Calculator Model :	

ORCHID PARK SECONDARY SCHOOL
Preliminary Examination 2024

CANDIDATE NAME			
CLASS		INDEX NUMBER	

MATHEMATICS **4052/01**

Paper 1 **15 August 2024**

Secondary 4 Express / 5 Normal (Academic) **2 hours 15 minutes**

Setter: Mr Wong Yiu Hang **90 Marks**

Additional Materials: NIL

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.
Write in dark blue or black pen.
Use a pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions.

If working is needed for any question it must be shown in the space below the question. Omission of essential working will result in loss of marks.
The use of an approved scientific calculator is expected, where appropriate.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

The number of marks is given in brackets [ ] at the end of each question or part question.

The total number of marks for this paper is **90**.

For Examiner's Use	
Total	

Mathematical Formulae

Compound interest

$$\text{Total amount} = P\left(1+\frac{r}{100}\right)^n$$

Mensuration

Curved surface area of a cone = πrl

Surface area of a sphere = $4\pi r^2$

$$\text{Volume of a cone} = \frac{1}{3}\pi r^2 h$$

$$\text{Volume of a sphere} = \frac{4}{3}\pi r^3$$

$$\text{Area of triangle } ABC = \frac{1}{2}ab\sin C$$

Arc length = $r\theta$, where θ is in radians

$$\text{Sector area} = \frac{1}{2}r^2\theta, \text{ where } \theta \text{ is in radians}$$

Trigonometry

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc\cos A$$

Statistics

$$\text{Mean} = \frac{\sum fx}{\sum f}$$

$$\text{Standard deviation} = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2}$$

Answer **all** the questions

1 **(a)** The approximate mass of the earth is 5.976×10^{24} kg. How many times is the earth heavier than an average male adult who weighs 75 kg?

Give your answer in standard form correct to 3 significant figures.

Answer: ..... [1]

(b) The sum of 3 consecutive even numbers is estimated to be 300 when rounded off to 1 significant figure. Find the largest possible set of the 3 numbers,

Answer: ..... , ... , ... [1]

2 **(a)** Solve the inequality $2y - 1 < \frac{11y}{4} < \frac{1}{4}$

Answer: ..... [2]

(b) Given $-25 \leq x \leq 50$ and $-15 \leq y \leq -5$, what is the smallest possible value for $x + y^2$?

Answer: ..... [1]

3 **(a)** Write 756 as a product of its prime factors.

Answer: ..... [1]

(b) Given that $495 = 3^2 \times 5 \times 11$, find the smallest positive integer p such that $756p$ is a multiple of 495.

Answer: ..... [1]

(c) The number $756 \times \frac{a}{b}$ is a perfect cube where a and b are both prime numbers.

Find the smallest possible value of a and smallest possible value of b.

Answer: a = ... , b = ... [2]

4 Simplify $\frac{a^2-3a+2}{9a^2-1} \div \frac{2a-2}{6a-2}$.

Answer: ..... [2]

5 **(a)** Simplify $\frac{(2x^3y^2)^{-4}}{(10x^{-2}y^3)^2} \div \sqrt[3]{27x^{-3}y^6}$.

Answer: ..... [3]

(b) Solve $3^{x+2} \times 3(3^5) = 1$.

Answer: ..... [2]

6 **(a)** Factorise $a^3 - 2a^2b - 4a + 8b$.

Answer: ..... [2]

(b) Solve $\frac{3x+2}{9x} = \frac{1}{7x-3}$.

Answer: ..... [3]

7 Peter has $20 000 to invest in either Bank A, Bank B or Bank C for 5 years. The table below shows the investment plans.

Bank	Interest rate per annum
A	3.0 % compound interest, compounded annually
B	3.2 % simple interest annually
C	Fixed interest of $3000 after 5 years

Which plan should he invest in? Explain your answer.

.....

.....

..... [3]

8 A carton contains 17 good apples and 3 rotten apples. A fruit seller picks three apples in random from the carton and puts them into a smaller box for sale.

(a) Find the probability that there is at least 1 rotten apple in the box for sale.

Answer: ..... [2]

(b) When Student A is asked to find the probability that the box contains two good apples and one rotten apple, he claims that the answer is $\frac{17}{20} \times \frac{16}{19} \times \frac{3}{18}$.

Do you agree with the Student A's claim? Explain your answer.

.....

.....

.....

..... [2]

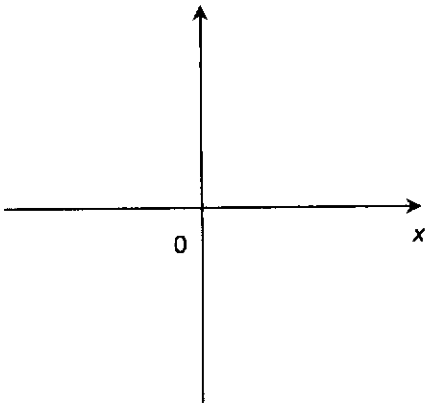
9 A set of Pollutant Standards Index (PSI) taken from different parts of Singapore is as follows.

28 30 48 19 70 50 32 72

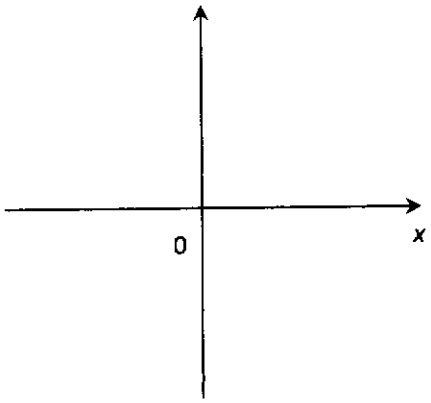
Represent the data using a box-and-whisker plot. [3]

10 Sketch the graph in the spaces below.

(a) $y = \frac{4}{x}$ [1]



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



(c) Hence, state the number of solutions for the equation $\frac{4}{x} + 2x^3 = 0$

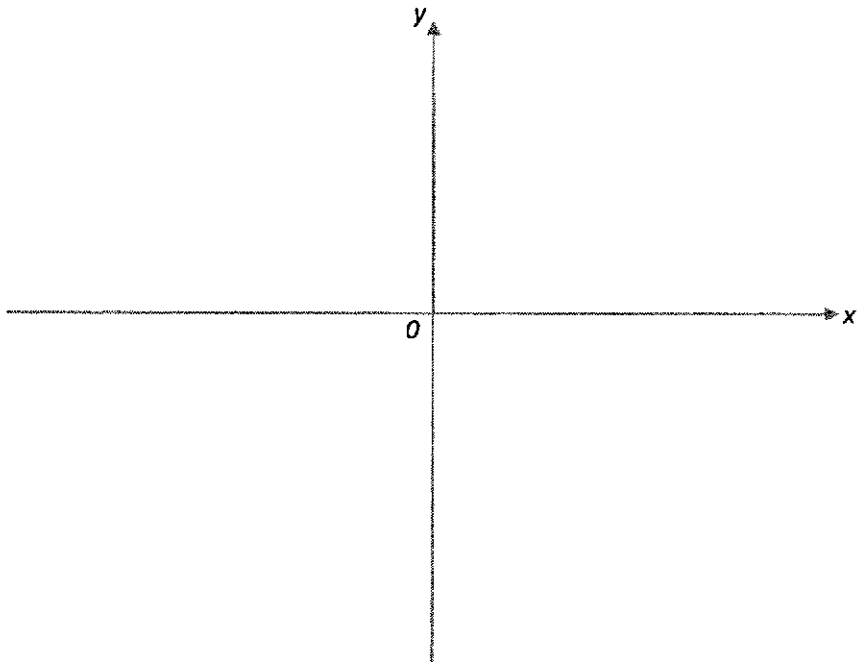
Answer: ..... [1]

11 **(a)** Express $y = -(x + 2)(x - 5)$ in the form of $y = -(x + p)^2 + k$.

State the value of p and the value of k.

Answer: p = ... k = ... [3]

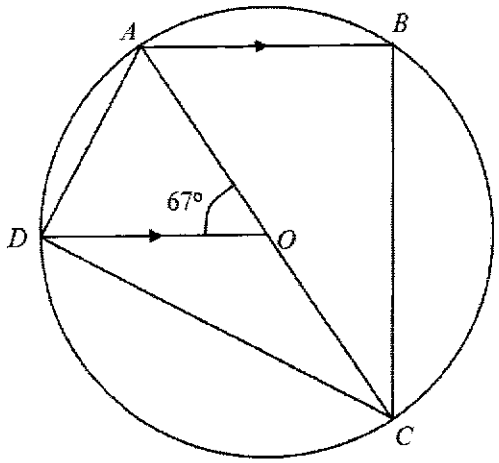
(b) Sketch the graph of $y = -(x + 2)(x - 5)$ in the given axes below. Indicate any intercepts on the axes. [3]



(c) Find the coordinates of the turning point of the graph $y = -(x + 2)(x - 5)$.

Answer: (..... , ...) [1]

12 **(a)** In the diagram, A, B, C and D are points on the circumference of a circle with centre O. AB is parallel to DO and angle $AOD = 67°$. AOC is the diameter of the circle.



Find angle BCD.

Give a reason for each step of your working.

Answer: ..... [3]

(b) Explain why angle DAB is 123.5°.

.....

..... [1]

(c) Find angle *DBC*.
Give a reason for each step of your working.

Answer: ..... [2]

13 It is given that $\sqrt{3p^3 + 6r^2} = \frac{5r}{2}$.

Make r the subject of the equation.

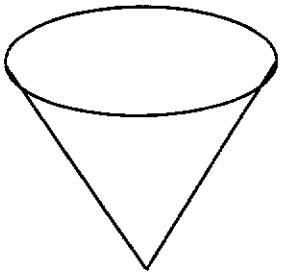
Answer: ..... [3]

14 The base areas of two geometrically similar cones are in the ratio of 9 : 49.

(a) If the volume of the bigger cone is 1200 cm^3, find the volume of the smaller cone.

Answer: ..... cm^3 [2]

(b) 80% of the smaller cone was filled with water. Find the height of water in the smaller cone given that the radius is 3 cm.



Answer: ..... cm [2]

15 The illumination, I units, of a bulb varies inversely as the square of the distance, d metres. It is given that the illumination is 8 units when the distance is 3 m.

(a) Find an equation connecting I and d.

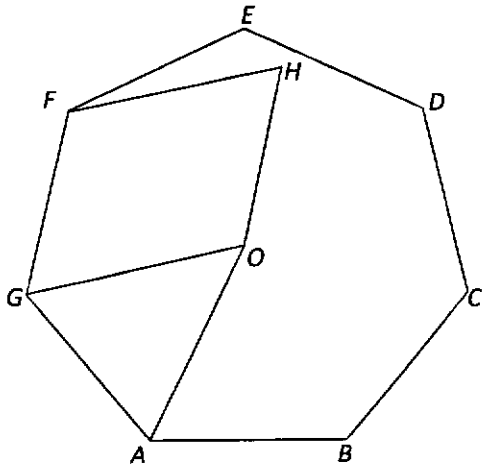
Answer: ..... [2]

(b) Find the percentage change in the illumination of the bulb when the bulb is shifted to a new location which is one quarter of the original distance.

Answer: ..... [2]

16 **(a)** The figure is made up of a 7-sided regular polygon with centre O, a triangle OAG and a parallelogram $OHFG$, where GF is parallel to OH and GO is parallel to FH.

(i) Find angle OGF.



Answer: ..... [2]

(ii) Find angle EFH.

Answer: ..... [2]

(b) Three of the exterior angles of an n-sided polygon are 18°, 22° and 32°, four of its interior angles are 163° each, and each of the remaining interior angles is 160°. Find the value of n.

Answer: ..... [2]

17 It is given that

ξ = {x: x is polygon},
p = {x: x is a parallelogram},
q = {x: x is a quadrilateral}.
r = {x: x is a rectangle} and
s = {x: x is a square}.

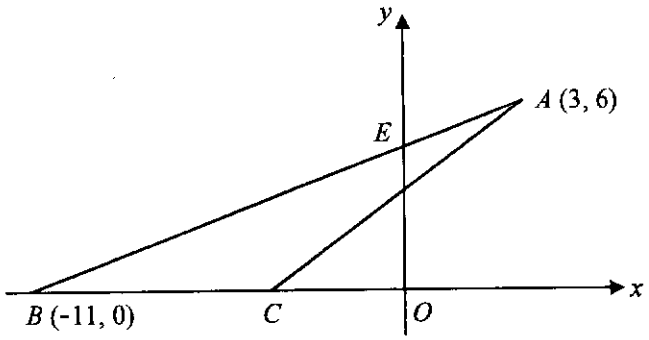
(a) Draw a clearly labelled Venn diagram in the space below to show the relationship between sets ξ, p, q, r and s. [3]

(b) Label in the Venn diagram above, the element "kite". [1]

18 **Solutions to this question by accurate drawing will not be accepted.**

The diagram below shows a triangle ABC, with $A(3, 6)$ and $B(-11, 0)$.

Triangle ABC has an area of 22.5 units^2. E is a point on the line AB passing through the y-axis.



(a) Find the length AB.

Answer: ..... [2]

(b) Find the equation of the line AB.

Answer: ..... [2]

(c) State the coordinates of E.

Answer: (..... , ...) [1]

(d) Find the coordinates of C.

Answer: (..... , ...) [2]

(e) Given that $ABDC$ is a parallelogram, find the coordinates of D.

Answer: (..... , ...) [1]

(f) The line l has equation $7y - 3x + 15 = 0$.

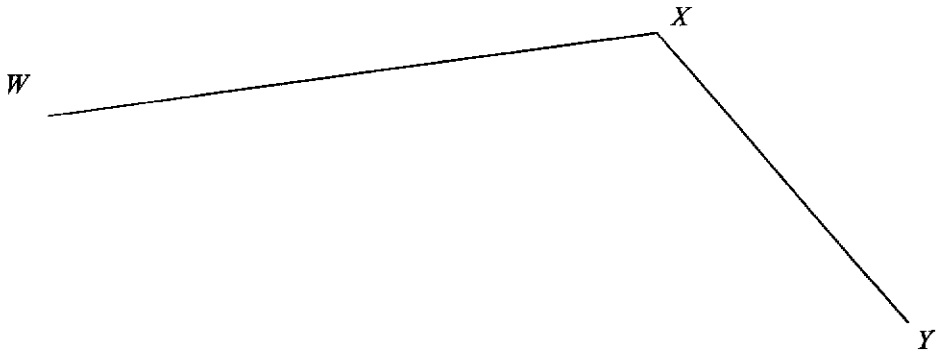
Explain whether line l will ever cut the line AB when both lines are extended. Show your workings clearly.

.....

.....

..... [2]

19 In a scale drawing, Town *W, X and Y* are shown below. Town *Z* is 10 cm from Town *W* and 8 cm from Town *Y*.



(a) **(i)** On the diagram, construct the quadrilateral *WXYZ*. [2]

(ii) Measure angle WZY.

Answer: ..... [1]

(b) On the diagram, using compass, construct

(i) the perpendicular bisector of *XY*. [1]

(ii) the angle bisector of angle *WXY*. [1]

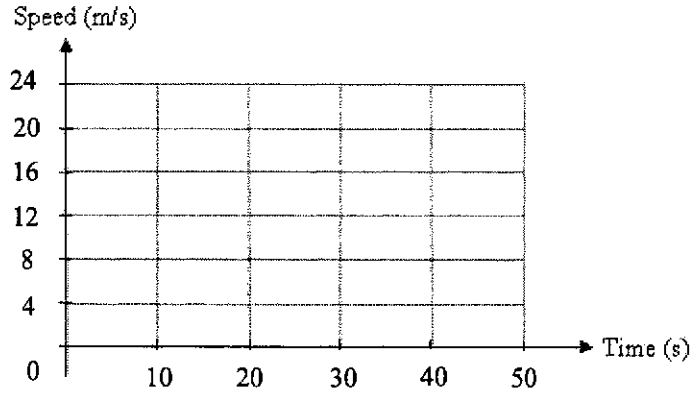
(c) Mark claimed that it is possible to locate Town *G* which is equidistant from Points *W, X* and Y, and angle *WXG* = angle *YXG*. Explain whether Mark's claim is valid. Show your workings clearly.

.....

..... [2]

20 Mr Tan rides his motorcycle to a coffee shop for breakfast.
He starts from rest and accelerates at a constant rate to a speed of 20 m/s in 15 seconds.
He then travels at this constant speed of 20 m/s for the next 20 seconds before coming to rest in the next 10 seconds.

(a) On the given axes below, sketch Mr Tan's speed-time graph. [2]



(b) **(i)** Find the acceleration in the first 15 seconds.

Answer: ..... m/s^2 [1]

(ii) Calculate the average speed for the whole journey.

Answer: ..... m [2]

--- END OF PAPER 1 ---

Calculator Model :

ORCHID PARK SECONDARY SCHOOL

Preliminary Examination 2024

CANDIDATE NAME

CLASS | | | | INDEX NUMBER | | |

MATHEMATICS **4052/02**

Paper 2 **19 August 2024**

Secondary 4 Express / 5 Normal (Academic) **2 hours 15 minutes**

Setter: Mrs. Jay **90 Marks**

Additional materials: NIL

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.
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Do not use staples, paper clips, glue or correction fluid.

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The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 90.

For Examiner's Use	
Total	

This document consists of 23 printed pages.

[Turn Over

Mathematical Formulae

Compound interest

Total amount = $P\left(1+\frac{r}{100}\right)^n$

Mensuration

Curved surface area of a cone = πrl

Surface area of a sphere = $4\pi r^2$

Volume of a cone = $\frac{1}{3}\pi r^2 h$

Volume of a sphere = $\frac{4}{3}\pi r^3$

Area of triangle ABC = $\frac{1}{2}ab\sin C$

Arc length = $r\theta$, where θ is in radians

Sector area = $\frac{1}{2}r^2\theta$, where θ is in radians

Trigonometry

$$\frac{a}{\sin A}=\frac{b}{\sin B}=\frac{c}{\sin C}$$

$$a^2=b^2+c^2-2bc\cos A$$

Statistics

Mean = $\frac{\sum fx}{\sum f}$

Standard deviation = $\sqrt{\frac{\sum fx^2}{\sum f}-\left(\frac{\sum fx}{\sum f}\right)^2}$

Answer **all** the questions.

1 **(a)** **(i)** Express $2x^2 - 6x - 12$ in the form $k(x-a)^2 - b$, where k is an integer.

Answer: ..... [1]

(ii) Hence, solve $2x^2 - 6x - 12 = 0$.

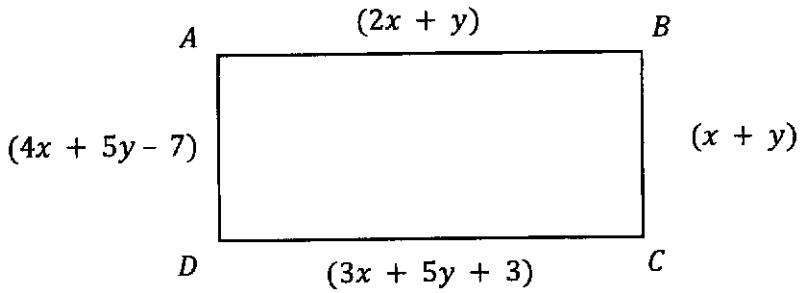
Answer: x = ... or ..... [2]

(b) Simplify $\frac{3x+1}{2x^2+11x+12} - \frac{1}{x+4}$.

Answer: ..... [3]

2 In the diagram, $ABCD$ is a rectangle. Given that $AB = (2x + y)$ cm, $BC = (x + y)$ cm, $CD = (3x + 5y + 3)$ cm and $AD = (4x + 5y - 7)$ cm.

Find the values of x and y.



Answer: $x =$ ..... $y =$ ..... [3]

3 **(a)** By using factorisation, solve $(x-3)(2x+8) = -12$.

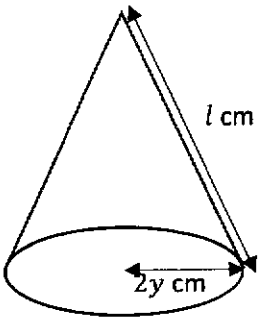
Answer: $x =$ ..... [3]

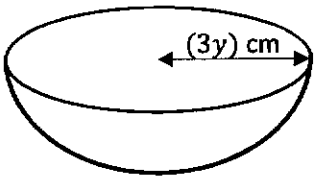
(b) Solve the equation $\frac{4}{2x-3} - \frac{3}{x+2} = 1$.

Give your solutions correct to two decimal places.

Answer: $x =$ ..... [3]

4 The diagrams below show a solid hemisphere and a solid cone. The hemisphere has a radius of $3y$ cm. The cone has a radius of $2y$ cm and slanted height l cm.





(a) Show that the total surface area of the solid cone is $2\pi y(l + 2y)$ cm^2. [2]

(b) The total surface area of the solid hemisphere is equal to the total surface area of the solid cone. Find l in terms of y.

Answer: ..... [3]

(c) The volume of the hemisphere is 729 cm^3. Calculate the volume of the cone.

Answer: ..... cm^3 [4]

5 The scale of a map is 2 cm : 1 km.

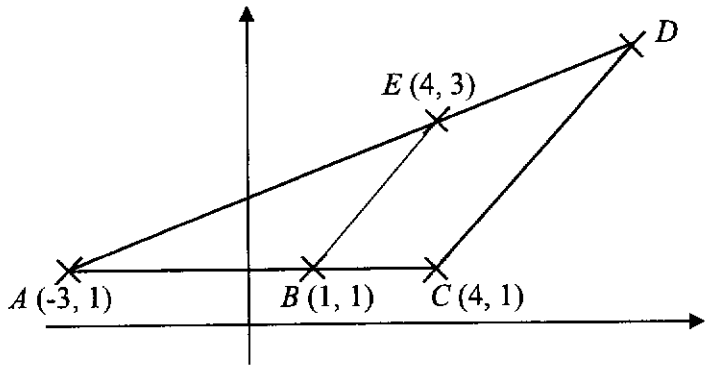
(a) Write this scale in the form 1 : n .

Answer: ..... [1]

(b) The area of a park is represented by an area of 456 cm^2 on the map. Calculate the actual area of the land in square kilometres.

Answer: ..... [2]

6 The points A, B, C, D and E are shown in the diagram below such that ABC and AED are straight lines and BE = $\sqrt{8}$ cm.



(a) Without using a calculator, find

(i) sin *ABE*.

Answer: ..... [1]

(ii) cos *ABE*

Answer: ..... [1]

(b) Using your answer in **(a)(i)**, calculate the area of triangle *ABE*

Answer: ..... [2]

(c) Given that triangle *ABE* and triangle *ACD* are similar, calculate the area of triangle *ACD*.

Answer: ..... [2]

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7 **(a)** Complete the table of values for $y = x - \frac{4}{x^2}$.

Values are given to one decimal place where appropriate.

x	−15	−10	−5	−1	1	5	10	15
y	−15.0		−5.2	−5	−3	4.8	10.0	15.0

[1]

(b) On the grid on page 11, draw the graph of $y = x - \frac{4}{x^2}$ for $-15 \leq x \leq 15$.

The graph has an asymptote at $x = 0$ (the graph goes near but do not cut through the y-axis). [3]

(c) **(i)** On the same grid, draw the graph of $2y - 2x = -7$ for $-15 \leq x \leq 15$. [2]

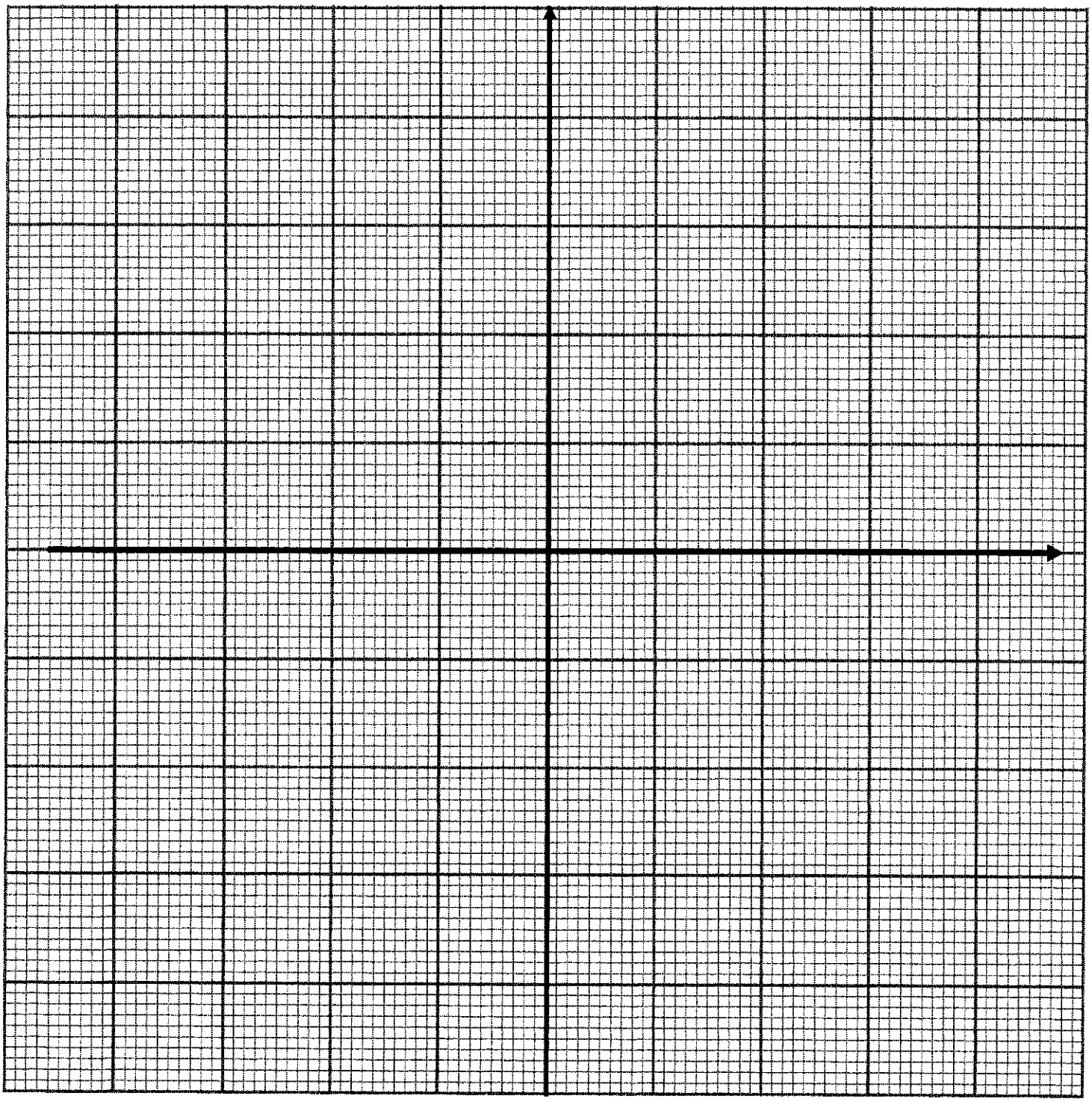
(ii) Write down the x-coordinates of the points where the line intersects the curve.

Answer: $x =$ ..... or ..... [1]

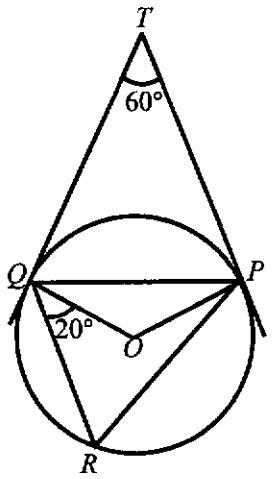
(iii) These values of x in part (ii) are the solutions of the equation $Ax^2 + B = 0$.

Find the value of A and the value of B.

Answer: $A =$ ..... $B =$ ..... [1]



8 P, R and Q are points on the circle with centre, O.
PT and QT are tangents to the circle at P and Q respectively.
$\angle PTQ = 60°$ and $\angle OQR = 20°$.



Writing your reasons clearly, find

(a) $\angle TQP$,

Answer: $\angle TQP =$ ..... ° [2]

(b) $\angle PRQ$,

Answer: $\angle PRQ =$ ..... ° [1]

(c) $\angle OPR$,

Answer: $\angle OPR =$ ..... ° [1]

(d) If the radius of the circle is 5 cm, find the area of the major segment QRP of the circle.

Answer: ..... cm^2 [3]

9 $ABCD$ is a parallelogram. A is the point $(-6, -2)$ and B is the point $(-4, -7)$.
$\overrightarrow{BC} = \begin{pmatrix} 8 \\ -2 \end{pmatrix}$.

(a) Find the length of the line AB.

Answer: ..... units [2]

(b) Find the equation of the line CD.

Answer: ..... [3]

(c) X is the point where the diagonals of the parallelogram intersect.

(i) Find $\overrightarrow{XC}$.

Answer: $\overrightarrow{XC}$ = (.....) [2]

(ii) Find the position vector of X.

Answer: ..... [2]

(d) P is the point on BC such that $\frac{BP}{PC} = \frac{2}{1}$.

Find the ratio of the area of $\frac{\Delta ABP}{\Delta ACP}$.

Answer: ..... [1]

10 The table below summarises the times taken by female participants to complete a 10 km race.

Time (t min)	$30 \leq t < 40$	$40 \leq t < 50$	$50 \leq t < 60$	$60 \leq t < 70$	$70 \leq t < 80$
Freq	20	39	16	20	x

(a) Given that the estimated mean time is 50.1 min, show that the value of x is 5. [2]

(b) Calculate an estimate of the standard deviation.

Answer: ..... min [1]

(c) The mean time for male participants to complete the race was 45.3 min and the standard deviation was 12.6 min. Make 2 comparisons between the times for male and female participants.

.....

.....

.....

.....

..... [2]

11 The first four terms in a sequence of numbers are given below.

$T_1 = 3^2 + 5 = 14$

$T_2 = 4^2 + 8 = 24$

$T_3 = 5^2 + 11 = 36$

$T_4 = 6^2 + 14 = 50$

(a) Find T_5.

Answer: ..... [1]

(b) Explain why the value of T_n must be even for all values of n.

.....

.....

..... [1]

(c) Show that the nth term of the sequence, T_n, is given by $n^2 + 7n + 6$. [2]

(d) T_p and T_{p+1} are consecutive terms in the sequence. Find and simplify an expression, in terms of p for $T_{p+1} - T_p$.

Answer: ..... [2]

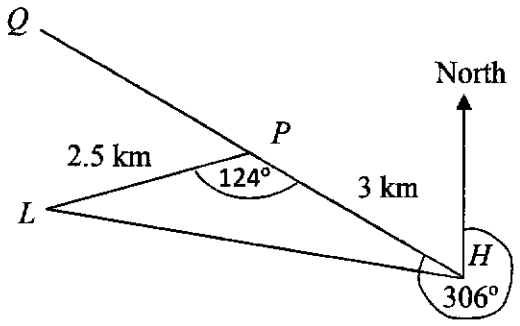
(e) Explain why two consecutive terms of the sequence cannot have a difference of 4.

.....

.....

..... [2]

12 The diagram shows the positions of a harbour, H, a lighthouse, L, and two buoys P and Q. HPQ is a straight line. The bearing of P from H is 306°. $HP = 3$ km, $PL = 2.5$ km and angle $HPL = 124°$.



(a) Find the bearing of

(i) H from P,

Answer: ..... [2]

(ii) L from P.

Answer: ..... [1]

(b) A helicopter is 500 m vertically above P. Find the angle of elevation from L to the helicopter.

Answer: ..... [1]

(c) Calculate HL.

Answer: ..... [2]

(d) A ship sailed from the harbour along the line HPQ at an average speed of 4.5 m/s. At 0809 hours, it reached a point X which is nearest to the lighthouse.

Find the time it left the harbour. Correct your answer to the nearest minute.

Answer: ..... [3]

13 In a shooting game, the player has to shoot with a gun to capture a monster. The bullet from the gun has to land on a circular target on the monster so that a net will open up. The circular target has four different sizes.

Target 1 is a big circle;

Target 2 is three quarters of the area of Target 1;

Target 3 is half of the area of Target 1;

Target 4 is one quarter of the area of Target 1.

(a) Sam estimates that the probability that he hits Target 1 is about 0.88. Given that the probability of hitting the circular target is proportional to its area, show that the probability that Sam hits Target 2 and Target 4 is estimated to be 0.66 and 0.44 respectively.

Answer: ..... [2]

Even if the bullet hits the circular target, the monster might not be captured as it can break free from the net. The probability of successfully capturing the monster depends on the area and colour of the circular target, and the type of bullet that the player uses.

Information that the players need is given below.

Estimated probability of Sam hitting the target.

	Target 1	**Target 2**	**Target 3**	**Target 4**
Probability of Sam hitting the target	0.88	0.66	0.44	0.22

In-built multipliers for capturing monster if the monster has been hit.

Targets of different sizes	**Target 1**	**Target 2**	**Target 3**	**Target 4**
Multiplier for capturing monster	0.7	0.8	0.95	0.5

Targets of different colours	**Green**	**Yellow**	**Orange**	**Red**
Multiplier for capturing monster	0.9	0.7	0.5	0.4

Types of bullets	**Hollow Point**	**Soft Point**	**Flat Nose**
Multiplier for capturing monster	0.6	0.7	0.9

To calculate this probability, in-built multipliers are assigned to each of these three factors. For example, if a player uses a hollow point bullet and captures a monster with a yellow Target 3, the probability of successfully capturing the monster is given by $0.6 \times 0.7 \times 0.95 = 0.399$.

(b) Show that the estimated probability that Sam will hit and capture a monster with an orange Target 4 using a Flat Nose Bullet is 0.0495.

[2]

In the game, the target changes colour from green to yellow to orange to red and finally back to green. Each change occurs every second. In addition, the target also changes its size from Target 1 to 2 to 3 to 4 and then back to Target 1. Each change also occurs every second. For example, if a monster appears with a yellow Target 3, it will change to an orange Target 4 in the next second, and then a red Target 1 in the following second.

(c) At time $t = 0$ seconds, Sam sees a monster with a red Target 2. He only has one Soft Point Bullet. State the colour, Target size and find the maximum probability and the number of seconds Sam should take to shoot at the monster in order to maximise his chance of hitting and capturing it. Justify your decision and show your calculations clearly.

[6]

~~~~~ END OF PAPER II ~~~~~
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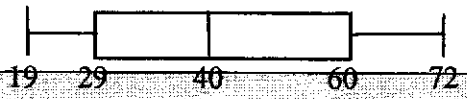
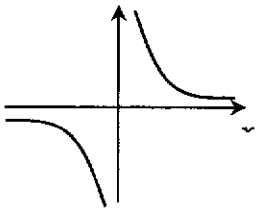
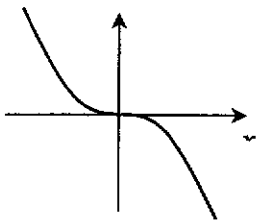
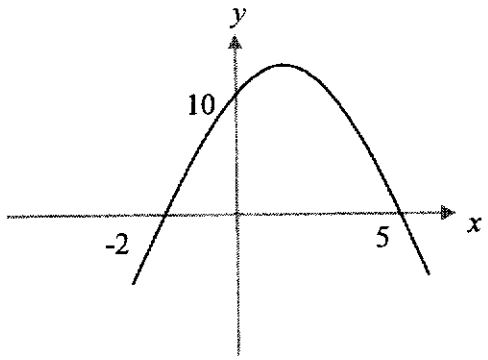
Paper 1

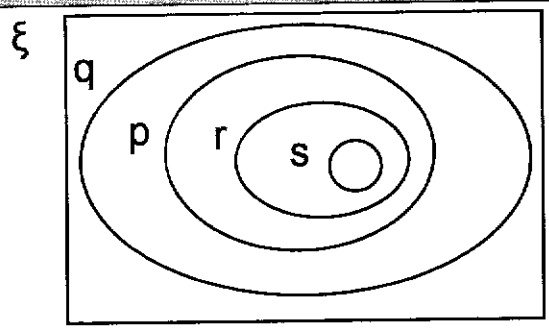
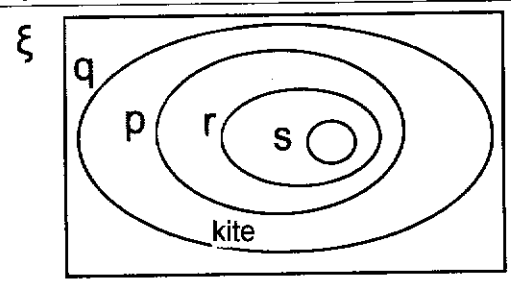
Qn No.	Solutions
1a	7.97×10^{22}
1b	Sum must be ≤ 349 $\frac{349}{3} = 116.333$ 3 even numbers are : 114, 116, 118
2a	$2y-1 < \frac{11y}{4}$ *and* $\frac{11y}{4} < \frac{1}{4}$ $8y-4 < 11y$ *and* $11y < 1$ $-3y < 4$ *and* $y < \frac{1}{11}$ $y > -1\frac{1}{3}$ *and* $y < \frac{1}{11}$ $-1\frac{1}{3} < y < \frac{1}{11}$
2b	$-25 + (-5)^2 = 0$
3a	$756 = 2^2 \times 3^3 \times 7$
3b	$756\ p = 2^2 \times 3^3 \times 7 \times p$ $495 = 3^2 \times 5 \times 11$ Smallest $p = 5 \times 11 = 55$ Or LCM $= 2^2 \times 3^3 \times 5 \times 7 \times 11$ $756p = 2^2 \times 3^3 \times 7 \times p$ $p = 5 \times 11 = 55$
3c	$756 \times \frac{a}{b}$ = perfect cube $2^2 \times 3^3 \times 7 \times \frac{a}{b}$ = perfect cube a = 2, b = 7
4a	$\frac{a^2-3a+2}{9a^2-1} \div \frac{2a-2}{6a-2}$ $= \frac{(a-2)(a-1)}{(3a-1)(3a+1)} \times \frac{2(3a-1)}{2(a-1)}$ $= \frac{a-2}{3a+1}$
5a	$\frac{(2x^3y^2)^{-4}}{(10x^{-2}y^3)^2} \div \sqrt[3]{27x^{-3}y^6}$

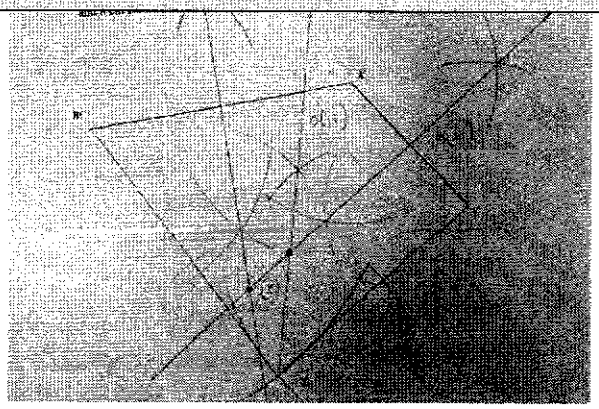
	$= \frac{2^{-4}x^{-12}y^{-8}}{100x^{-4}y^{6}} \times \frac{1}{(27x^{-3}y^{6})^{\frac{1}{3}}}$ $= \frac{1}{1600x^{8}y^{14}} \times \frac{1}{3x^{-1}y^{2}}$ $= \frac{1}{4800x^{7}y^{16}}$
5b	$3^{x+2} \times 3(3^{5}) = 1$ $3^{x+2} \times 3^{1}(3^{5}) = 1$ $3^{x+2} \times 3^{6} = 3^{0}$ $x + 2 + 6 = 0$ $x = -8$
6a	$a^{3} - 2a^{2}b - 4a + 8b$ $= a^{2}(a - 2b) - 4(a - 2b)$ $= (a^{2} - 4)(a - 2b)$ $= (a - 2)(a + 2)(a - 2b)$
6b	$\frac{3x+2}{9x} = \frac{1}{7x-3}$ $(3x + 2)(7x - 3) = 9x$ $21x^{2} - 9x + 14x - 6 = 9x$ $21x^{2} - 4x - 6 = 0$ Using general formula $x = 0.638$ *or* $x = -0.448$
7	Bank A: Total amount = $P\left(1 + \frac{r}{100}\right)^{n}$ $= 20000\ (1 + \frac{3}{100})^{5}$ = \$23,185.48 Bank B: Total amount = $20000 + \frac{3.2}{100} \times 20000 \times 5$ =\$23,200 Bank C: Total amount = \$23,000 He should invest in Bank B as the interest he get is the highest.
8a	Probability of all good apple $= \frac{17}{20} \times \frac{16}{19} \times \frac{15}{18}$

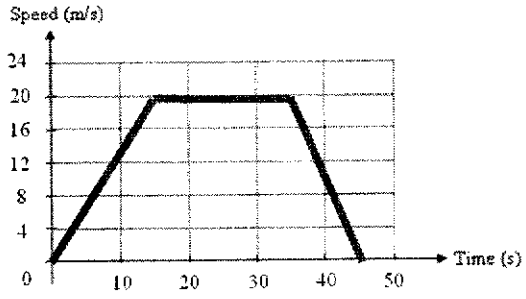
	= 0.59649 Probability of at least 1 bad = 1- 0.59649 = 0.404 or $\frac{23}{57}$
8b	No. $\frac{17}{20}\times\frac{16}{19}\times\frac{3}{18}$ refers to the probability of (Good, Good, Bad). It can also be (Good, Bad, Good) or (Bad, Good, Good). Probability should be $\frac{17}{20}\times\frac{16}{19}\times\frac{3}{18}+\frac{17}{20}\times\frac{3}{19}\times\frac{16}{18}+\frac{3}{20}\times\frac{17}{19}\times\frac{6}{18}$ $=3\left(\frac{17}{20}\times\frac{16}{19}\times\frac{3}{18}\right)$
9	19 28 30 32 48 50 70 72 Median = $\frac{32+48}{2}=40$ Lower quartile = $\frac{28+30}{2}=29$ Upper quartile = $\frac{50+70}{2}=60$ 
10a	
10b	
10c	$\frac{4}{x}+2x^3=0$ $\frac{4}{x}=-2x^3$ no intersection for $y=\frac{4}{x}$ *and* $y=-2x^3$

	0 solution
11a	$-(x+2)(x-5)$ $=-(x^2-5x+2x-10)$ $=-(x^2-3x-10)$ $=-[(x-1.5)^2-(-1.5)^2-10]$ $=-[(x-1.5)^2-12.25]$ $=-(x-1.5)^2+12.25$ $p=-1.5.\qquad k=12.25$
11b	
11c	(1.5, 12.25)
12a	Angle ACD = 2 angle AOD = 67°÷ 2 = 33.5° (angle at centre = 2 angle at circumference) Angle BAO = 67° (alt angles, AB // DO) Angle BCA = 180° −67°−90° = 23° (right angle in semicircle) Angle BCD = 23° + 33.5° = 56.5°
12b	Angle DAB and angle DCB are angles in opposite segments in a circle and adds up to 180°
12c	Angle DBA = angle DCA = 33.5° (angles in same segment) Angle DBC = 90° − 33.5° = 56.5° (right angle in semicircle)
13	$\sqrt{3p^3+6r^2}=\frac{5r}{2}$ $3p^3+6r^2=\frac{25r^2}{4}$ $12p^3+24r^2=25r^2$

	$12p^3 = r^2$ $r = \pm\sqrt{12p^3}$
14a	$\frac{A_1}{A_2} = \left(\frac{l_1}{l_2}\right)^2$ $\frac{9}{49} = \left(\frac{l_1}{l_2}\right)^2$ $\frac{l_1}{l_2} = \frac{3}{7}$ $\frac{V_1}{V_2} = \left(\frac{l_1}{l_2}\right)^3$ $\frac{V_1}{V_2} = \frac{27}{343}$ $V_1 = 1200 \div 343 \times 27 = 94.5\ cm^3$
14b	Radius 3 refers to that of water though qn may be a bit vague Volume of water = $94.5 \times 80\% = 75.6$ $\frac{1}{3}\pi(3)^2 h = 75.6$ h = 8.02 cm Accept 3 as radius of cone also $\frac{V_1}{V_2} = \frac{4}{5}$ $\frac{r_1}{r_2} = \sqrt[3]{\frac{4}{5}}$ $r_1 = \sqrt[3]{\frac{4}{5}} \times 3 = 2.78495$ $\frac{1}{3}\pi(2.78495)^2 h = 75.6$ H = 9.31 cm
15a	$I = \frac{k}{d^2}$ $8 = \frac{k}{3^2}$ k = 72 $I = \frac{72}{d^2}$
15b	$I = \frac{72}{(0.25d)^2}$ $I = \frac{72}{0.0625d^2}$ $I = \frac{1152}{d^2}$ $\frac{1152}{72} = 16\ times$ % change = $\frac{1152-72}{72} \times 100\% = 1500\%$

16ai	Angle FGA= $\frac{(7-2)180}{7} = 128.57°$ Angle OGF = $128.57° \div 2 = 64.3°$
16aii	Angle GFH = $180 - 64.3 = 115.7°$ Angle EFH = $128.57 - 115.7 = 12.9°$
16b	Sum of exterior angle = 360° $18 + 22 + 32 + 4(17) + (n-7)(20) = 360$ $140 + 20n - 140 = 360$ $n = 18$
17a	 Square is a type of rectangle Square and rectangle is a type of parallelogram
17b	
18a	$AB = \sqrt{(6-0)^2 + (3-(-11))^2}$ $= \sqrt{36 + 196}$ =15.2 units
18b	Gradient = $\frac{6-0}{3-(-11)} = \frac{3}{7}$ y = mx +C At (3,6), $6 = \frac{3}{7}(3) + C$ C = $4\frac{5}{7}$ y = $\frac{3}{7}$x +$4\frac{5}{7}$
18c	y = mx +$4\frac{5}{7}$ at x = 0 y = $4\frac{5}{7}$

	E = $(0, 4\frac{5}{7})$
18d	$\frac{1}{2}(BC)(6) = 22.5$ BC = 7.5 C = $(-3.5, 0)$
18e	Coordinate A to C x shifted -6.5 units y shifted -6 units Coordinate D = $(-11 - 6.5\ ,\ 0 - 6)$ = $(-17.5\ ,\ -6)$
18f	$7y - 3x + 15 = 0$ $7y = 3x - 15$ $y = \frac{3}{7}x - \frac{15}{7}$ As line *l* has the same gradient $\frac{3}{7}$ as AB, the two lines are parallel and will not meet
19ai	
19aii	86°
19bi	See diagram above
19bii	See diagram above
19c	Draw perpendicular bisector of WX It is not possible to so, as the perpendicular bisector of WX, the perpendicular bisector of XY, and the angle bisector of WXY do not meet at a single point

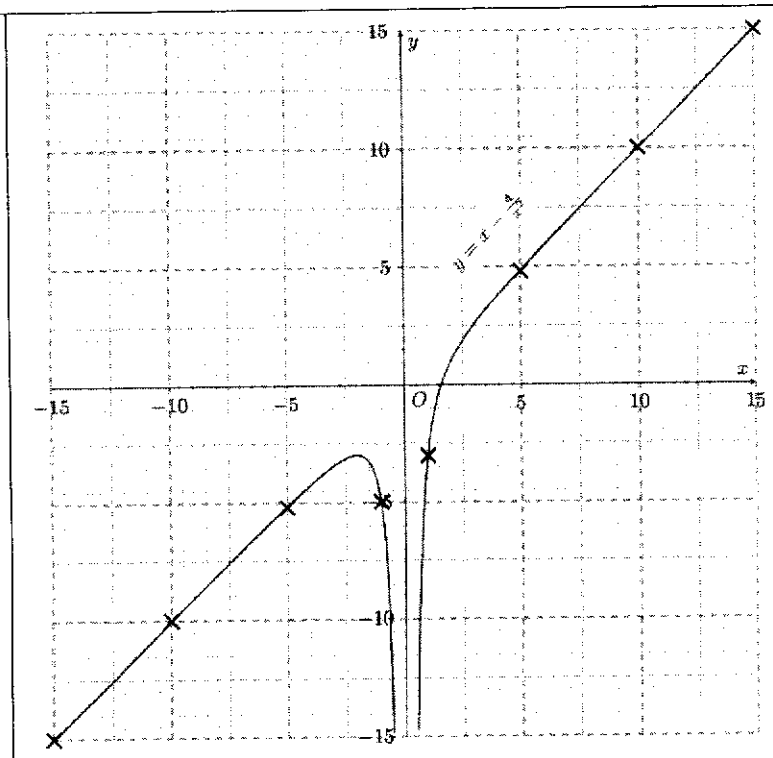
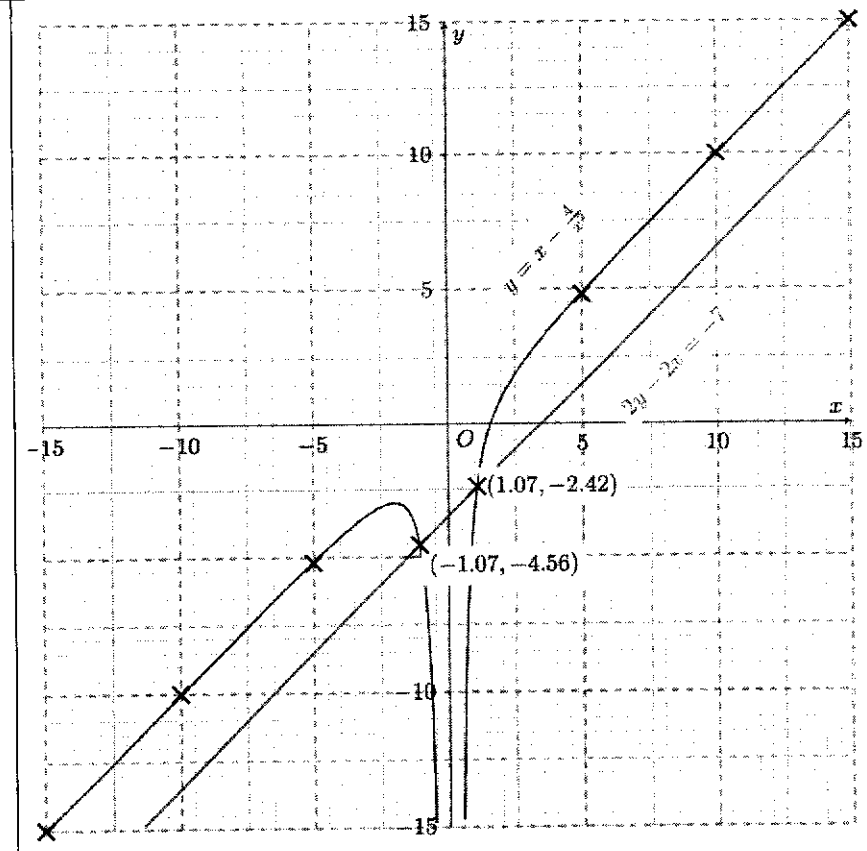
20a	
20b	$a = \frac{change\ in\ speed}{change\ in\ time}$ $= \frac{20}{15}$ $= 1.33\ m/s^2$
20c	Total distance $= (0.5)(20)(15) + (20)(20) + (0.5)(10)(20)$ $= 650\ m$ Average speed $= \frac{650}{45} = 14.4\ m/s$

Paper 2

Qn No.	Solutions
1ai	$2x^2 - 6x - 12$ $= 2(x^2 - 3x - 6)$ $= 2[(x - 1.5)^2 - 2.25 - 6]$ $= 2[(x - 1.5)^2 - 8.25]$ $=2(x - 1.5)^2 - 16.5$
1aii	$2x^2 - 6x - 12 = 0$ $2(x - 1.5)^2 - 16.5 = 0$ $2[(x - 1.5)^2 = 16.5$ $(x - 1.5)^2 = 8.25$ $x - 1.5 = 2.87 \quad or \quad x - 1.5 = -2.87$ $x = 4.37 \quad or \quad x = -1.37$
1b	$\frac{3x+1}{2x^2+11x+12} - \frac{1}{x+4}$ $= \frac{3x+1}{(2x+3)(x+4)} - \frac{1}{x+4}$ $= \frac{3x+1}{(2x+3)(x+4)} - \frac{(2x+3)}{(2x+3)(x+4)}$ $= \frac{3x+1-2x-3}{(2x+3)(x+4)}$ $= \frac{x-2}{(2x+3)(x+4)}$
2	$2x + y = 3x + 5y + 3$ $x = -4y - 3 \quad -(1)$ $4x + 5y - 7 = x + y$ $3x + 4y = 7 \quad -(2)$ Sub (1) into (2) $3(-4y - 3) + 4y = 7$ $-12y - 9 + 4y = 7$ $-8y = 16$ $y = -2$ Sub $y = -2$ into (1) $x = -4(-2) - 3$

	$x = 5$
3a	$(x-3)(2x+8) = -12$ $2x^2 + 8x - 6x - 24 + 12 = 0$ $2x^2 + 2x - 12 = 0$ $x^2 + x - 6 = 0$ $(x+3)(x-2) = 0$ $x = -3 \ \ or \ x = 2$
3b	$\frac{4}{2x-3} - \frac{3}{x+2} = 1$ $\frac{4(x+2)-3(2x-3)}{(2x-3)(x+2)} = 1$ $4(x+2) - 3(2x-3) = (2x-3)(x+2)$ $4x + 8 - 6x + 9 = 2x^2 + x - 6$ $2x^2 + 3x - 23 = 0$ $x = \frac{-3 \pm \sqrt{3^2 - 4(2)(-23)}}{2(2)}$ $x = \frac{-3 \pm \sqrt{193}}{4}$ $x = \ 2.72 \ or \ -4.22$
4a	TSA of cone $= \pi r^2 + \pi rl$ $= \pi(2y)^2 + \pi(2y)(l)$ $= 2\pi y(2y + l)$
4b	TSA of hemisphere $= \pi r^2 + \frac{1}{2}(4\pi r^2)$ $= \pi(3y)^2 + 2\pi(3y)^2$ $= 9\pi y^2 + 18\pi y^2$ $= 27\pi y^2$ $2\pi y(2y + l) = 27\pi y^2$ $2y + l = \frac{27y}{2}$ $l = \frac{27y}{2} - 2y$ $l = \frac{23y}{2} \ or \ 11.5y$
4c	Vol of hemisphere $\frac{1}{2}\left(\frac{4}{3}\pi r^3\right) = 729$ $\frac{2}{3}\pi(3y)^3 = 729$ $18\pi y^3 = 729$ $y \ = \ 2.3448$

	height of cone $= \sqrt{(l^2 - r^2)}$ $= \sqrt{\left(\left(\frac{23}{2}(2.3448)^2\right)^2 - (2 \times 2.3448)^2\right)}$ $= 26.554$ cm Vol of cone $= \frac{1}{3}\pi r^2 h$ $= \frac{1}{3}(\pi)(2 \times 2.3448)^2(26.554)$ $= 611.547 \approx 612cm^3\ (to\ 3s.f.)$
5a	$2 : 100000$ $1 : 50000$
5b	$1\ cm : 50000\ cm$ $1\ cm : 0.5\ km$ Area 1 cm^2 : 0.25 km^2 456 cm^2 : 114 km^2
6ai	sin ABE = sin EBC $= \frac{2}{\sqrt{8}}$
6aii	cos ABE $= -cos\ EBC$ $= -\frac{3}{\sqrt{8}}$
6b	Area $= \left(\frac{1}{2}\right)(AB)(BE)sinABE$ $= \left(\frac{1}{2}\right)(4)(\sqrt{8})\left(\frac{2}{\sqrt{8}}\right)$ $= 4$ cm^2
6c	$\frac{AB}{AC} = \frac{4}{7}$ $\frac{Area\ ABE}{Area\ ACD} = \frac{16}{49}$ Area $ABE = 4 \div 16 \times 49 = 12.25$ cm^2
7a	When $x = -10$, $y = -10 - \frac{4}{(-10)^2} = -10.0$

7b	
7ci	
7cii	-1.07 or 1.07 (±0.1)
7ciii	$2y - 2x = -7$: (equation 1) $y = x - \frac{4}{x^2}$: (equation 2)

	Sub (2) into (1): $2\left(x-\frac{4}{x^2}\right)-2x=-7$ $2x-\frac{8}{x^2}-2x=-7$ $-\frac{8}{x^2}=-7$ $8=7x^2$ $7x^2-8=0$ $A=7, B=-8$
8a	$\angle POQ=180°-60°=120°$ $\angle OQP=\frac{180°-120°}{2}=30°$ (base $\angle$ of iso $\triangle$) $\angle TQP=90°-30°=60°$
8b	$\angle PRQ=\frac{120°}{2}=60°$ ($\angle$ at centre = 2 $\angle$ at circumference)
8c	$OPR=180°-60°-20°-(2\times 30°)=40°$ (sum of $\angle$ of $\triangle$)
8d	Obtuse $\angle QOP=360°-120°=240°$ Area of major sector $=\frac{240°}{360°}\times\pi(5)^2=\left(\frac{50}{3}\pi\right)\ cm^2$ Area of $\triangle POQ=\frac{1}{2}(5)(5)\sin 120°=10.825$ Total Area = 63.2 cm^2
9a	$Length=\sqrt{[-6-(-4)]^2+[-2-(-7)]^2}$ $=\sqrt{(-2)^2+5^2}$ $=5.39$
9b	$m_{AB}=m_{CD}=\frac{-2-(-7)}{-6-(-4)}=\frac{5}{-2}$ $\overrightarrow{OC}=\overrightarrow{BC}+\overrightarrow{OB}$ $=\begin{pmatrix}8\\-2\end{pmatrix}+\begin{pmatrix}-4\\-7\end{pmatrix}$ $=\begin{pmatrix}4\\-9\end{pmatrix}$ $C(4,-9)$ $y=-2.5x+c$ $-9=-2.5(4)+c$ $c=1$ $y=-\frac{5}{2}x+1$ *or* $2y=-5x+2$
9ci	$\overrightarrow{XC}=\frac{1}{2}\overrightarrow{AC}$ $=\frac{1}{2}\left[\overrightarrow{OC}-\overrightarrow{OA}\right]$

	$= \frac{1}{2}\left[\begin{pmatrix}4\\-9\end{pmatrix} - \begin{pmatrix}-6\\-2\end{pmatrix}\right]$ $= \begin{pmatrix}5\\-7/2\end{pmatrix}$
9cii	$\overrightarrow{OX} = \overrightarrow{OC} - \overrightarrow{XC}$ $= \begin{pmatrix}4\\-9\end{pmatrix} - \begin{pmatrix}5\\-7/2\end{pmatrix}$ $= \begin{pmatrix}-1\\-11/2\end{pmatrix}$
9d	$\frac{2}{1}$ *or* $2:1$
10a	$(35 \times 20) + (45 \times 39) + (55 \times 16) + (65 \times 20) + (75x)$ $= 50.1(20 + 39 + 16 + 20 + x)$ $4635 + 75x = 50.1(95 + x)$ $4635 + 75x = 4759.5 + 50.1x$ $24.9x = 124.5$ $x = 5$
10b	Std Deviation = 11.6 min
10c	The **male participants** ran faster than the females participants as their **mean time** was shorter. The **female participants** were **more consistent** in their running speed as their **standard deviation** was lesser than that of the males.
11a	$T_5 = 7^2 + 17 = 66$
11b	The sum of 2 odd numbers or the sum of 2 even numbers will always be an even number.
11c	$T_n = (n+2)^2 + 5 + 3(n-1)$ $= n^2 + 4n + 4 + 5 + 3n - 3$ $= n^2 + 7n + 6$
11d	$T_{p+1} - T_p$ $= (p+1)^2 + 7(p+1) + 6 - [p^2 + 7p + 6]$ $= p^2 + 2p + 1 + 7p + 7 + 6 - p^2 - 7p - 6$ $= 2p + 8$
11e	$2p + 8 = 4$ $2p = -4 \Rightarrow p = -2$ Since p cannot be negative, consecutive terms of the sequence cannot have a difference of 4 .
12ai	Let X be North of H Angle $PHX = 360° - 306° = 54°$ Bearing of H from P = $180° - 54° = 126°$ (int angles)
12aii	Bearing of L from P = $126° + 124° = 250°$
12aiii	$\tan\theta = \frac{500}{2500}$ angle of elevation = 11.3°

12b

$HL^2 = 2.5^2 + 3^2 - 2(2.5)(3)\cos 124°$

$HL = 4.86$ km

12c

Let X be the point where LX is the shortest distance to HPQ

$\cos 56° = \frac{XP}{2.5}$

$XP = 1.39798$

$HX = 1.39798 + 3 = 4.39798$

$\text{Time} = \frac{4397.98\ m}{4.5\ m/s} = 977.33$ s $= 16.289$ min

It left harbour at 0753 hours

13a

$\frac{3}{4} \times 0.88 = 0.66$ (shown)

$\frac{1}{2} \times 0.88 = 0.44$ (shown)

13b

$0.5 \times 0.5 \times 0.22 \times 0.9$

$= 0.0495$

13c

Time	Color	Target Size	Probability (Hit + Capture)
0s	Red	2	Target 2 $= 0.66 \times 0.8 \times 0.4 \times 0.7 = 0.14784$
1s	Green	3	Target 3 $= 0.44 \times 0.95 \times 0.9 \times 0.7 = 0.26334$
2s	Yellow	4	Target 4 $= 0.22 \times 0.5 \times 0.7 \times 0.7 = 0.0539$
3s	Orange	1	Target 1 $= 0.88 \times 0.7 \times 0.5 \times 0.7 = 0.2156$

∴ Maximum probability happens at green Target 2

Sam should wait for 1 second for the target to change from red Target 2 to green Target 3, with maximum probability of 0.26334

∴