, some students didn't use the null factor law to solve for x.

---

e) Given $p = \log_a 4$ and $q = \log_a 5$, express each of the following logarithms in terms of p and q.

i) $\log_a 100$ **2**

$= \log_a (4 \times 5^2)$

$= \log_a 4 + \log_a 5^2$

$= \log_a 4 + 2\log_a 5$

$= p + 2q$

REALLY poorly done. Students' knowledge of logarithm laws was EXTREMELY poor.

ii) $\log_a 0.4$ **2**

$= \log_a \frac{2}{5}$

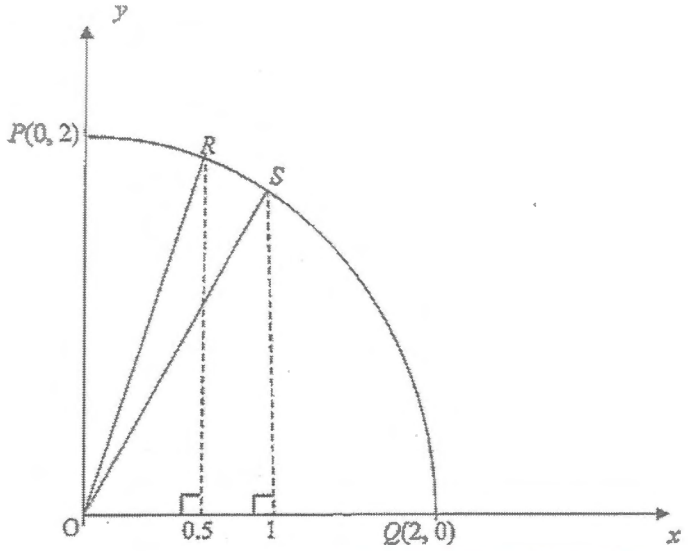
$= \log_a 4^{\frac{1}{2}} - \log_a 5$

$= \frac{1}{2}\log_a 4 - \log_a 5$

$= \frac{1}{2}p - q$

Question 3 (16 marks)

a) The diagram shows an arc PQ, part of the circumference of a circle (centre O), drawn on the co-ordinate axes.
The points R and S are also on the circumference of the circle, and have horizontal distances from the origin, as shown.



i) What is the length of OS? **1**

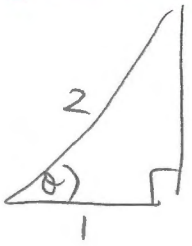
2

poorly done
radius is 2 (no need for pythagoras)

ii) Calculate the size of $\angle SOQ$. **1**

$\cos \angle SOQ = \frac{1}{2}$

$\angle SOQ = 60^\circ$



ok

iii) Show that the value of $\angle ROS = 15.5^o$ (1 decimal place) **2**

$\cos \angle ROQ = \frac{0.5}{2}$

$\angle ROQ = \cos^{-1}\left(\frac{1}{4}\right) = 75.5^\circ$

$\angle ROS = 75.5 - 60.$

$= 15.5^\circ$

* poorly done

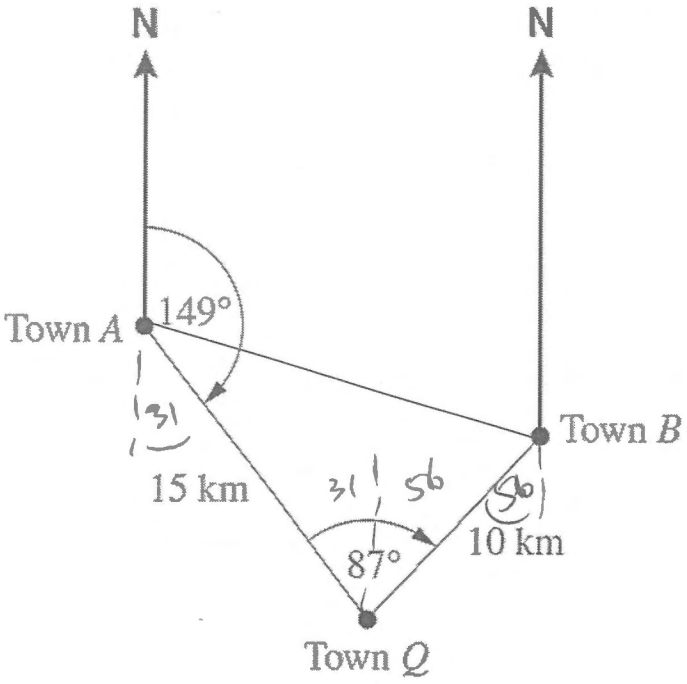
iv) Calculate the arc length (to 2 decimal places) between R and S. **1**

arc length $RS = \frac{15.5}{360} \times 2\pi \times 2$

$= 0.54$ (2 dp)

* Some students used the cosine rule but RS is an arc, not a straight line.

b) The diagram shows information about the locations of towns A, B and Q.



NOT TO SCALE

i) Amy walks to Town B from Town A and then to Town Q. **2**
Find the distance from Town A to Town B. Give your answer to the nearest km.

$AB = \sqrt{15^2 + 10^2 - 2.15.10 \cos 87}$

$= 17.5869..$

$AB = 18$ km (nearest km)

Generally well done.

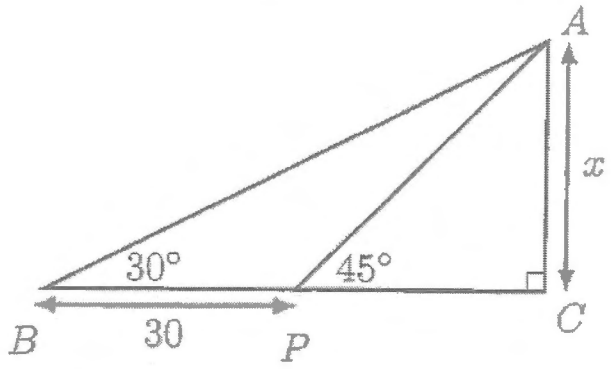
ii) Calculate the bearing of Town Q from Town B. **1**

$180 + 56 = 236°$ T

* Many used trigonometry instead of geometry, however a number of errors were made and the correct bearing was not obtained.

Examination continues next page…

c) Ayana finds that the angle of elevation of the top of a pole A,from B is 30^o, but when she walks 30 metres towards a point P, the angle of elevation is 45^o.



i) Show that $AP = \dfrac{30 \sin 30^o}{\sin 15^o}$ **2**

many did not justify 15°.

$\angle BAP = 45 - 30 = 15°$ (exterior angle of a triangle)

In $\triangle BPA$

$$\frac{AP}{\sin 30} = \frac{30}{\sin 15}$$

$$AP = \frac{30 \times \sin 30}{\sin 15}$$

Ensure you show all working for 'show that' questions.

ii) Hence, calculate the height of the pole correct to the nearest metre. **2**

In $\triangle PAC$

$$\sin 45 = \frac{x}{AP}$$

$$= \frac{x}{\frac{30 \sin 30}{\sin 15}}$$

$$x = \frac{30 \sin 45 \times \sin 30}{\sin 15}$$

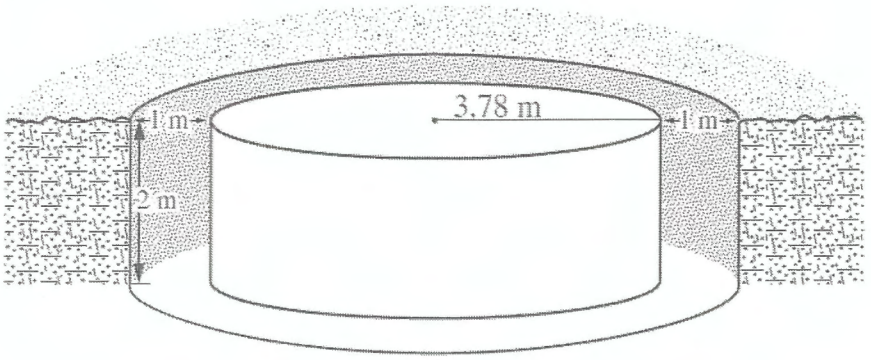
$x = 40.98\ldots$

$x = 41$ m

Generally well done.

d) A cylindrical water tank, of height 2 m, is placed in the ground at a school.

The radius of the tank is 3.78 metres. The hole is 2 metres deep. When the tank is placed in the hole there is a gap of 1 metre all the way around the side of the tank.



NOT TO SCALE

i) When digging the hole for the water tank, what volume of soil was removed? **2**
Give your answer to the nearest cubic metre.

$V = \pi r^2 h$
$= \pi \times 4.78^2 \times 2$
$= 143.56...$
$= 144 m^3$

* many students found the amount of 'soil' around the tank.

* quite a few students did not use the correct formula
* many used incorrect radius

ii) Water is to be collected in the tank from the roof of the school hall, which has an area of $400m^2$. During a storm, 20mm of rain falls on the roof and is collected in the tank. How many litres of water were collected? **2**

$V = 400 \times 0.02$ (Using $V = Ah$)
$V = 8 m^3$
$V = 8000 L$

* poorly done overall.
* many did not know they had to use $V = Ah$.
* many did not convert 20mm = 0.02m correctly
* poor conversions to litres.

Examination continues next page…

Question 4 (19 marks)

a) A new test has been developed for determining whether or not people are carriers of the Noether virus.

Two hundred people are tested. A two-way table is being used to record the results.

	Positive	*Negative*
Carrier	74	12
Not a carrier	16	*A*

i) What is the value of A? **1**

$200 - (74 + 16 + 12) = 98$

Well done.

ii) A person selected from the tested group is a carrier of the virus. What is the **probability** that the test results would show this? **1**

$$\frac{74}{74+12}$$

$$= \frac{37}{43}$$

Some students had trouble with this question.

iii) For **how many** of the people tested were their test results inaccurate? **1**

$12 + 16 = 28$

Some didn't read the question carefully and gave given the answer in fraction form

Examination continues next page…

b) Jason travels to work by car on all five days of this working week, leaving home at 7am each day. He compares his travel times using roads without tolls and roads with tolls over a period of 12 working weeks.

He records his travel times (in minutes) in a back to back stem and leaf plot.

Travel time (minutes)

Without tolls		*With tolls*
9	3	5 8 9 9
9 9 8 7 7 6 5 5 4 4 3 2 0	4	0 1 2 6 7 7 8 8 8 9
9 8 7 5 4 3 3 3 2 2 2 2 1 1 0	5	2 4 4 5 6 8 9
1	6	1 3 5 7
	7	0 2 8
	8	2
	9	0

i) What is the modal travel time when he uses roads without tolls? **1**

52 mins

Done well.

ii) What is the median travel time with he uses roads without tolls? **1**

$\frac{30+1}{2}$ = 15th 16th scores

$\frac{50+51}{2}$ = 50.5

Some had trouble with this question.

iii) Describe the **shape/skewness** of **each** distribution: 'Without tolls' and 'Tolls'. **2**

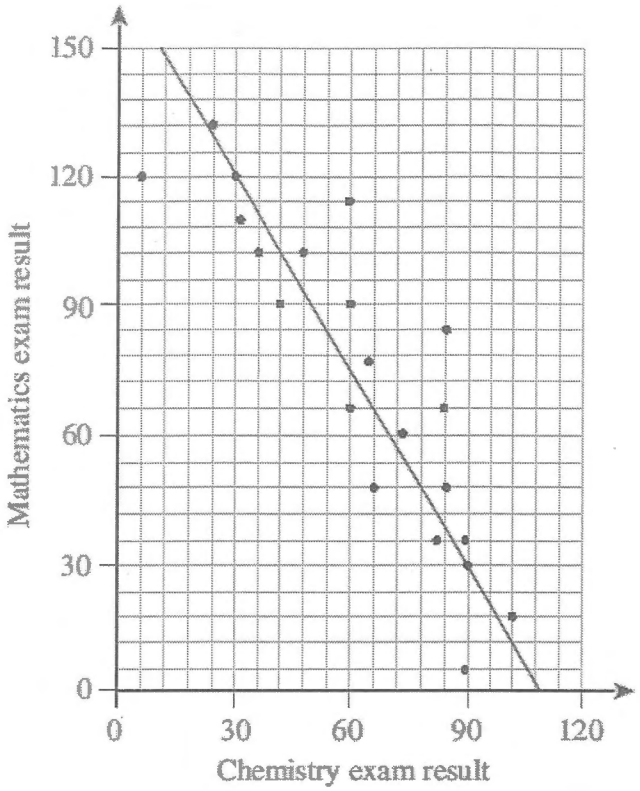
'without tolls' is symmetrical

'with tolls' is positively skewed.

Some students didn't write 'symmetrical' for 'without tolls'

Examination continues next page…

c) The Mathematics and Chemistry exam results for a group of students are recorded in the scatterplot. A line of best fit was drawn as shown.



i) Calculate the gradient of the line of best fit. **1**

(90, 30) (30, 120)

$M = \frac{120 - 30}{30 - 90} = \frac{90}{-60} = -\frac{3}{2}$

Mostly done well.

ii) Describe the strength and direction of the correlation between the Mathematics and Chemistry exam results using the words below: *(Circle your answer)* **2**

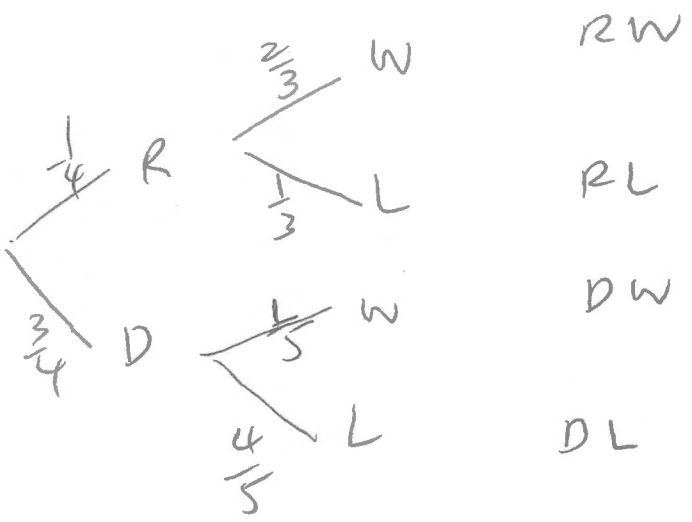
α) strong or weak

β) positive or negative

Mostly done well.

d) The coach of a football team notices that the team has a probability of $\frac{2}{3}$ of winning if it is rainy (R) and if the weather is dry (D), the probability of the team winning is $\frac{1}{5}$. The probability of rainy weather is $\frac{1}{4}$.

i) Draw a probability tree diagram of this scenario and list the outcomes. **2**



Mostly done well. Some didn't list the outcomes.

ii) Find the probability that the team will win. **2**

$$P(RW \text{ or } DW) = \frac{1}{4} \times \frac{2}{3} + \frac{3}{4} \times \frac{1}{5}$$

$$= \frac{19}{60}$$

A few students had trouble with this question.

iii) Given that the team has won a game, calculate the probability that it rained on the day of the match. **2**

$$P(R|W) = \frac{P(R \cap W)}{P(W)}$$

$$= \frac{\frac{1}{4} \times \frac{2}{3}}{\frac{19}{60}} = \frac{10}{19}$$

Some had trouble with this question.

e) A bag has x discs of the same size, of which 6 are blue and the rest are white.
Two discs are randomly selected from the bag, **without replacement**.

i) Find the probability (in terms of x), of choosing two white discs. **1**

(You may draw a tree diagram to help you)

$$P(WW) = \frac{x-6}{x} \times \frac{x-6-1}{x-1}$$

$$= \frac{(x-6)(x-7)}{x(x-1)}$$

Some students couldn't find the probability.

ii) Show that the probability of selecting at least one blue disc can be given by: $\frac{6(2x-7)}{x^2-x}$ **2**

$$P(\text{at least one Blue}) = 1 - P(WW)$$

$$= 1 - \frac{(x-6)(x-7)}{x(x-1)}$$

$$= \frac{x(x-1) - (x-6)(x-7)}{x(x-1)}$$

$$= \frac{x^2 - x - (x^2 - 13x + 42)}{x(x-1)}$$

$$= \frac{x^2 - x - x^2 + 13x - 42}{x(x-1)}$$

$$= \frac{12x - 42}{x(x-1)} = \frac{6(2x-7)}{x^2-x}$$

Some students had trouble with this question. Some got the concepts. Since they calculated the probability incorrectly they couldn't show the answer.

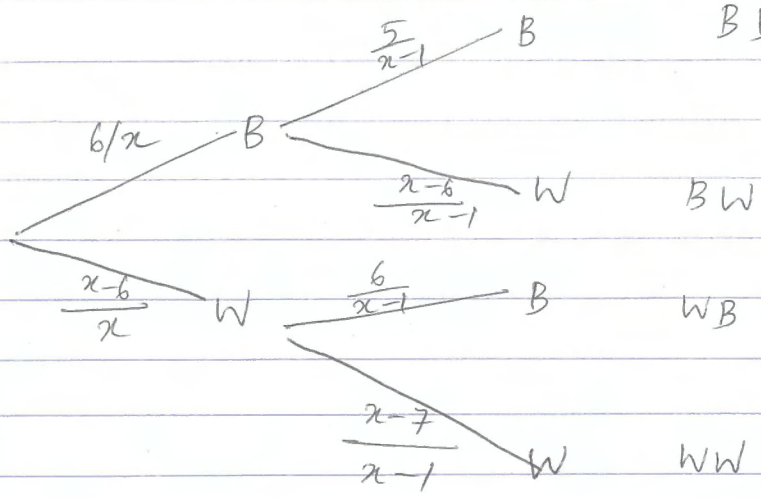
See alternate solution next page

End of examination.

Alternate Solution

(e)

(ii)



$$P(\text{at least 1 Blue}) = P(BB) + P(BW) + P(WB)$$

$$= \frac{6}{x} \times \frac{5}{x-1} + \frac{6}{x} \times \frac{x-6}{x-1} + \frac{x-6}{x} \times \frac{6}{x-1}$$

$$= \frac{30 + (6x-36) + (6x-36)}{x(x-1)}$$

$$= \frac{30 + 12x - 72}{x(x-1)}$$

$$= \frac{12x - 42}{x(x-1)}$$

$$= \frac{6(2x-7)}{x(x-1)}$$

$$= \frac{6(2x-7)}{x^2 - x}$$