TANJONG KATONG GIRLS' SCHOOL
PRELIMINARY EXAMINATION
SECONDARY FOUR EXPRESS

CANDIDATE NAME

CLASS

INDEX NUMBER

MATHEMATICS 4052/01

Paper 1

16 August 2024

2 hours 15 minutes

Candidates answer on the Question Paper

READ THESE INSTRUCTIONS FIRST

Write your index number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE ON ANY BARCODES.

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

If working is needed for any question it must be shown with the answer.
Omission of essential working will result in loss of marks.
The total of the marks for this paper is 90.

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.

For Examiner's use

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

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

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

Answer **all** the questions.

1 **(a)** Calculate $\dfrac{165^2+\sqrt[4]{75.125-11.2\times(-3)}}{3.142}$.

Write your answer correct to 2 significant figures.

Answer ..... [1]

(b) The number of people in a shopping mall is 1100, correct to the nearest hundred.
Write down the minimum number of people there are in the mall.

Answer ..... [1]

2 Simplify

(a) $5-2(6x-1)$,

Answer ..... [1]

(b) $\left(\dfrac{27b^9}{a^6}\right)^{-\frac{1}{3}}$.

Answer ..... [2]

3 Albert and Chris have some savings in the ratio 5 : 3.
They spent \$30 each from their savings and the new ratio of their savings is 2 : 1.
Find the amount of savings Chris has at the start.

Answer \$ ..... [2]

4 **(a)** Express 1400 as a product of its prime factors.

Answer ..... [1]

(b) q is a number between 70 and 90.
The highest common factor of q and 1400 is 28.
Find the smallest possible value of q.

Answer $q =$ ..... [2]

5 Given that $\frac{1}{2^{a-1}} = 2^3 + 2^3 + 2^3 + 2^3$, find the value of a.

Answer $a =$ ..... [2]

6 **(a)** Expand and simplify $2(5m+3n)^2$.

Answer ..... [2]

(b) Factorise completely $24(mn)^2 - 21mn^3$.

Answer ..... [1]

7 The area of triangle XYZ is 12.6 cm^2.
$XY = 4.5$ cm and $YZ = 7.1$ cm.

Find two possible values for angle XYZ. Give your answers in radians.

Answer .....rad or ..... rad [3]

8 P is inversely proportional to Q^3.
Find the percentage change in P when Q is reduced by 20%.

Answer .....% [2]

9 It is given that $p = \dfrac{q+r^2}{q-5}$.

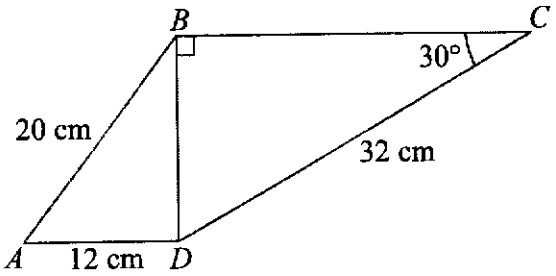
(a) Find p when $q = \dfrac{1}{5}$ and $r = -6$.

Answer $p =$ ..... [1]

(b) Express q in terms of p and r.

Answer ..... [2]

10 The diagram shows a quadrilateral $ABCD$ made up of two triangles.
$AB = 20$ cm, $AD = 12$ cm, $CD = 32$ cm.
Angle $CBD = 90°$ and angle $BCD = 30°$.



(a) Find BD.

Answer ..... cm [2]

(b) **Hence or otherwise**, show that it is possible to form a circle with diameter AB such that point D lies on the circumference of the circle.

Answer

[2]

11 Write as a single fraction in its simplest form $\frac{3}{(1-2h)^2}+\frac{8}{2h-1}$.

Answer ..... [3]

12 k is a positive integer.
An odd number is formed when 5 is subtracted from twice of k.

(a) Write down an expression for the odd number in terms of k.

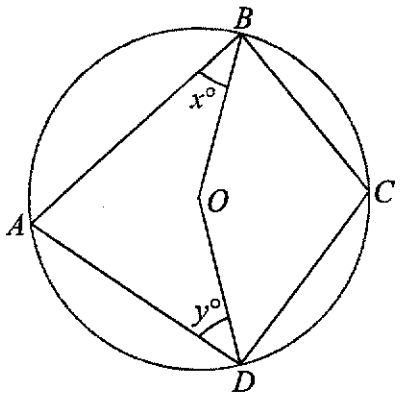
Answer ..... [1]

(b) The sum between the odd number and the next consecutive odd number is greater than 16.

Form an inequality in terms of k and solve it to find the smallest possible value of the larger odd number.

Answer ..... [3]

13 In the diagram, A, B, C and D are four points on a circle, centre O.
Angle $ABO = x°$ and angle $ADO = y°$.



Find angle BCD in terms of x and y.
Give reasons for each step of your working.

Answer .....° [3]

14 **(a)** Factorise $3x^2-14x-5$.

Answer ..... [2]

(b) **Hence**, factorise completely $3(y+1)^2-14y-19$.

Answer ..... [2]

15 The points $P(2,3)$ and $Q(-1,-3)$ lie on the curve $y=ax^2+bx+2$.
Form and solve two simultaneous equations to find the values of a and b.

Answer $a=$ .....

$b=$ ..... [4]

16 A bag contains 15 red marbles, some blue marbles and some yellow marbles.
A marble is chosen at random from the bag.

The probability of choosing a blue marble is $\frac{1}{6}$ and the probability of choosing a yellow marble is $\frac{7}{12}$.

(a) Show that there are 60 marbles in total in the bag.

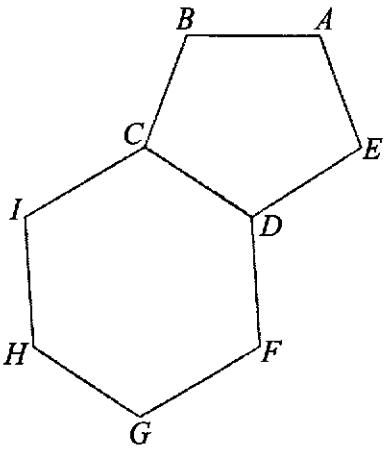
Answer

[2]

(b) Two marbles are chosen at random from the bag.
Find the probability that both marbles are blue.

Answer ..... [2]

17 The figure is made up of a regular pentagon *ABCDE* and a regular hexagon *CDFGHI*.



(a) Find angle *BCI*.

Answer .....° [2]

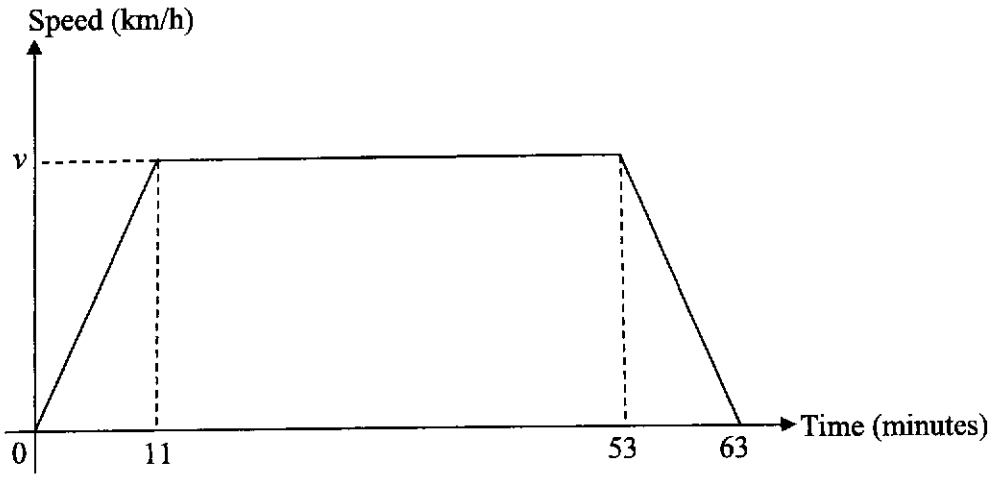
(b) Determine whether *BC* and *CI* are two sides of another regular polygon.
Justify your answers with mathematical working.

Answer

.....

..... [2]

18 The diagram shows the speed-time graph of a cyclist from Town A to Town B.



(a) The total distance travelled by the cyclist is 14 km.
Show that $v = 16$.

Answer

[2]

(b) Find the speed of the cyclist 5 minutes from the start of the journey.

Answer ..... km/h [1]

(c) Calculate the acceleration of the car in the last 10 minutes.

Answer ..... km/h^2 [1]

19 The times taken, in minutes, by 14 students to complete a Mathematics assignment are recorded.

The results are shown in the stem-and-leaf diagram.

1	1	5	9			
2	0	3	3	3	6	9
3	4	8	8	9		
4	0					

Key:
4 | 0 represents 40 minutes

(a) Find the modal time.

Answer ..... mins [1]

(b) Find the percentage of students who took at most 20 minutes to complete the assignment.

Answer ..... % [1]

(c) The time taken for the 15th student to complete the assignment is recorded.
The range increases to 31 minutes.
Find two possible times this student spent completing the assignment.

Answer ..... mins or ..... mins [2]

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

$$T_1 = \frac{2}{1} - \frac{3}{5} = \frac{7}{5}$$

$$T_2 = \frac{3}{5} - \frac{4}{5^2} = \frac{11}{25}$$

$$T_3 = \frac{4}{5^2} - \frac{5}{5^3} = \frac{3}{25}$$

$$T_4 = \frac{5}{5^3} - \frac{6}{5^4} = \frac{19}{625}$$

(a) Find T_5.

Answer ..... [1]

(b) Find an expression, in terms of n, for T_n.

Answer $T_n =$ ..... [2]

(c) Evaluate the sum of the first ten terms, $T_1 + T_2 + T_3 + \ldots + T_{10}$.

Answer ..... [2]

21 Benedict left his house to go to the library.
He took the first bus, which travelled 5 km in t minutes.

He then alighted at a bus stop and waited for 12 minutes to switch to the next bus.

The second bus took 2 minutes less than the first bus to reach his destination after travelling a further 3.75 km.

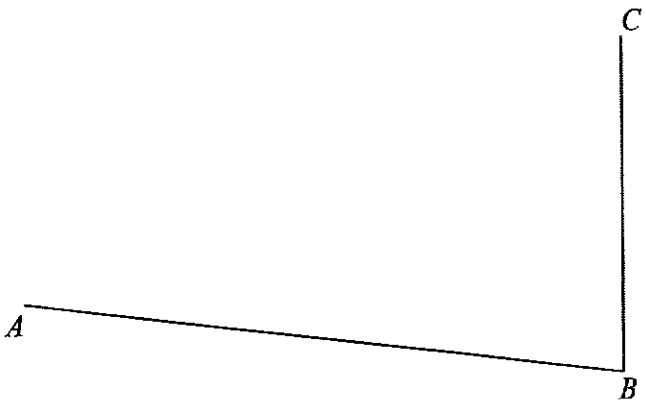
(a) Find the time taken for the whole journey, in minutes, in terms of t.

Answer ..... minutes [1]

(b) Given that the average speed for the whole journey is 10.5 km/h, form an equation in terms of t to calculate the total time taken for the journey.

Answer ..... minutes [3]

22 In this scale drawing, A, B and C are three corners of a park $ABCD$ with C due north of B.



(a) Construct the perpendicular bisector of BC. [1]

(b) D is on a bearing of 065° from A and equidistant from B and C.
Mark and label point D on the drawing. [1]

(c) Construct the bisector of angle ABC. [1]

(d) Eleanor is standing inside the park $ABCD$ such that she is closer to BC than AB and closer to B than C.
Shade the region where Eleanor could be standing. [1]

23 The table below shows the number of books read by 50 students in Class A in semester 1.

Number of books read, n	Frequency
$0 < n \leq 2$	8
$2 < n \leq 4$	21
$4 < n \leq 6$	11
$6 < n \leq 8$	3
$8 < n \leq 10$	7

(a) Calculate an estimate for

(i) the mean number of books read by the students,

Answer ..... [1]

(ii) the standard deviation of the number of books read by the students.

Answer ..... [1]

(b) After introducing a reading programme in semester 2, the number of books read by each student in Class A increased by 2.
State how the mean and standard deviation will change after the increase.

Answer

.....

..... [2]

(c) The standard deviation of the number of books read by the students from Class B was 3.15.

Use this information to comment on one difference between the two distributions.

Answer

.....

.....

..... [1]

24 An enrichment centre offers drama, writing and speech enrichment classes on weekdays during the school holiday.

The matrix **S** shows the number of students who attend the different classes for beginners and advanced levels in a day.

$$\begin{matrix} & \text{drama} & \text{writing} & \text{speech} \\ \mathbf{S} = & \begin{pmatrix} 25 & 32 & 40 \\ 21 & 19 & 32 \end{pmatrix} & \begin{matrix} \text{beginners} \\ \text{advanced} \end{matrix} \end{matrix}$$

(a) Evaluate the matrix $\mathbf{W} = 5\mathbf{S}$.

Answer $\mathbf{W} =$ [1]

The school fee for drama cost \$40 per session, \$25 per session for writing and \$30 per session for speech. The fees for beginner and advanced learners are the same for each type of class.

(b) Represent these amounts in a column matrix **C**.

Answer $\mathbf{C} =$ [1]

(c) Evaluate the matrix $\mathbf{T} = \mathbf{WC}$.

Answer $\mathbf{T} =$ [2]

(d) Explain what the elements in **T** represent.

Answer

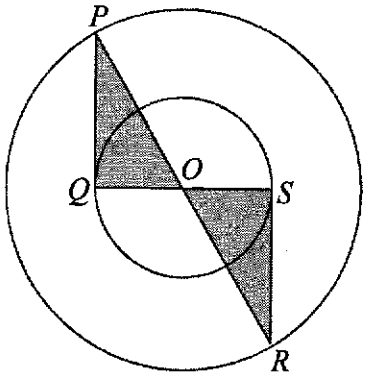
.....

.....

..... [1]

25 PR is a diameter of the large circle, centre O.
QS is a diameter of the small circle, centre O.

PQ and RS are tangents to the small circle.



(a) Show that triangle OPQ is congruent to triangle ORS.
Give a reason for each statement you make.

Answer

[3]

(b) The ratio of OQ to PQ to OP is 5 : 12 : 13.
Express the area of the shaded region as a percentage of the large circle.

Answer ..... % [3]

TANJONG KATONG GIRLS' SCHOOL
PRELIMINARY EXAMINATION
SECONDARY FOUR EXPRESS

CANDIDATE NAME

CLASS

INDEX NUMBER

MATHEMATICS

4052/02

Paper 2

7 August 2024

2 hour 15 minutes

Candidates answer on the Question Paper

READ THESE INSTRUCTIONS FIRST

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For π, use either your calculator value or 3.142.

For Examiner's use

Mathematical Formulae

Compound interest

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

Mensuration

$$\text{Curved surface area of a cone} = \pi rl$$

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

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

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

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

$$\text{Arc length} = r\theta, \text{ where } \theta \text{ is in radians}$$

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

Trigonometry

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

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

Statistics

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

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

TURN OVER FOR QUESTION 1

1 **(a)** Solve the equation $\frac{3-2x}{7} = \frac{1}{3}(2x-1)$.

Answer $x =$ ..... [2]

(b) Simplify

(i) $\frac{25a^2 - 9b^2}{15a - 10ab + 6b^2 - 9b}$

Answer ..... [3]

(ii) $\frac{3c}{4ab} \div \frac{c^3}{12a^2b}$.

Answer ..... [2]

(c) **(i)** Solve the equation $-x^2+9x-\frac{7}{2}=0$ by **completing the square**. Give your solutions correct to two decimal places.

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

(ii) Explain why $-x^2+9x-\frac{7}{2}=18$ has no real solution.

.....

.....

.....

..... [2]

2 (a) In a particular month, 21 people took a driving test.

One of the 21 people is selected at random.
The probability that it is a man who passed the test is $\frac{1}{7}$.

Two of the 21 people are selected at random.
The probability that they are both women who failed the test is $\frac{1}{10}$.

Complete the table of information about the 21 people who took the test on that particular month.

	Passed the test	**Failed the test**
Men		**9**
Women		

[4]

(b) $\varepsilon = \{x : x \text{ is a student in a class}\}$
$A = \{x : x \text{ is a student who listens to pop music}\}$
$B = \{x : x \text{ is a student who listens to classical music}\}$

It is given that $\text{n}(\varepsilon) = 35$, $\text{n}(A) = 22$, $\text{n}(B) = 14$ and $\text{n}(A \cap B') = 12$.

(i) Describe in words the set $A \cap B'$.

.....

..... [1]

(ii) Find the number of students who listen to both pop and classical music.

Answer ..... [1]

(iii) Find the number of students who listen to classical music only.

Answer ..... [1]

(iv) Find the number of students who listen to neither pop nor classical music.

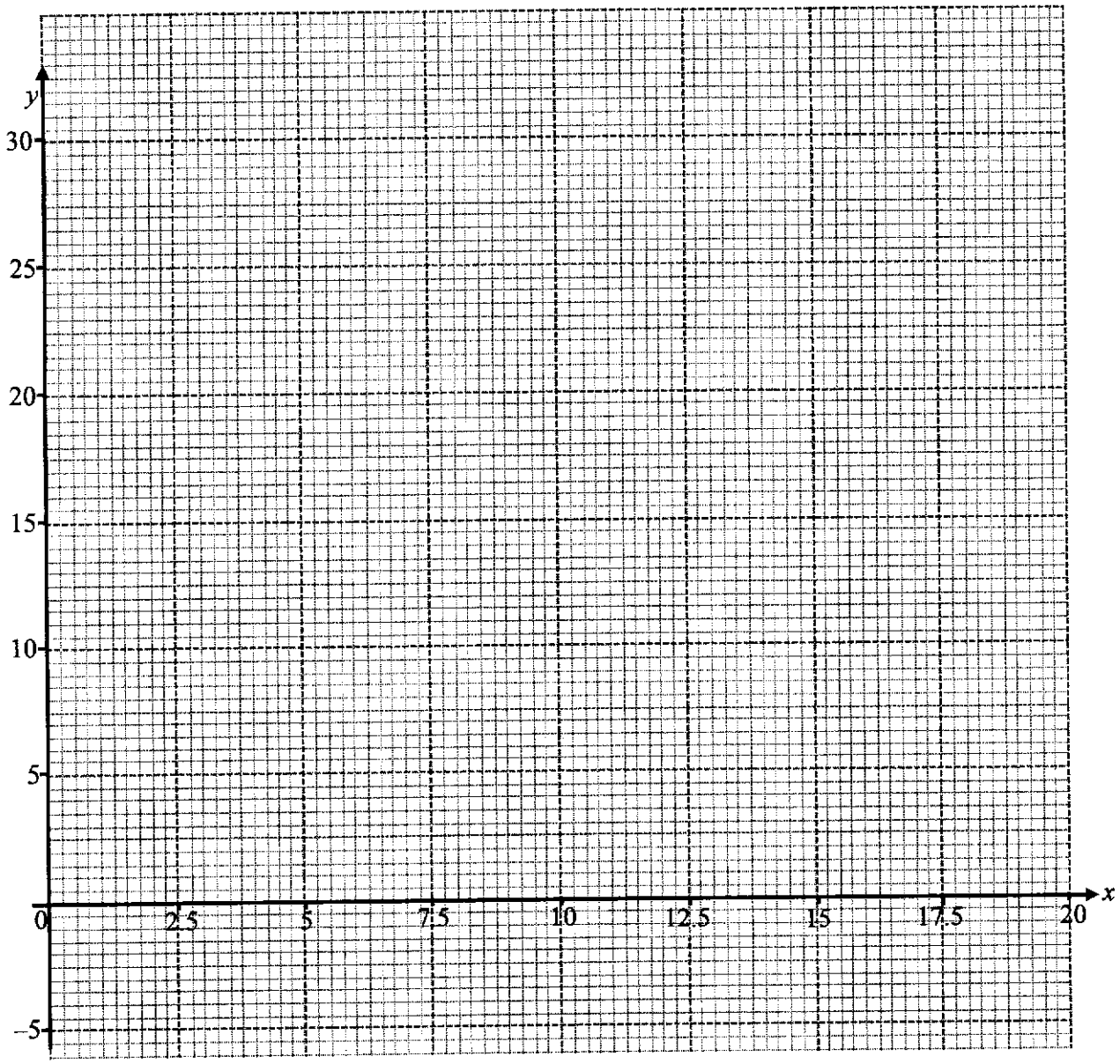
Answer ..... [1]

3 **(a)** Complete the table of values for $y = 2x + \frac{20}{x} - 15$.

x	1	2.5	5	10	12.5	15	20
y	7		−1	7	11.6	16.3	26

[1]

(b) On the grid, draw the graph of $y = 2x + \frac{20}{x} - 15$ for $0 < x \leq 20$.



[3]

(c) Using the graph, state the range of values of x for which $2x + \frac{20}{x} < 22$.

Answer ..... [2]

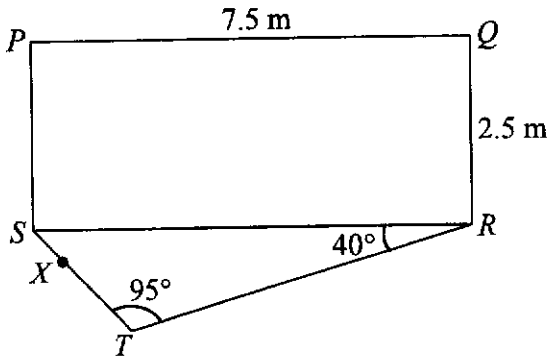
(d) By drawing a tangent, find the gradient of the curve at the point where $x = 4$.

Answer ..... [2]

(e) By drawing a suitable straight line on the grid, find the solutions of the equation $x^2 - 13x + 20 = 0$.

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

4 In the diagram, $PQRS$ is a vertical rectangular wall of height 2.5 m and length 7.5 m.
T is a point on level ground from the base of the wall RS.
$\angle STR = 95°$ and $\angle SRT = 40°$.
X is a point on ST such that $SX : XT$ is 1 : 3.



(a) Calculate the length of SX.

Answer ..... m [3]

(b) Calculate the length of XR.

Answer ..... m [3]

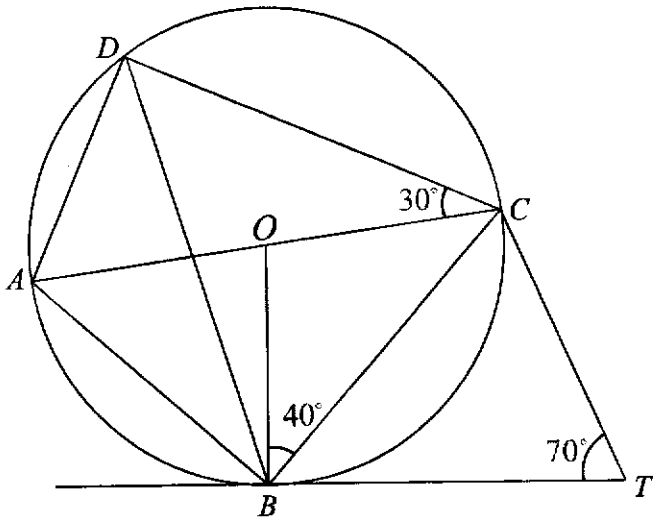
(c) Calculate the length of PT.

Answer ..... m [1]

(d) A bird sat on the ledge of the wall along PQ such that its angle of elevation θ from X is the largest. Find θ.

Answer ..... ^{o} [4]

5 In the diagram, O is the centre of the circle through A, B, C, D and TB is the tangent at B. AC is the diameter of the circle, and the length of the minor arc BAD is 11 cm.
Given that $\angle OBC = 40^\circ$, $\angle ACD = 30^\circ$ and $\angle BTC = 70^\circ$.



(a) Find, giving a reason for each step of your working,

(i) $\angle ABD$,

Answer ..... ° [1]

(ii) $\angle BAD$.

Answer ..... ° [2]

(iii) Taking $\pi = \frac{22}{7}$, calculate the radius of the circle.

Answer ..... cm [2]

(b) **(i)** Show that triangle BCD is similar to triangle CTB. Give a reason for each statement you make.

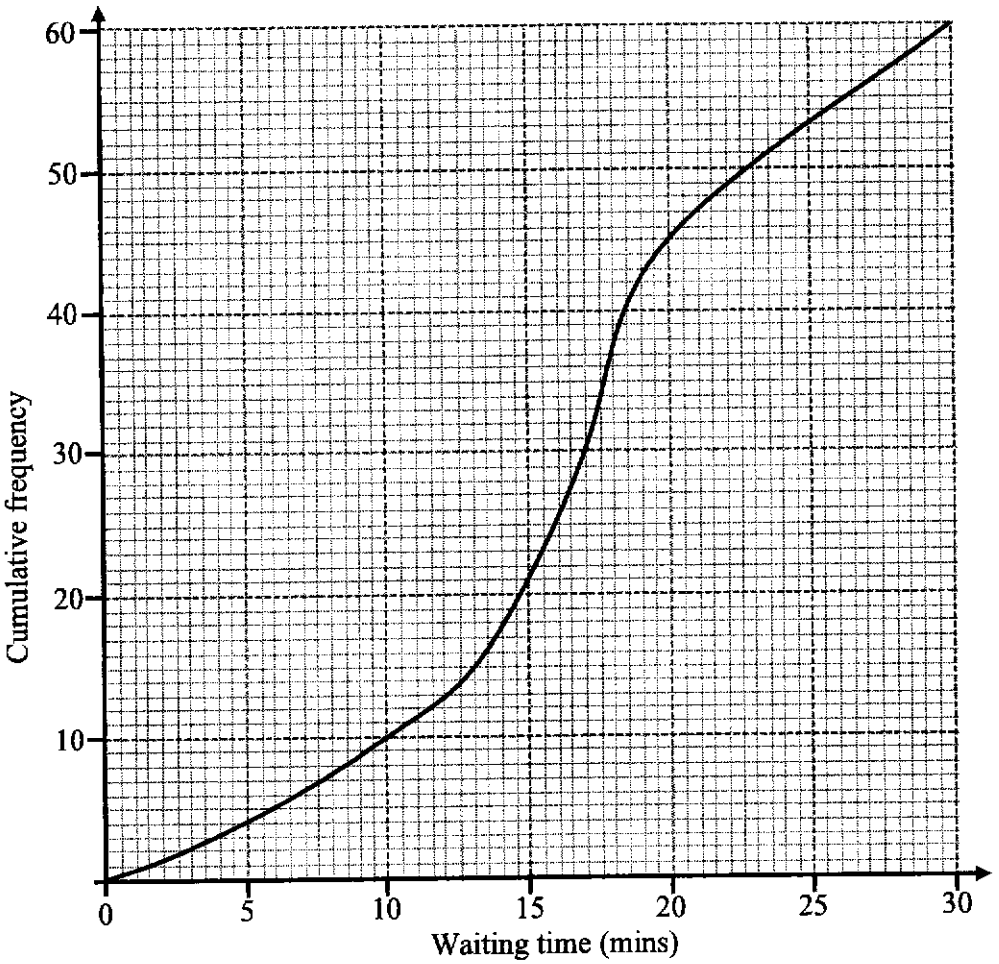
Answer

[4]

(ii) **Hence**, express CT in terms of x and y given that $BC = x$ cm and $BD = y$ cm.

Answer ..... [2]

6 The cumulative frequency graph shows distribution of the waiting times before being served, in minutes, of 60 customers at restaurant *A* on a particular day.



(a) Use the curve to estimate

(i) the median waiting time,

Answer ..... min [1]

(ii) the interquartile range,

Answer ..... min [1]

(iii) the 35th percentile of the waiting time.

Answer ..... min [1]

(b) Given that 20% of the customers waited more than x minutes to be served, find the value of x.

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

(c) The data below represents the waiting times of 10 customers from restaurant B on the same day.

10, 12, 14, 14, 15, 17, 17, 18, 22, 28

Calculate

(i) the median waiting time,

Answer ..... min [1]

(ii) the interquartile range.

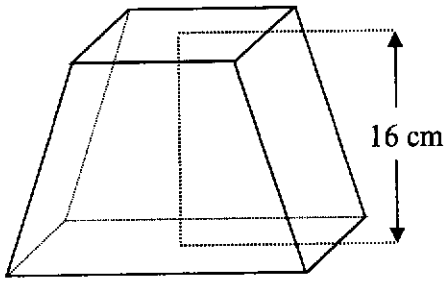
Answer ..... min [1]

(d) The owner of restaurant B claims that his restaurant is more efficient and consistent in their service compared to restaurant A based on the data given. Give a reason why this is not a fair comparison.

.....

..... [1]

7 (a)



The figure shows a solid frustum of height 16 cm cut from right pyramid with square base. The horizontal top surface has an area of 5 cm^2 while the base area is 125 cm^2. The portion that is removed is h cm high.

(i) Show that $h = 4$.

Answer

[2]

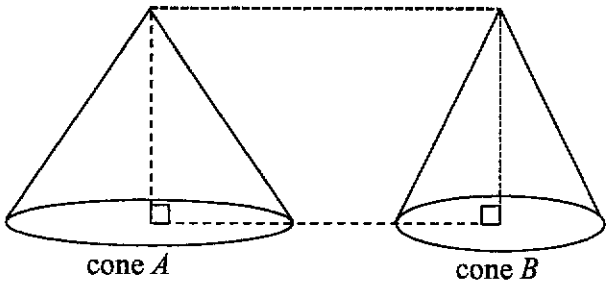
(ii) Calculate the volume of the frustum.

Answer ..... cm^3 [3]

(iii) Find the percentage of the right pyramid that has been removed.

Answer ..... % [2]

(b) Two solid cones have the same height but the radius of cone A is 1.5 times of cone B. Given that the volume of cone B is 240 cm^3.



Find the volume of cone A.

Answer ..... cm^3 [3]

8 **(a)** $\overrightarrow{AB} = \begin{pmatrix} -3 \\ 9 \end{pmatrix}$, $\overrightarrow{BC} = \begin{pmatrix} 2 \\ 5 \end{pmatrix}$, $\overrightarrow{CD} = \begin{pmatrix} d \\ 4 \end{pmatrix}$.

(i) Given that $\overrightarrow{CD}$ is parallel to $\overrightarrow{AB}$, find the value of d.

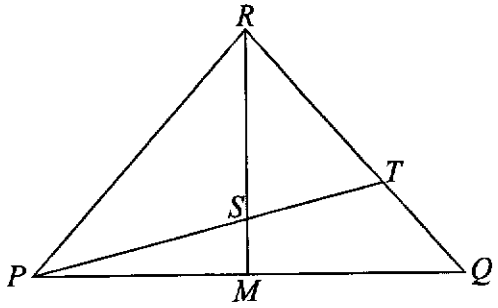
Answer $d =$ ..... [2]

(ii) Find $\left|\overrightarrow{AC}\right|$.

Answer ..... units [2]

TURN OVER FOR QUESTION 8(b)

(b)



PQR is a triangle and M is the mid-point of PQ. It is given that $\overrightarrow{PQ} = \mathbf{a}$, $\overrightarrow{PR} = \mathbf{b}$, $\overrightarrow{QT} = h\overrightarrow{QR}$ and $\overrightarrow{RS} = k\overrightarrow{RM}$, where k and h are constants.

(i) Express $\overrightarrow{PS}$ in terms of k, **a** and **b**.

Answer ..... [2]

(ii) Express $\overrightarrow{PT}$ in terms of h, **a** and **b**.

Answer ..... [2]

(iii) **Hence** show that $hk + 2 = 2(h + k)$ if P, S and T are collinear.

Answer

[1]

(iv) Given that $h = \frac{1}{3}$ and $k = \frac{4}{5}$, find the ratio of $PS : ST$.

Answer ..... : ..... [2]

9 A factory prints posters for corporate events. The prices of printing posters of different sizes are listed below:

Type of banners	Size in inches	Prices (per copy)	Additional cost
Bulletin poster	11×17	$2.00	5% of the total cost if printing a total area of more than 120 m^2
Mini poster	12×18	$2.50	
Medium poster	18×24	$3.50	
Large poster	24×36	$5.00	

The factory has the following guidelines for operating the printers.

Guidelines
• A printer operates from 9.00 am to 4.00 pm every day. • A printer needs to be cooled for a period of 30 minutes after every 2 hours of printing. • A printer needs to be serviced if its rate of printing has slowed down to less than 60 m^2 a day.

(a) Given that 1 inch = 2.54 cm, find the area of a bulletin poster in m^2.

Answer ..... m^2 [1]

(b) Mr Tan wants to print 1200 bulletin posters for an event. Calculate how much does it cost.

Answer $ ..... [2]

(c) The factory uses 2 printers to print Mr Tan's order for an entire day. The older printer takes 15 seconds more to print one bulletin poster compared to the newer printer and the rates of printing of the 2 printers are constant throughout the day.

An operator of the printers claims that the older printer needs servicing. Do you agree? Justify your answers with clear working.

Answer

.....

..... [7]

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2024 TKGS PRELIM MATH P1 SOLUTION

Qn		Solution	Content/Success Criteria	
1	(a)	8700	I can perform calculations with a calculator. I can round off values to the nearest hundred.	
	(b)	1050	Content	L
			Complexity	L
			Context	L
			Response Strategy	L
			Assessment Objective	AO1

Qn		Solution	Content/Success Criteria	
2	(a)	$5-2(6x-1)$ $=5-12x+2$ $=7-12x$	I can expand and simplify algebraic expressions. I can apply simplify expression using laws of indices.	
			Content	L
			Complexity	L
			Context	L
	(b)	$\left(\frac{27b^9}{a^6}\right)^{-\frac{1}{3}}=\left(\frac{a^6}{27b^9}\right)^{\frac{1}{3}}$ $=\frac{a^2}{3b^3}$	Response Strategy	L
			Assessment Objective	AO1

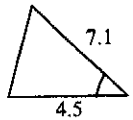
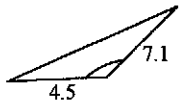
Qn	Solution	Content/Success Criteria	
3	Let amount of savings Albert and Chris have initially be $5x$ and $3x$ respectively. $\frac{5x-30}{3x-30}=\frac{2}{1}$ $5x-30=2(3x-30)$ $5x-30=6x-60$ $x=30$ $3x=90$ The amount of savings Chris has at the start = \$90	Content	L
		Complexity	L
		Context	L
		Response Strategy	M
		Assessment Objective	AO2

Qn		Solution	Content/Success Criteria	
4	(a)	$1400=2^3\times5^2\times7$	I can express a number in its prime factors. I can use the prime factors from HCF to find the original number.	
	(b)	$1400=2^3 \quad \times5^2\times7$ $q=2^2\times3 \quad \times7=84$ $\text{HCF}=2^2 \quad \times7$ $\therefore q=84$	Content	L
			Complexity	H
			Context	L
			Response Strategy	M
			Assessment Objective	AO1/ AO2

BP~720

Qn	Solution	Content/Success Criteria
5	$\frac{1}{2^{a-1}} = 2^3 + 2^3 + 2^3 + 2^3$ $\frac{1}{2^{a-1}} = 32$ $2^{1-a} = 2^5$ Comparing indices, $1 - a = 5$ $a = -4$	I can solve equation using laws of indices. $a^m \times a^n = a^{m+n}$ $a^{-n} = \frac{1}{a^n}$ Content: L Complexity: H Context: L Response Strategy: H **Assessment Objective**: AO2
OR	$\frac{1}{2^{a-1}} = 2^3 + 2^3 + 2^3 + 2^3$ $\frac{1}{2^{a-1}} = 2^3(1+1+1+1)$ $\frac{1}{2^{a-1}} = 2^3(2^2)$ $\frac{1}{2^{a-1}} = 2^5$ $2^{-(a-1)} = 2^5$ $-a + 1 = 5$ $a = -4$	

Qn		Solution	Content/Success Criteria
6	(a)	$2(5m+3n)^2$ $= 2(25m^2 + 30mn + 9n^2)$ $= 50m^2 + 60mn + 18n^2$	I can use identity $(a+b)^2 = a^2 + 2ab + b^2$ to expand algebraic expressions.
	(b)	$24(mn)^2 - 21mn^3$ $= 24m^2n^2 - 21mn^3$ $= 3mn^2(8m - 7n)$	I can factorise algebraic expressions by taking out common factor. Content: L Complexity: M Context: L Response Strategy: M **Assessment Objective**: AO1

Qn	Solution	Content/Success Criteria
7	$\frac{1}{2}(4.5)(7.1)\sin\angle XYZ = 12.6$ $15.975\sin\angle XYZ = 12.6$ $\sin\angle XYZ = \frac{12.6}{15.975}$ $\sin\angle XYZ = \frac{56}{71}$   $\angle XYZ = \sin^{-1}\left(\frac{12.6}{15.975}\right)$ or $\angle XYZ = \pi - \sin^{-1}\left(\frac{12.6}{15.975}\right)$ $\angle XYZ = 0.909$ radian $\angle XYZ = 2.23$ radian	I can use $\frac{1}{2}ab\sin C$ for area of triangle to find sine of acute and obtuse angles in radians. Content: L Complexity: M Context: L Response Strategy: L **Assessment Objective**: AO2

Qn	Solution	Content/Success Criteria	
8	$P=\frac{k}{Q^3}$, where k is a non-zero constant Q is reduced by 20%, substitute original Q with $0.8Q$. $P_{new}=\frac{k}{(0.8Q)^3}$ $=\frac{k}{0.512Q^3}$ New percentage of $P=\frac{1}{0.512}\times100\%$ $=195\frac{5}{16}\%$ Percentage change in $P=95\frac{5}{16}\%$ or 95.3125%	I can use inverse proportion to find percentage change.	
		Content	L
		Complexity	M
		Context	L
		Response Strategy	L
		Assessment Objective	AO2
OR	$Q_{new}=80\%\ of\ Q$ $=\frac{4}{5}Q$ $P_{new}\left(\frac{4}{5}Q\right)^3=PQ^3$ $P_{new}=\frac{125}{64}P$ Percentage change in $P=\frac{\frac{125}{64}P-P}{P}\times100\%$ $=\frac{61}{64}\times100\%$ $=95\frac{5}{16}\%$ or 95.3125%		

Qn		Solution	Content/Success Criteria	
9	(a)	$p=\frac{\frac{1}{5}+(-6)^2}{\frac{1}{5}-5}$ $=-\frac{181}{24}$ or $-7\frac{13}{24}$ or -7.54	I can evaluate algebraic expressions by substitution.	
	(b)	$p=\frac{q+r^2}{q-5}$ $p(q-5)=q+r^2$ $pq-5p=q+r^2$ $pq-q=r^2+5p$ $q(p-1)=r^2+5p$ $q=\frac{r^2+5p}{p-1}$	I can change the subject of the formula.	
			Content	L
			Complexity	L
			Context	L
			Response Strategy	L
			Assessment Objective	AO1

Qn		Solution	Content/Success Criteria
10	(a)	$\sin 30° = \frac{BD}{32}$ $\boxed{DB = 32\sin 30°}$ **Essential step** $= 16$ cm	I can use TOA CAH SOH to find unknown sides in right-angled triangle. Content: L Complexity: L Context: L Response Strategy: L **Assessment Objective**: AO1
	(b)	$AD^2 + BD^2 = 12^2 + 16^2$ $= 400$ $AB^2 = 20^2$ $= 400$ Since $AD^2 + BD^2 = AB^2$, angle $ADB = 90°$ by the converse of Pythagoras' Theorem. Since angle $ADB = 90°$, by the property right angle in semicircle, it is possible to draw diameter AB such that point D lies on the circumference of the circle.	I can use converse of Pythagoras Theorem to prove right angles. I can use right-angle in semicircle to determine that the points in triangle lie on the circumference of circle. Content: H Complexity: H Context: L Response Strategy: H **Assessment Objective**: AO3

Qn	Solution		Content/Success Criteria
11	$\frac{3}{(1-2h)^2} + \frac{8}{2h-1}$ $= \frac{3}{(1-2h)^2} - \frac{8}{1-2h}$ $= \frac{3-8(1-2h)}{(1-2h)^2}$ $= \frac{3-8+16h}{(1-2h)^2}$ $= \frac{-5+16h}{(1-2h)^2}$	Alternatively, $\frac{3}{(1-2h)^2} + \frac{8}{2h-1}$ $= \frac{3}{(2h-1)^2} + \frac{8}{2h-1}$ $= \frac{3+8(2h-1)}{(1-2h)^2}$ $= \frac{3+16h-8}{(1-2h)^2}$ $= \frac{16h-5}{(1-2h)^2}$	I can add two algebraic fractions with quadratic denominators. Content: L Complexity: M Context: L Response Strategy: M **Assessment Objective**: AO1

Qn		Solution	Content/Success Criteria
12	(a)	$2k - 5$	I can form and solve linear inequalities in one variable. Content: L Complexity: L Context: L Response Strategy: L **Assessment Objective**: AO1
	(b)	$2k - 5 + 2k - 3 > 16$ $4k - 8 > 16$ $4k > 24$ $k > 6$ Smallest possible value of the larger odd number $= 2(7) - 3$ $= 11$	

Qn	Solution	Content/Success Criteria	
13	$OA = OB = OD$ (radius of circle) Angle $BAO = x°$ (base $\angle s$ of isos Δ) Angle $AOB = 180° - 2x°$ ($\angle$ sum of isosceles Δ) Angle $DAO = y°$ (base $\angle s$ of isos Δ) Angle $AOD = 180° - 2y°$ ($\angle$ sum of isosceles Δ) Angle $BCD = \frac{1}{2}[(180° - 2x°) + (180° - 2y°)]$ ($\angle$ at centre = 2 $\angle$ at circumference) $= \frac{1}{2}(360° - 2x° - 2y°)$ $= 180° - x° - y°$	I can use angle properties of circles to find an unknown angle.	
		Content	L
		Complexity	L
		Context	L
		Response Strategy	M
		Assessment Objective	AO2
OR	Angle $BAO = x°$ (base $\angle s$ of isos Δ) Angle $DAO = y°$ (base $\angle s$ of isos Δ) Angle $BCD = 180° - x° - y°$ ($\angle s$ in opp. segment)		

Qn		Solution	Content/Success Criteria	
14	(a)	$(3x+1)(x-5)$	I can factorise quadratic expression in the form $ax^2 + bx + c$.	
	(b)	$3(y+1)^2 - 14y - 19$ $= 3(y+1)^2 - 14y - 14 - 5$ $= 3(y+1)^2 - 14(y+1) - 5$ By observation with algebraic expression in part (a), it is observed that $y + 1 = x$. Using answer from part (a), $[3(y+1)+1][(y+1)-5]$ $= (3y+4)(y-4)$	Content	L
			Complexity	M
			Context	L
			Response Strategy	M
			Assessment Objective	AO1/ AO2

Qn	Solution	Content/Success Criteria	
15	Substitute $x = 2$ and $y = 3$ into equation of the curve $3 = a(2)^2 + b(2) + 2$ $3 = 4a + 2b + 2$ $1 = 4a + 2b$ ----------(1) Substitute $x = -1$ and $y = -3$ into equation of the curve $-3 = a(-1)^2 + b(-1) + 2$ $-3 = a - b + 2$ $-5 = a - b$ ----------(2) From (2), $a = -5 + b$ ----------(3) Substitute (3) into (1) $1 = 4(-5 + b) + 2b$ $1 = -20 + 4b + 2b$ $21 = 6b$ $b = 3.5$ Substitute $b = 3.5$ into (3) $a = -5 + 3.5$ $a = -1.5$ Therefore, $a = -1.5$ and $b = 3.5$	I can apply the concept of substituting coordinates of points to form and solve linear equations in two variables.	
		Content	M
		Complexity	L
		Context	L
		Response Strategy	L
		Assessment Objective	AO2

Qn		Solution	Content/Success Criteria
16	(a)	P(choosing a red marble) $= 1-\frac{1}{6}-\frac{7}{12}$ $=\frac{1}{4}$ Let the total number of marbles in the bag be x. $\frac{1}{4}x=15$ $x=15\times4$ $=60$	I can find the probability of single and combined events.
	(b)	Number of blue marbles $=\frac{1}{6}\times60$ $=10$ $\frac{10}{60}\times\frac{9}{59}$ $=\frac{3}{118}$	

Content	L
Complexity	L
Context	L
Response Strategy	L
Assessment Objective	AO1

Qn		Solution	Content/Success Criteria
17	(a)	$\angle BCD=\frac{(5-2)\times180°}{5}$ $=108°$ $\angle DCI=\frac{(6-2)\times180°}{6}$ $=120°$ $\angle BCI=360°-108°-120°$ ($\angle$s at a point) $=132°$	I can able to apply concepts of interior and exterior angles of polygons and angles at a point to find unknown. Int. $\angle$ + Ext. $\angle=180°$ Sum of int. $\angle$s $=(n-2)\times180°$ Number of sides $=\frac{360°}{\text{Value of 1 ext. }\angle}$
		Alternatively, One ext. $\angle$ of pentagon $=\frac{360°}{5}$ $=72°$ One ext. $\angle$ of hexagon $=\frac{360°}{6}$ $=60°$ $\angle BCI=72°+60°$ $=132°$	
	(b)	Exterior angle $=180°-132°$ $=48°$ Number of sides of polygon $=\frac{360°}{48°}$ $=7.5$ Since the number of sides is not a positive integer greater than 3, BC and CI cannot be sides of a regular polygon. Alternatively, using interior angles of polygon $132°=\frac{(n-2)\times180°}{n}$ $132°n=180°n-360°$ $48°n=360°$ $n=7.5$ Since the number of sides is not a positive integer greater than 3, BC and CI cannot be sides of a regular polygon.	I can use properties of polygons to determine if a polygon has equal sides.

Content	L
Complexity	L
Context	L
Response Strategy	L
Assessment Objective	AO2

Content	L
Complexity	L
Context	L
Response Strategy	M
Assessment Objective	AO3

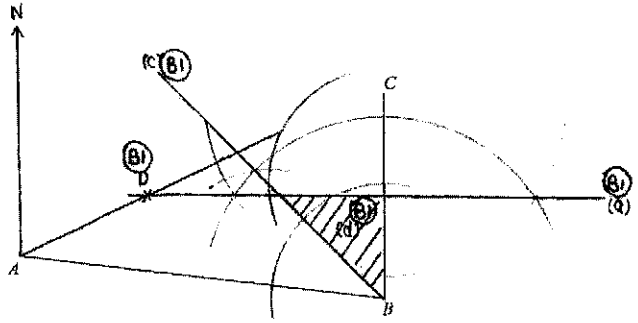
Qn		Solution	Content/Success Criteria
18	(a)	$\frac{1}{2}\times\left(\frac{42}{60}+\frac{63}{60}\right)\times v=14$ $\frac{7}{8}v=14$ $v=16$ (shown) Alternatively, $v=\frac{4}{15}$ km/h $=\frac{4}{15}\div 60$ km/h $=16$ km/h or $v=\frac{4}{15}$ km/min $=\frac{4\text{ km}}{\frac{15}{60}\text{ h}}$ $=16$ km/h	I can use distance in speed-time graph to find speed. Content: L Complexity: M Context: L Response Strategy: H **Assessment Objective**: AO2
	(b)	$\frac{5}{11}\times 16$ $=7\frac{3}{11}$ km/h or 7.27 km/h (3 sf)	I can find unknown speed and acceleration in speed-time graph. Content: L Complexity: L Context: L Response Strategy: L **Assessment Objective**: AO1
	(c)	Acceleration = Gradient in last 10 mins $=\frac{0-16}{\frac{10}{60}}$ $=-96$ km/h^2	

Qn		Solution	Content/Success Criteria
19	(a)	23	I can apply concepts of mode and range to stem-and-leaf diagram. Content: L Complexity: M Context: L Response Strategy: M **Assessment Objective**: AO1/AO2
	(b)	$\frac{4}{14}\times 100\%=28\frac{4}{7}\%$	
	(c)	$11+31=42$ $40-31=9$	

Qn		Solution	Content/Success Criteria
20	(a)	$T_5=\frac{6}{5^4}-\frac{7}{5^5}=\frac{23}{3125}$	I can recognize and represent pattern by finding an algebraic expression for the nth term. Skills: $5^{n-1}=5^n\times 5^{-1}$ $5^{-1}=\frac{1}{5}$ Content: L Complexity: M Context: L Response Strategy: M **Assessment Objective**: AO1/AO2
	(b)	$T_n=\frac{n+1}{5^{n-1}}-\frac{n+2}{5^n}$ $=\frac{5(n+1)}{5^n}-\frac{n+2}{5^n}$ $=\frac{5(n+1)-(n+2)}{5^n}$ $=\frac{5n+5-n-2}{5^n}$ $=\frac{4n+3}{5^n}$ (shown)	
	(c)	$T_1+T_2+T_3+\ldots+T_{10}$ $=\left(\frac{2}{1}-\frac{3}{5}\right)+\left(\frac{3}{5}-\frac{4}{5^2}\right)+\left(\frac{4}{5^2}-\frac{5}{5^3}\right)+\ldots+\left(\frac{11}{5^9}-\frac{12}{5^{10}}\right)$ $=\frac{2}{1}-\frac{12}{5^{10}}$ $=2.00$ (to 3 s.f.)	Content: L Complexity: M Context: L Response Strategy: H **Assessment Objective**: AO3

Qn		Solution	Content/Success Criteria
21	(a)	$t+12+t-2$ $=(2t+10)$ minutes	I can apply concepts of average speed to find time.
	(b)	$\text{Average speed} = \dfrac{\text{Total distance}}{\text{Total time}}$ $10.5 = \dfrac{8.75}{\left(\dfrac{2t+10}{60}\right)}$ $\dfrac{2t+10}{60} = \dfrac{8.75}{10.5}$ $2t+10 = 60\left(\dfrac{8.75}{10.5}\right)$ $2t+10 = 50$ Total time = 50 minutes ***Alternatively:*** $10.5 \text{ km/h} = \dfrac{10.5 \text{ km}}{1 \text{ h}}$ $= \dfrac{10.5 \text{ km}}{60 \text{ min}}$ $= \dfrac{7}{40}$ km/min $\text{Average speed} = \dfrac{\text{Total distance}}{\text{Total time}}$ $\dfrac{7}{40} = \dfrac{8.75}{2t+10}$ $7(2t+10) = 350$ $14t+70 = 350$ $14t = 280$ $t = 20$ Time taken for the whole journey $= 2(20)+10$ $= 50$ minutes	

Content	L	
Complexity	L	
Context	L	
Response Strategy	L	
Assessment Objective	AO1/ AO2	

Qn	Solution
22	 **Note: North line at A must be parallel to BC because C is due north of B.*

	Content/Success Criteria	
	I can construct perpendicular bisectors, angle bisectors and points with given bearing. I can draw conclusions of the required area after constructing the bisectors.	
	Content	L
	Complexity	L
	Context	L
	Response Strategy	M
	Assessment Objective	AO1/AO2

Qn		Solution	Content/Success Criteria
23	(a)(i)	4.2	I can calculate mean and standard deviation from grouped data using a calculator.
	(a)(ii)	2.47	

Content	L
Complexity	L
Context	L
Response Strategy	L
Assessment Objective	AO1

	(b)	The mean number of books will increase by 2 while the standard deviation value will remain the same.	I can draw simple inferences from mean and standard deviation values.
			Content: M; Complexity: L; Context: L; Response Strategy: H; **Assessment Objective**: AO3
	(c)	SD of class $A = 2.47$ SD of class $B = 3.15$ Since the standard deviation value of class A is lesser than class B by 0.68, class A has a smaller spread about the mean and the number of books read by class A is more homogeneous in general.	

Qn		**Solution**	**Content/Success Criteria**
24	**(a)**	$W = 5\begin{pmatrix} 25 & 32 & 40 \\ 21 & 19 & 32 \end{pmatrix}$ $= \begin{pmatrix} 125 & 160 & 200 \\ 105 & 95 & 160 \end{pmatrix}$	I can solve problems involving sum and product of matrices.
	(b)	$C = \begin{pmatrix} 40 \\ 25 \\ 30 \end{pmatrix}$	
	(c)	$T = \begin{pmatrix} 125 & 160 & 200 \\ 105 & 95 & 160 \end{pmatrix}\begin{pmatrix} 40 \\ 25 \\ 30 \end{pmatrix}$ $= \begin{pmatrix} 15000 \\ 11375 \end{pmatrix}$	Content: L; Complexity: L; Context: L; Response Strategy: M; **Assessment Objective**: AO1/ AO2
	(d)	The elements in **T** represent the total amount of school fees paid for weekdays in a week for beginner and advanced students respectively.	

Qn		**Solution**	**Content/Success Criteria**
25	**(a)**	$OQ = OS$ (radii of small circle) $\angle OQP = \angle OSR$ (radius $\perp$ tangent) $\angle POQ = \angle ROS$ (vert. opp. $\angle$s) ΔOPQ is congruent to ΔORS (ASA congruency test) Alternatively, $OQ = OS$ (radii of small circle) $OP = OR$ (radii of big circle) $\angle PQO = \angle RSO$ (radius $\perp$ tangent) ΔOPQ is congruent to ΔORS (RHS congruency test)	I can determine if two triangles are congruent. Content: L; Complexity: M; Context: H; Response Strategy: H; **Assessment Objective**: AO3
	(b)	Let the radius of the small circle be $5r$. $\angle PQO = \angle RSO$ (radius $\perp$ tangent) Area of one shaded triangle $= \frac{1}{2} \times 5r \times 12r$ $= 30r^2$ Area of big circle $= \pi(13r)^2$ $= 169\pi r^2$ Percentage of shaded region $= \frac{2 \times 30r^2}{169\pi r^2} \times 100\%$ $= \frac{60}{169\pi} \times 100\%$ $= 11.3\%$ (3 s.f.)	I can use ratio and percentage to find area of circles and triangles. Content: L; Complexity: L; Context: H; Response Strategy: M; **Assessment Objective**: AO2
OR		Let the radius of the small circle be r. $PQ = \frac{12}{5}r$ $OP = \frac{13}{5}r$ Area of one shaded triangle $= \frac{1}{2} \times r \times \left(\frac{12}{5}r\right)$ $= 1.2r^2$ Area of big circle $= \pi\left(\frac{13}{5}r\right)^2$ $= 6.76\pi r^2$ Percentage of shaded region $= \frac{2 \times 1.2r^2}{6.76\pi r^2} \times 100\%$ $= \frac{2.4}{6.76\pi} \times 100\%$ $= 11.3\%$ (3 s.f.)	

2024 TKGS PRELIM MATH P2 MARK SCHEME

Qn			Solution	Content/Success Criteria
1	(a)		$\frac{3-2x}{7}=\frac{1}{3}(2x-1)$ $3(3-2x)=7(2x-1)$ $9-6x=14x-7$ $20x=16$ $x=0.8/\frac{4}{5}$	I can multiply LCM to remove the denominators on both sides of a linear equation involving fractions. I can solve a linear equation. Content: L; Complexity: L; Context: L; Response Strategy: Simple; **Assessment Objective**: AO1
	(b)	(i)	$\frac{25a^2-9b^2}{15a-10ab+6b^2-9b}$ $=\frac{(5a)^2-(3b)^2}{5a(3-2b)+3b(2b-3)}$ $=\frac{(5a-3b)(5a+3b)}{5a(3-2b)-3b(3-2b)}$ $=\frac{(5a-3b)(5a+3b)}{(5a-3b)(3-2b)}$ $=\frac{5a+3b}{3-2b}$	I can factorise algebraic expressions by identity and grouping. Content: L; Complexity: L; Context: L; Response Strategy: Simple; **Assessment Objective**: AO1
		(ii)	$\frac{3c}{4ab}\div\frac{c^3}{12a^2b}$ $=\frac{3c}{4ab}\times\frac{12a^2b}{c^3}$ $=\frac{36a^2bc}{4abc^3}$ $=\frac{9a}{c^2}$	I can take reciprocal to convert division to multiplication. I can apply laws of indices to simplify algebraic expressions. Content: L; Complexity: L; Context: L; Response Strategy: Routine; **Assessment Objective**: AO1

Qn			Solution	Content/Success Criteria
	(c)	(i)	$-x^2+9x-\frac{7}{2}=0$ $x^2-9x+\frac{7}{2}=0$ $\left(x-\frac{9}{2}\right)^2+\frac{7}{2}-\left(-\frac{9}{2}\right)^2=0$ $\left(x-\frac{9}{2}\right)^2-\frac{67}{4}=0$ $\left(x-\frac{9}{2}\right)^2=\frac{67}{4}$ $x=\pm\sqrt{\frac{67}{4}}+\frac{9}{2}$ $x=8.59268$ or 0.407324 $x=8.59$ or 0.41	I can complete the square. I can solve equation using complete the square method Content: L; Complexity: L; Context: L; Response Strategy: Routine; **Assessment Objective**: AO1
		(ii)	$-x^2+9x-\frac{7}{2}=-(x-4.5)^2+16.75/\frac{67}{4}$ Since the maximum value of $y=-x^2+9x-\frac{7}{2}$ is $16.75/\frac{67}{4}<18$. There is no solution when $y=18$.	I know that $y=-x^2+9x-\frac{7}{2}$ has max. value. I can find max. value with complete square form of quadratic equation. Content: L; Complexity: M; Context: M; Response Strategy: Routine; **Assessment Objective**: AO3
OR			$-x^2+9x-\frac{7}{2}=18$ $-x^2+9x-\frac{43}{2}=0$ Discriminant $=(9)^2-4(-1)\left(-\frac{43}{2}\right)$ $=-5$ Since discriminant <0, $-x^2+9x-\frac{7}{2}=18$ has no solution.	

BP~730

Qn		Solution	Content/Success Criteria
2	(a)	P(man who passed test) $= \frac{1\times 3}{7\times 3} = \frac{3}{21}$ $\therefore$ the number of men who passed the test $= 3$ Let the number of women who failed the test be x P(both women failed the test) $= \frac{x}{21}\times\frac{x-1}{20} = \frac{1}{10}$ $x^2 - x = \frac{420}{10}$ $x^2 - x - 42 = 0$ $(x-7)(x+6) = 0$ $x = 7$ or -6 (rejected) Women who passed the test $= 21 - 9 - 7 - 3$ $= 2$	I can find the probability of a single event. I can use multiplication of probabilities for simple combined events.

	Passed	Failed
Men	3	**9**
Women	2	7

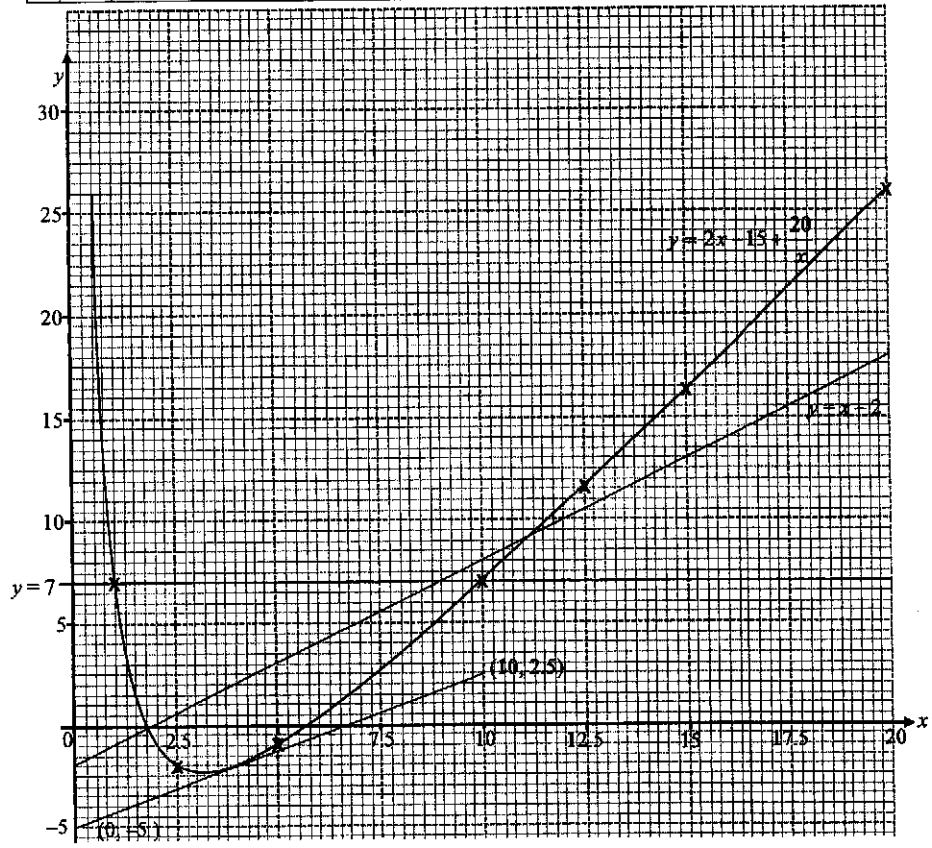
Content	M
Complexity	M
Context	M
Response Strategy	Unfamiliar
Assessment Objective	AO2

Qn			Solution	Content/Success Criteria
2	(b)	(i)	A set of students who only listen to pop music but not classical music.	I can represent elements of set notation in words. I can find the number of elements in any sets.
		(ii)	10	
		(iii)	4	
		(iv)	9	

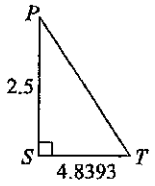
Content	L
Complexity	M
Context	M
Response Strategy	Simple
Assessment Objective	AO2

Qn		Solution	Content/Success Criteria
3	(a)	-2	I can find the value by substitution.
	(b)	See graph below	I can draw graph that passes through all points plotted smoothly.

Content	L
Complexity	L
Context	L
Response Strategy	Routine
Assessment Objective	AO1



Qn		Solution	Content/ Success Criteria	
	(c)	$2x+\frac{20}{x}<22$ $2x+\frac{20}{x}-15<22-15$ $2x+\frac{20}{x}-15<7$ Draw a line of $y=7$ on the graph $\therefore\ 1<x<10$	I can solve inequality using graph.	
			Content	M
			Complexity	M
			Context	L
			Response Strategy	unfamiliar
			Assessment Objective	AO2
	(d)	Draw a tangent at $x=4$ gradient $=\frac{2.5-(-5)}{10-0}$ $=0.75$ (accept ± 0.2)	I know how to find tangent on a graph.	
			Content	L
			Complexity	L
			Context	L
			Response Strategy	Routine
			Assessment Objective	AO1
	(e)	$x^2-13x+20=0$ $\frac{x^2}{x}-\frac{13x}{x}+\frac{20}{x}=\frac{0}{x}$ $x-13+\frac{20}{x}=0$ $2x-15+\frac{20}{x}=x-2$ Draw $y=x-2$ on the graph $x=1.783$ or 11.217 (accept ± 0.15)	I can solve quadratic equation using graph.	
			Content	L
			Complexity	M
			Context	M
			Response Strategy	Routine
			Assessment Objective	AO2

Qn		Solution	Content/Success Criteria	
4	(a)	Using sine rule, $ST=\frac{7.5}{\sin 95^\circ}\times\sin 40^\circ$ **Essential step** $=4.83932$ $SX=\frac{1}{4}ST$ $=1.209831$ $=1.21$ m	I can use sine rule to find unknown length	
			Content	L
			Complexity	L
			Context	L
			Response Strategy	simple
			Assessment Objective	AO1
	(b)	$\angle RSX=180^\circ-40^\circ-95^\circ$ (angle sum of triangle) $=45^\circ$ Using cosine rule, **Essential step** $XR=\sqrt{1.209831^2+7.5^2-2(1.209831)(7.5)\cos 45^\circ}$ $=6.69937$ $=6.70$ m	I can apply cosine rule to find unknown length	
			Content	L
			Complexity	L
			Context	L
			Response Strategy	simple
			Assessment Objective	AO1
	OR	Using sine rule, $TR=\frac{7.5\times\sin 45^\circ}{\sin 95^\circ}$ **Essential step** $=5.3236$ m $XT=\frac{3}{4}\times 4.83932$ $=3.62949$ m Using cosine rule, **Essential step** $XR=\sqrt{3.62949^2+5.3236^2-2(3.62949)(5.3236)\cos 95^\circ}$ $=6.69937$ $=6.70$ m		
	(c)	By Pythagoras' Theorem, $PT=\sqrt{2.5^2+4.8393^2}$ $=5.4469$ $=5.45$ m  	I can use Pythagoras' Theorem to find unknown length	
			Content	L
			Complexity	L
			Context	L
			Response Strategy	simple
			Assessment Objective	A01

Qn		Solution	Content/Success Criteria
	(d)	Let the point directly below the bird be B. $\angle SBX = 90°$ for XB to be the shortest distance $\boxed{XB = \sin 45° \times 1.209831}$ **Essential step** $= 0.8554797$ m $\boxed{\tan\theta = \frac{2.5}{0.8554797}}$ **Essential step** $\theta = \tan^{-1}\left(\frac{2.5}{0.8554797}\right)$ $= 71.10947$ $= 71.1°$ (1 d.p)	I know that shortest distance gives largest angle of elevation I can use trigo ratio to find unknown angle Content: L Complexity: M Context: M Response Strategy: taught **Assessment Objective**: A02
	OR	$\frac{1}{2} \times 7.5 \times h = \frac{1}{2} \times 1.20983 \times 7.5 \times \sin 45$ $h = 0.85547$ $\theta = \tan^{-1}\left(\frac{2.5}{0.8554797}\right)$ $= 71.10947$ $= 71.1°$ (1 d.p)	

Qn			Solution	Content/Success Criteria
5	(a)	(i)	$\angle ABD = \angle ACD$ ($\angle s$ in same segment) $= 30°$	I can apply circle properties to find angle
		(ii)	$\angle ACB = \angle OBC$ (base $\angle s$ of isosceles Δ) $= 40°$ $\angle BCD = 40° + 30°$ $= 70°$ $\angle BAD = 180° - 70°$ ($\angle s$ in opposite segments) $= 110°$	I can apply circle properties to find angle Content: L Complexity: L Context: L Response Strategy: taught **Assessment Objective**: AO1
		(iii)	Let r be the radius of the circle, $\angle DOB = 140°$ ($\angle$ at centre $= 2\angle$ at circumferene) $\frac{140°}{360°} \times 2\pi r = 11$ $r = \frac{11}{\frac{7}{18} \times 2\pi}$ $= 4.5$	I can find radius given angle Content: L Complexity: L Context: M Response Strategy: taught **Assessment Objective**: AO2
	OR		Let r be the radius of the circle, $\angle DOB = 140°$ ($\angle$ at centre $= 2\angle$ at circumferene) $r\theta = 11$ $r = \frac{11}{140 \times \frac{\pi}{180}}$ $= 4.5$	
	(b)	(i)	$\angle BTC = \angle BCD = 70°$ (found in (a(ii)) $\angle OBT = 90°$ (tan $\perp$ radius) $\angle CBT = 90° - 40°$ $= 50°$ $\angle BOC = 180° - (40° \times 2)$ (base $\angle$s of isosceles Δ) $= 100°$ $\angle BDC = \frac{100°}{2}$ ($\angle$ at centre $= 2\angle$at circumference) $= 50°$ $\therefore \angle CBT = \angle BDC = 50°$ $\therefore \Delta CTB$ is similar to ΔBCD by AA similary test	I can apply circle properties to find angle to prove similarity Content: L Complexity: M Context: M Response Strategy: taught **Assessment Objective**: AO2

Qn			Solution	Content/Success Criteria	
		(ii)	$\frac{CT}{BC}=\frac{BC}{DB}$ (corresponding sides of similar triangles) $CT=\frac{BC}{DB}\times BC$ $CT=\frac{x}{y}\times x$ $=\frac{x^2}{y}$	I can use ratios of corresponding sides of similar triangles to solve unknown	
				Content	L
				Complexity	M
				Context	M
				Response Strategy	taught
				Assessment Objective	AO2

Qn			Solution	Content/Success Criteria	
6	(a)	(i)	median = 17 min	I know how to read CFC and find median and IQR. I know the meaning of percentile.	
		(ii)	interquartile = 20 − 13 = 7 min		
		(iii)	number of customers = $\frac{35}{100}\times 60$ = 21 From the graph, 35th percentile = 15 min	Content	L
				Complexity	L
				Context	L
				Response Strategy	simple
				Assessment Objective	AO1
	(b)		If 20 % waited <u>more than</u> x minutes, then 100% − 20% = 80% waited <u>less than or equal to</u> x minutes $\frac{80}{100}\times 60 = 48$ customers From the graph, $x = 21.5$ min	I can interpret the 'more than' CFC.	
				Content	L
				Complexity	L
				Context	L
				Response Strategy	taught
				Assessment Objective	AO1
	(c)	(i)	median = $\frac{15+17}{2}$ = 16 min	I know how to find median and IQR for discrete data.	
		(ii)	interquartile = 18 − 14 = 4 min	Content	L
				Complexity	L
				Context	L
				Response Strategy	taught
				Assessment Objective	AO1
	(d)		The sample sizes are not the same. **OR** Sample size for restaurant B is not large enough.	Content	M
				Complexity	M
				Context	M
				Response Strategy	unfamiliar
				Assessment Objective	AO3

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Qn			Solution	Content/Success Criteria
7	(a)	(i)	$\frac{h}{h+16}=\sqrt{\frac{5}{125}}$ $\frac{h}{h+16}=\sqrt{\frac{1}{25}}$ $h=\frac{1}{5}(h+16)$ $h=\frac{1}{5}h+\frac{16}{5}$ $\frac{4}{5}h=\frac{16}{5}$ $h=4$ (shown)	I can use ratio of the areas of similar figures to solve for unknown Content: L; Complexity: M; Context: M; Response Strategy: taught; **Assessment Objective**: AO2
		(ii)	Vol. of large pyramid $=\frac{1}{3}\times(125)\times(16+4)$ $=833\frac{1}{3}$ cm^3 Vol. of small pyramid $=\frac{1}{3}\times(5)\times(4)$ $=6\frac{2}{3}$ cm^3 Vol. of frustum $=833\frac{1}{3}-6\frac{2}{3}$ $=826\frac{2}{3}$	I can apply the formula to find volume of pyramid Content: L; Complexity: L; Context: L; Response Strategy: taught; **Assessment Objective**: AO1
		(iii)	% removed $=\left(\frac{4}{20}\right)^3\times100$ $=\frac{1}{125}\times100$ $=\frac{4}{5}\%$ / 0.8%	I can apply ratio of volumes of similar pyramid to find percentage Content: L; Complexity: L; Context: M; Response Strategy: simple; **Assessment Objective**: AO1
	(b)		$\frac{\text{Volume of cone } A}{\text{Volume of cone } B}=\frac{\frac{1}{3}\pi(3r)^2h}{\frac{1}{3}\pi(2r)^2h}$ $\frac{\text{Volume of cone } A}{240}=\frac{9}{4}$ Volume of cone $A=\frac{9}{4}\times240$ $=540$ cm^3	I know how to find unknown volume when figures are not similar Content: L; Complexity: M; Context: M; Response Strategy: taught; **Assessment Objective**: AO2

Qn			Solution	Content/Success Criteria
8	(a)	(i)	Since $\overrightarrow{AB}$ // $\overrightarrow{CD}$, $n\begin{pmatrix}-3\\9\end{pmatrix}=\begin{pmatrix}d\\4\end{pmatrix}$ $\begin{pmatrix}-3n\\9n\end{pmatrix}=\begin{pmatrix}d\\4\end{pmatrix}$ $9n=4$ and $d=-3n$ $n=\frac{4}{9}$ and $d=-3\left(\frac{4}{9}\right)$ $d=-\frac{4}{3}$	I can use scalar multiples to find unknown given parallel vectors. Content: L; Complexity: M; Context: M; Response Strategy: Simple; **Assessment Objective**: AO2
		(ii)	$\overrightarrow{AC}=\overrightarrow{AB}+\overrightarrow{BC}$ $\overrightarrow{AC}=\begin{pmatrix}-3\\9\end{pmatrix}+\begin{pmatrix}2\\5\end{pmatrix}$ $=\begin{pmatrix}-1\\14\end{pmatrix}$ $\lvert\overrightarrow{AC}\rvert=\sqrt{(-1)^2+(14)^2}$ $=\sqrt{197}$ $=14.0$ unit	I can find the magnitude of vectors Content: M; Complexity: L; Context: L; Response Strategy: Simple; **Assessment Objective**: AO2
	(b)	(i)	$\overrightarrow{RM}=\overrightarrow{PM}-\overrightarrow{PR}$ $=\frac{1}{2}\mathbf{a}-\mathbf{b}$ $\overrightarrow{PS}=\overrightarrow{PR}+\overrightarrow{RS}$ $=\mathbf{b}+k\left(\frac{1}{2}\mathbf{a}-\mathbf{b}\right)$ $=\mathbf{b}+\frac{1}{2}k\mathbf{a}-k\mathbf{b}$ $=\frac{1}{2}k\mathbf{a}+(1-k)\mathbf{b}$ (there should only be one **a** & one **b** in the final answer)	I can express a vector in the form of 2 other vectors. Content: M; Complexity: H; Context: H; Response Strategy: Unfamiliar; **Assessment Objective**: AO3
		(ii)	$\overrightarrow{QR}=\overrightarrow{PR}-\overrightarrow{PQ}$ $=\mathbf{b}-\mathbf{a}$ $\overrightarrow{PT}=\overrightarrow{PQ}+\overrightarrow{QT}$ $=\mathbf{a}+h(\mathbf{b}-\mathbf{a})$ $=\mathbf{a}+h\mathbf{b}-h\mathbf{a}$ $=(1-h)\mathbf{a}+h\mathbf{b}$ (there should only be one **a** & one **b** in the final answer)	I can express a vector in the form of 2 other vectors. Content: M; Complexity: H; Context: H; Response Strategy: Unfamiliar; **Assessment Objective**: AO3

Qn		Solution	Content/Success Criteria
	(iii)	Since P, S and T are collinear, $\frac{\frac{1}{2}k}{1-h}=\frac{1-k}{h}$ $\left(\frac{1}{2}k\right)h=(1-h)(1-k)$ $\frac{1}{2}hk=1-h-k+hk$ $hk=2-2h-2k+2hk$ $2h+2k=hk+2$ $2(h+k)=hk+2$ (shown)	I know that for collinear point, the ratio of the scalar multiples of 2 parallel lines are equal. Content: M Complexity: H Context: H Response Strategy: Unfamiliar **Assessment Objective**: AO3
	(iv)	$\frac{\lvert\overrightarrow{PS}\rvert}{\lvert\overrightarrow{PT}\rvert}=\frac{\frac{1}{2}\left(\frac{4}{5}\right)}{1-\frac{1}{3}}=\frac{3}{5}$ $PS : ST = 3 : 5-3$ $PS : ST = 3 : 2$	I can find the ratio of 2 line segments using vectors. Content: M Complexity: L Context: L Response Strategy: Simple **Assessment Objective**: AO2

Qn		Solution	Content/Success Criteria
9	(a)	Area $=11\times17$ $=187$ inch^2 $=187\times2.54^2$ cm^2 $=\frac{1206.4492}{100^2}$ m^2 $=0.12064492$ m^2 $=0.121$ m^2	I can convert inches to metres Content: L Complexity: L Context: L Response Strategy: routine **Assessment Objective**: AO1
	(b)	Total area of 1200 bulletin posters $=1200\times0.12064492$ $=144.774$ m^2 Since the area > 120 m^2, there is an additional 5% charge. Total cost $=2\times1200+\frac{5}{100}\times2\times1200$ $=\$2520$	I can calculate the cost Content: L Complexity: M Context: M Response Strategy: taught **Assessment Objective**: AO2
	(c)	Let the time taken by the new printer to print 1 bulletin posters be t. The time taken by the old printer to print 1 bulletin posters will be $t+15$. $\frac{6\times60\times60}{t}+\frac{6\times60\times60}{t+15}=1200$ $\frac{21600(t+15)+21600t}{t(t+15)}=1200$ $21600(t+15)+21600t=1200t(t+15)$ $21600t+324000+21600t=1200t^2+18000t$ $1200t^2-25200t-324000=0$ $t^2-21t-270=0$ $t=30$ or -9 (reject) Number of posters printed by the old printer $=\frac{21600}{30+15}$ $=480$ Total area printed by old printer $=480\times0.21064$ m^2 $=57.91$ m^2 Since the older printer only printed 57.9 m^2 < 60 m^2. It will need to be serviced.	I can solve problem using various heuristics Content: M Complexity: H Context: H Response Strategy: unfamiliar **Assessment Objective**: AO2 / AO3
	OR	To print an area of 60m^2, printer must print $\frac{60}{0.12064492}=497.33$ posters. Since the older printer only printed 480 posters < 495.86 posters, it will need to be serviced.	