Name		Class				Index Number		

BROADRICK SECONDARY SCHOOL
SECONDARY 4 EXPRESS / SECONDARY 5 NORMAL ACADEMIC
PRELIMINARY EXAMINATION 2024

MATHEMATICS **4052/01**

Paper 1 **Aug 2024**

Candidates answer on the Question Paper **2 hours 15 minutes**

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.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Errata
Q13b -- For P>10 instead of P>/= 0

Answer **all** questions.
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 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 of the marks for this paper is 90.

For Examiner's Use		
Error In	**Question Number**	**Marks Deducted**
Rounding-off		
Reasoning		
Presentation		

For Examiner's Use
90

This document consists of **21** printed pages.

Setter(s) :

Mathematical Formulae

Compound interest

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

Mensuration

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

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

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

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

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

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

$$\text{Sector area} = \frac{1}{2}r^2\theta$$, 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

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

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

Errata

Q13b -- For P>10 instead of P>/= 0

Answer **all** the questions.

1 Evaluate $\dfrac{(-3.85)^2-\sqrt{10-0.9\times(-6)}}{3.11-4^3}$, giving your answer to 4 significant figures.

Answer …..……..…….. [1]

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2 The frequency table shows the reaction time, t seconds, for a chemical to change the colour of the litmus paper in 100 laboratory sessions.

Time (t sec)	$0 < t \leq 1$	$1 < t \leq 2$	$2 < t \leq 3$	$3 < t \leq 4$	$4 < t \leq 5$
Frequency	8	28	44	18	2

Calculate an estimate for the

(a) mean reaction time,

Answer …..……..….. s [1]

(b) standard deviation of the reaction times.

Answer …..……..….. s [1]

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3 Given that $\dfrac{5^x}{2^{2x}\times 5^{3-x}} = 2^m 5^n$, express m and n in terms of x.

Answer $m =$ .....……..……..

$n =$ [2]

.....……..……..

4 The highest common factor of two numbers is 18.
The lowest common multiple of the two numbers is 324.
Both numbers are greater than 20.

Find the two numbers.

Answer ….....…… and …..…….. [2]

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5 A map has a scale of 1 : 50 000.

(a) The distance between two towns on the map is 7.5 cm.
Calculate the actual distance between the two towns in kilometres.

Answer ….....……..…..….. km [1]

(b) A lake covers an actual area of 2.25 square kilometres.
Find the area of the lake on the map in square centimetres.

Answer …..…….. cm^2 [2]

6 A wooden block has a mass of 115 grams, correct to the nearest gram.
The volume of the block is 6 cm^3, correct to the nearest cm^3.
Find the largest possible density of the block in g/cm^3.

$$Density = \frac{Mass}{Volume}$$

Answer ….....…….…. g/cm^3 [2]

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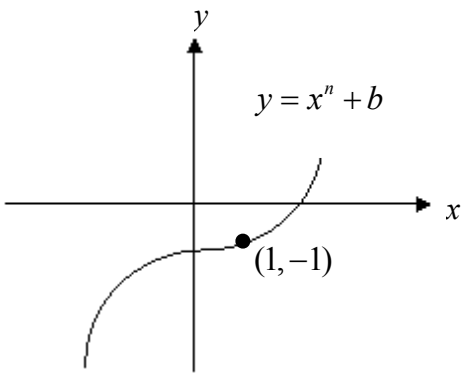
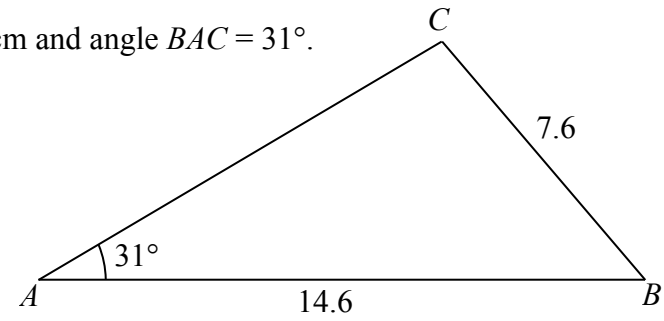
7 In the following graph, write down a possible value of n and the corresponding value of b for the equation.



Answer n = ...……..……..

b = ...……..…….. [2]

8 In triangle ABC, $AB = 14.6$ cm, $BC = 7.6$ cm and angle $BAC = 31°$.



Find

(a) obtuse angle ACB,

Answer …….....……..……. ° [2]

(b) area of triangle ABC.

Answer …….....……..…….. cm^2 [2]

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9 Keila travels from Singapore to Japan.
She wants to change 850 Singapore dollars ($) into Yen (¥).

The exchange rate in Singapore is \$100 = ¥11600 and the exchange rate in Japan is ¥1 = \$0.0086.
She claims that she will receive more if she changes the money in Singapore.
Justify if her claim is true.
Show your working.

Answer

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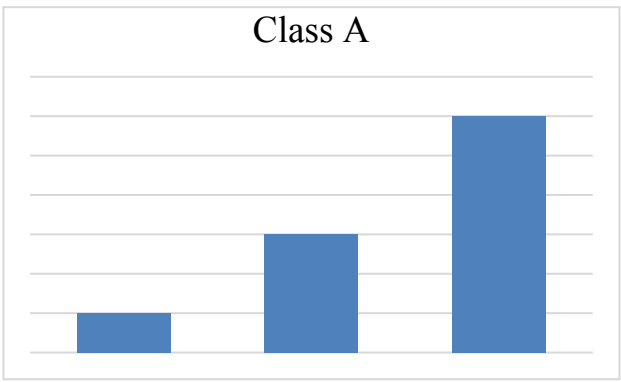
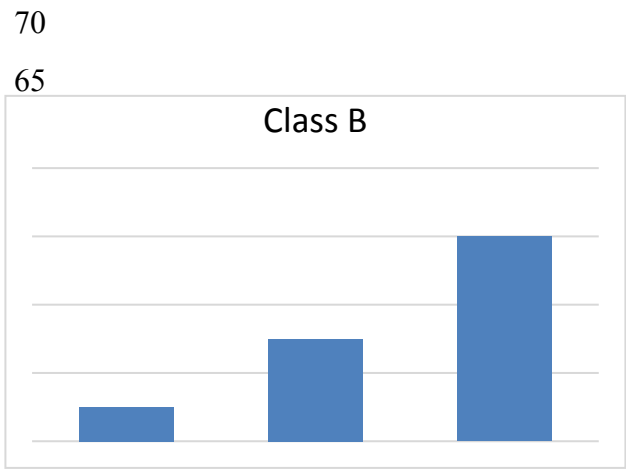
..... [3]

10 The graphs below show the average test scores of Class *A* and Class *B* over three consecutive years.





(a) What feature of the graph misleads readers to think that the scores of Class *A* in 2022 had increased to 6 times that in 2024?

……

……

..... [1]

(b) Hailey claims that the scores of Class *A* and Class *B* shows the same improvement from 2022 to 2024.
Do you agree?
Explain your answer.

……

……

……

……

..... [1]

11 The number $2^p \times 5^q \times \frac{5}{2}$ is a perfect cube where p and q are greater than 1.
Find the smallest possible integer values of p and of q.

Answer p = ...

q = ... [2]

---

12 **(a)** Simplify $\left(16y^3\right)^{\frac{3}{2}}$.

Answer ..... [1]

(b) $5^k = 125\sqrt[3]{5\sqrt{5}}$
Use laws of indices to find the value of k.
Show your working.

Answer $k =$ ……..……..…….. [3]

13 Given that $\xi = \{\text{integers } x : \ p \le x < 20\}$
$A = \{\text{factors of } 24\}$
$B = \{\text{prime numbers}\}$
$C = \{\text{perfect squares}\}$

(a) List the elements of A if $p = 2$.

Answer ……..……..…….. [1]

(b) For $p \ge 0$, list the elements of $(B \cup C)'$ such that $\text{n}(B \cup C)' = 4$.

Answer ……..……..…….. [1]

(c) Find the smallest p such that $A \cap C = \varnothing$.

Answer $p =$ ……..……..…….. [1]

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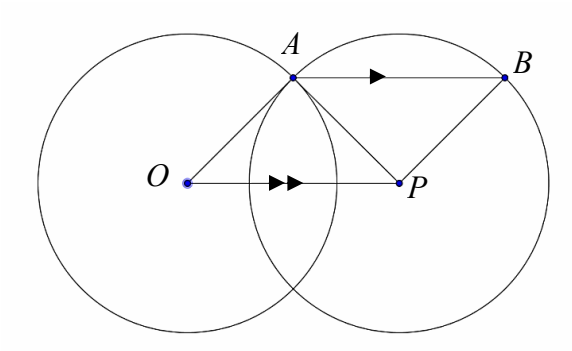
14 A company divided a bonus among its employees A, B, and C in the ratio 2 : 3 : 7.
C's bonus was X % more than the combined bonus of A and B.
Find X.

Answer $X =$ .....…….….. [2]

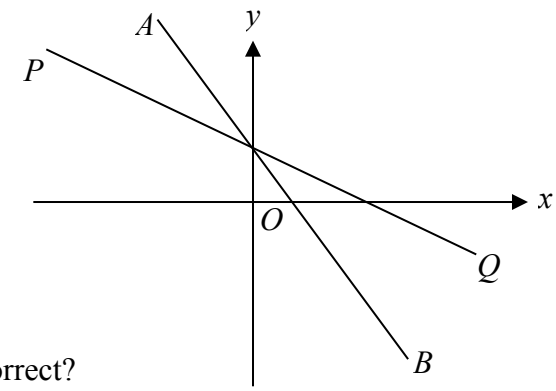
15 In the diagram, two circles with centres O and P respectively intersects at A.
The two circles have the same radius and AB // OP.
Show that $AB = OP$.

Answer



[3]

16 (a) Leanne says that the equation of the line AB is $2y = -4x + 1$ and the equation of the line PQ is $4y = -9x + 2$.



Is she correct?
Explain your answer.

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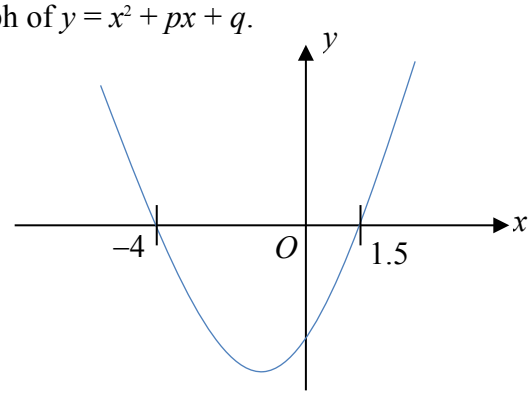
……

……

…… [2]

(b) The diagram shows the graph of $y = x^2 + px + q$.



(i) Write down equation of the graph in the form $y = x^2 + px + q$.

Answer ……..……..……..…….. [2]

(ii) Find the coordinates of the minimum point.

Answer (..……....., ...…….) [2]

17

Write as a single fraction in its simplest form .

Answer …..…..……..…….. [2]

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18 (a) Factorise completely.

(i) $24a^2b + 12ab^2 - ab$

Answer ….....……..…….. [1]

(ii) $mn - 18 - 9m + 2n$

Answer ….....……..…….. [2]

(b) Expand and simplify $(-2x + 3q)(x - 2q)$.

Answer ….....……..…….. [2]

19 Rayden invested \$20 000 at a rate of 0.3% per month compound interest.

(a) Find the value of his investment at the end of 2 years.

Answer \$ .....……..…….. [2]

(b) Rayden then withdrew $\frac{1}{5}$ of the accumulated amount at the end of the 2 years. Find the new rate of compound interest per month so that his remaining investment reaches the same value in **(a)** in another 3 years.

Answer …...……...……..... % [2]

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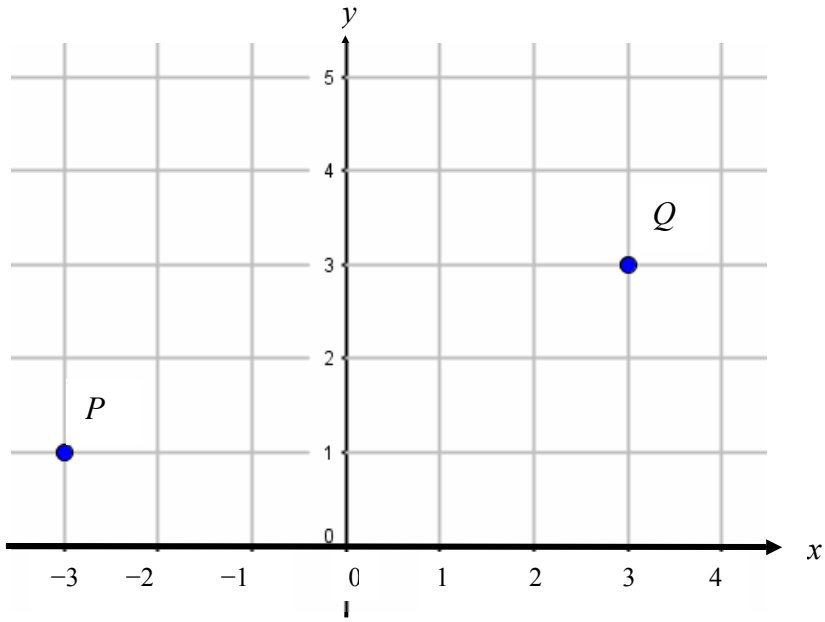
20 Simplify $\dfrac{2x^2-5xy-12y^2}{x^2-16y^2}$.

Answer ….....……..…….. [3]

21 P is the point $(-3, 1)$ and Q is the point $(3, 3)$.



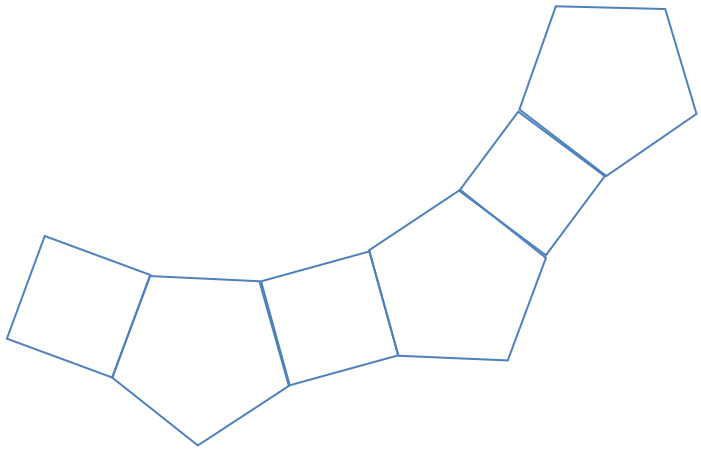
(a) Find the length of the PQ.

Answer …….....……..…… units [2]

(b) The point R is such that PQR forms an isosceles triangle.
The angle bisector of angle PQR has an equation of $y = x$.
Find the coordinates of R.

Answer (……..……..., ……..……..) [1]

22 Regular pentagons and squares of the same sides are placed together in a pattern as shown in the diagram.
Caleb claims that if he continues the pattern, a closed loop will form.
Explain whether his claim is true, showing your working clearly.



Answer

.....

.....

..... [3]

23 A cylinder X has radius, r cm and height h cm.
A hemisphere S is such that its radius is half of the radius of cylinder X.

(a) The volume of the cylinder is 4 times that of the hemisphere.
Express h in terms of r.

Answer $h =$ ……..……..……... [3]

(b) Another cylinder Y is geometrically similar to cylinder X.
The ratio of the curved surface area of $X : Y = 9 : 4$.
Find the height of cylinder Y in terms of r.

Answer ……..……..……..……... [2]

24 The sum of the first n terms of a linear sequence is .

(a) Show that the sum of the first n terms in the sequence is always even.

…….....

…….....

…….....

…….....

..... [2]

(b) By finding the first three terms in the sequence or otherwise, find, in terms of n, an expression for the nth term of the sequence.

Answer ……....……..……. [2]

25 In bookstore A, a fiction book costs \$8, a non-fiction book costs \$10 and a science book costs \$11.50.
In bookstore B, a fiction book costs \$1.10 less, a non-fiction book costs \$2.80 less and a science book costs \$1.50 more than that in bookstore A.

	A	B
F		
NF		
S		

The information can be represented by the matrix

(a) Kevin bought 4 fiction books, 3 non-fiction books and 2 science books.
Molly bought 2 fiction book and x science books.
Represent their purchases, in terms of x, in a 2×3 matrix **P**.

Answer **P** = [1]

(b) Evaluate the matrix **R** = **PQ**.

Answer **R** = [2]

(c) Explain what the elements in the first column of matrix **R** represent**.**

…….....

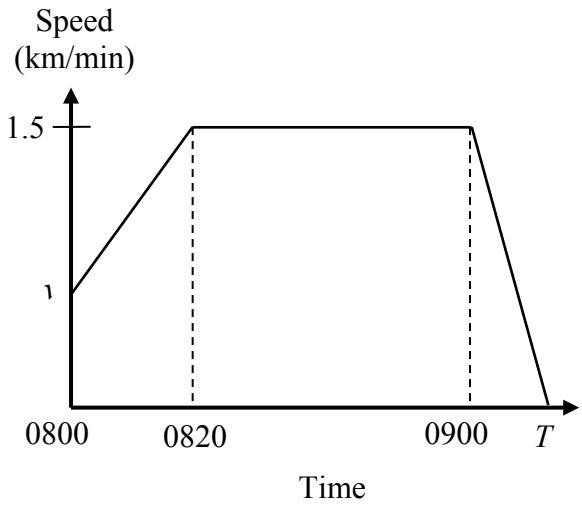
…….....

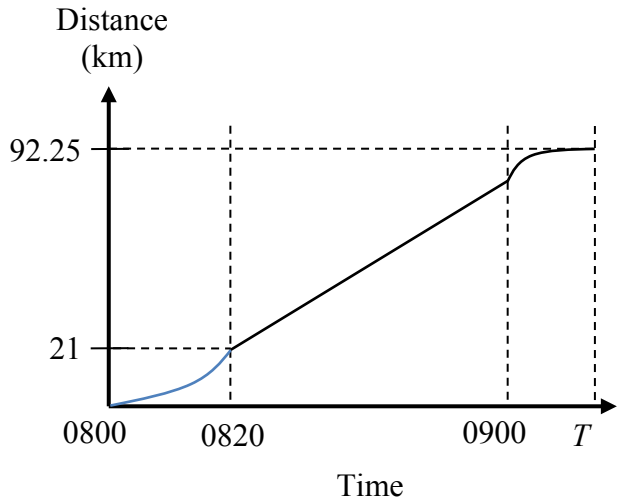
..... [1]

(d) Molly can save \$5.30 by purchasing in bookstore A.
Using your answer in **(b)**, find the value of x.

Answer x = …...……..…….. [1]

26 The diagrams show the speed-time graph and the corresponding distance-time graph of a car.
The car travelled from a point P to Q and in the journey, its greatest speed attained was 1.5 km/min.





(a) Convert 1.5 km/min to m/s.

Answer ……..……..……m/s [1]

(b) Show that v, the initial speed, was 0.6 km/min.

[2]

(c) Find the speed of the car, in m/s, at 0812.

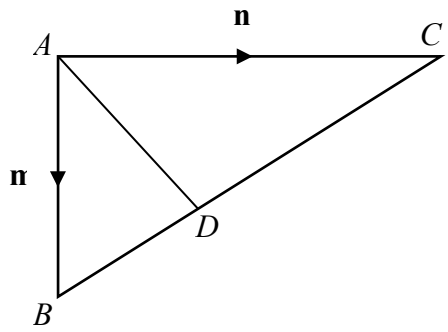
Answer ……..……..……m/s [2]

(d) The total distance travelled by the car is 92.25 km.
Find the time, T, when it comes to a complete stop.

Answer ……..……..……... [2]

27 ABC is a triangle.
D is the point on BC such that $3BD = 2DC$.

and .



(a) Find $\overrightarrow{AD}$ in terms of **m** and **n**.

Answer ……...……...……... [2]

(b) R is on AD produced such that $\overrightarrow{AR} = k\overrightarrow{AD}$ and AC is parallel to BR.

(i) Show that $k = \frac{5}{3}$.
Answer

[3]

(ii) Find the ratio $\frac{\text{area of triangle } ABD}{\text{area of triangle } RBD}$.

Answer ……...……...……... [1]

End of Paper

Paper 1 Answer Key

1	-0.17898 = -0.1790
2a	Mean = $\frac{228}{100}$ = 2.28 s
b	0.901 s (3sf)
3	$m = -2x$ $n = 2x - 3$
4	X = $2^2 \times 3^2 = 36$ Y = $2 \times 3^4 = 162$
5a	3.75 km
b	9 cm^2
6	21 g/ cm^3
7	$n = 3$ or 5 (any odd integer more than 1) $b = -2$
8a	98.3° (1dp)
b	42.9 cm^2 (3sf)
9	Her claim is not true. She will receive (237.21 Yen) more if she changes in Japan.
10a	The vertical axis did not start from 0. (Optional: The scores in 2022 looked like it had increased to 6 times but the increase was from 55 to 80 (which is slightly less than double.)
b	I disagree. Although the increase in the height of the bar looks the same from 2022 to 2024 for both classes, the scale of the two graphs are different. It exaggerates the increase in test scores of Class B.
11	$p = 4$ $q = 2$
12a	$64y^{\frac{9}{2}}$
b	$k = 3\frac{1}{2}$
13a	A={2,3,4,6,8,12}
b	$(B \cup C)' = \{12,14,15,18\}$
c	smallest p = 5
14	40%
15	$\Delta OPA \equiv \Delta BAP$ (AAS) Hence $AB = OP$
16a	The gradient of PQ should be steeper than that of AB. Hence she is not correct.
bi	$y = x^2 + 2.5x - 6$
bii	Min point (-1.25, -7.5625)
17	$= \frac{4x^2 - 10x + 4}{(3x-1)(2x+1)}$

18ai	$= ab(24a + 12b - 1)$
aii	$(m + 2)(n - 9)$
b	$= -2x^2 + 7xq - 6q^2$
19a	= \$21490.79 (2dp)
b	$r = 0.622\%$
20	$= \dfrac{2x + 3y}{x + 4y}$
21a	= 6.32 units (3sf)
b	R is (1, −3)
22	$n = \dfrac{360}{18} = 20$ Since n is a positive integer, it is possible to form a regular polygon, hence a closed loop.
23a	$h = \dfrac{1}{3}r$
b	$H = \dfrac{2}{9}r$
24a	$5n^2 - n = n(5n - 1)$
b	$10n - 6$
25a	$P = \begin{pmatrix} 4 & 3 & 2 \\ 2 & 0 & x \end{pmatrix}$
b	$= \begin{pmatrix} 85 & -9.8 \\ 16 + 11.5x & -2.2 + 1.5x \end{pmatrix}$
c	It represents the amount of money Kevin and Molly spent respectively at Bookstore A.
d	$x = 5$
26a	25 m/s
b	Area = dist travelled
c	19m/s
d	T is 0915
27a	$= \dfrac{3}{5}\mathbf{m} + \dfrac{2}{5}\mathbf{n}$
bii	$\dfrac{3}{2}$