

Mathematical Formulae*Compound interest*

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

Mensuration

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

- 1 Calculate $\sqrt[3]{\frac{1371}{5.5^2 - 45}}$. Write your answer correct to 4 significant figures.

Answer [1]

- 2 In 2017, the total operating revenue of the Singapore government was \$75.15 billion.

(a) Express \$75.15 billion in standard form.

Answer (a) \$..... [1]

(b) Calculate the estimated total operating revenue of the Singapore government in 2018 in billion.

Answer (b) \$..... billion [1]

- 3 The interior angle of a regular polygon is 140° .
Calculate the number of sides that the polygon has.

4

4 Factorise fully $4ax - 3bx + 6by - 8ay$.

Answer [2]

5 The height of a cone is increased by 10% and its radius is decreased by 10%.
Find the percentage change in the volume of the cone.

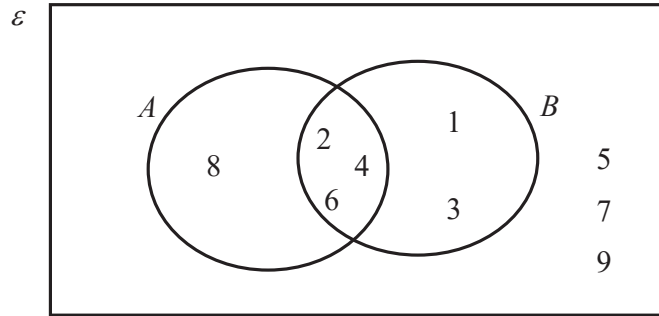
Answer % [2]

6 Four workers can paint a house in four days. Find the number of workers required,
working at the same rate, to paint twelve houses in eight days.

Answer..... workers [2]

7 $\varepsilon = \{ \text{integers } x : 1 \leq x \leq 9 \}$

The Venn diagram shows the elements of ε and two sets A and B .



(a) Describe set A in words.

[1]

(b) List the elements in $A' \cap B'$.

$A' \cap B' = \dots\dots\dots$ [1]

(c) Write down $n(A \cup B)$.

Answer (c) $\dots\dots\dots$ [1]

8 In Singapore, David pays S\$3.20 for a litre of milk.
 During his holiday in London, he paid £0.80 for 2 pints of milk.

1 British pound (£) = 1.8234 Singapore dollars (S\$)
 1 pint = 568 ml

Determine if milk is cheaper in Singapore or in London.
 Show your calculations clearly.

Answer $\dots\dots\dots$ [3]

9 The first five terms of a sequence are 4, 13, 26, p and 64.

(a) State the value of p .

Answer (a) $p = \dots\dots\dots$ [1]

(b) Find an expression, in terms of n , for the n th term of this sequence.

Answer (b) $\dots\dots\dots$ [2]

10 Simplify $\left(\frac{-x^2}{2y}\right)^3 \div \frac{\sqrt{x^4y^{-1}}}{2y^3} \times 2y^0$.

Answer $\dots\dots\dots$ [3]

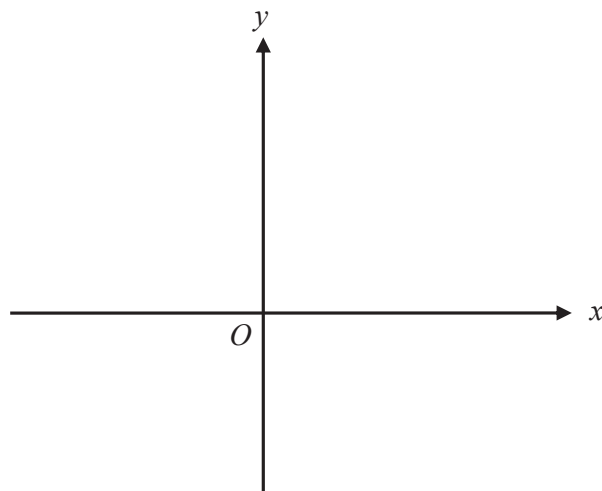
- 11 (a) Express 490 as the product of its prime factors.

Answer (a) [1]

- (b) Find two numbers, both greater than 40, that have a lowest common multiple of 490 and a highest common factor of 35.

Answer (b) and [2]

- 12 (a) Sketch the graph of $y = 2x^2 - 4x$.



[2]

- (b) Write down the equation of the line of symmetry of $y = 2x^2 - 4x$.

Answer (b) [1]

13 Solve the simultaneous equations,

$$6x = 10y - 19,$$

$$3 = 2x - y.$$

Answer $x = \dots\dots\dots$

$y = \dots\dots\dots$ [3]

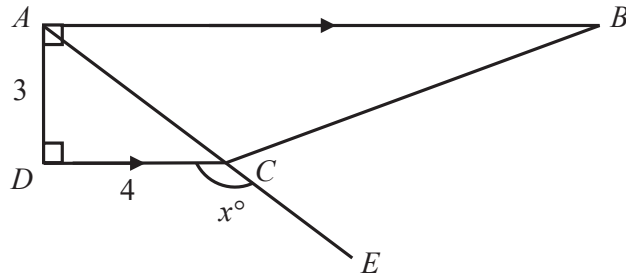
14 (a) Express $2x^2 - 8x + 1$ in the form $a(x - b)^2 + c$.

Answer (a) $\dots\dots\dots$ [2]

(b) Hence, solve $2x^2 - 2x = 6x - 1$, giving your answers to 2 decimal places.

Answer (b) $x \dots\dots\dots$ or $\dots\dots\dots$ [2]

- 15 In the diagram, $ABCD$ is a trapezium with AB parallel to DC . AD is perpendicular to AB and DC , and ACE is a straight line. $AD = 3$ cm and $CD = 4$ cm.



- (a) Find the value of $\cos x^\circ$.

Answer (a) $\cos x^\circ = \dots\dots\dots$ [2]

- (b) The area of the trapezium $ABCD$ is 4 times the area of the triangle ADC . Find AB .

[2]

16 (a) Solve the inequality $-2x - 4 \leq 2x - 3 < \frac{4x + 2}{3}$.

Answer (a) [3]

(b) Represent your answer to part (a) on the number line below.



17 A map has a scale of 1 : n .
The estimated area of Pulau Ubin, 10.19 km^2 , is represented by 163.04 cm^2 on the map.

(a) Find the value of n .

[2]

(b) On the map, the distance from Pulau Ubin jetty to Chek Jawa coastal boardwalk measures 13.2 cm. Find the actual length of the distance from Pulau Ubin jetty to Chek Jawa coastal boardwalk in kilometres.

Answer (b) km [2]

18 3 fair six-sided dice are thrown together. Find the probability that

(a) the sum of the three numbers shown is 3,

Answer (a) [1]

(b) the sum of the three numbers shown is larger than 3,

Answer (b) [1]

(c) the sum of the three dice is an odd number,

Probability = $P(\text{all dice show odd}) + P(\text{1 dice shows odd, 2 dice show even})$

Answer (c) [1]

(d) the three dice shows different numbers.

Answer (d) [1]

19 A studio offers Art lessons for adults and children on weekdays and on weekends. Each student, adult or children, has a 8-week block of lessons with one lesson per week. The matrix \mathbf{Q} shows the number of students the studio teaches each week in a 8-week block.

(a) Given the matrix $\mathbf{M} = 8\mathbf{Q}$, write down the matrix \mathbf{M} .

Answer (a) $\mathbf{M} = \dots\dots\dots$ [1]

(b) The studio charges \$30 for each lesson for children and \$55 for each lesson for adults. Write down the column matrix \mathbf{N} that represents the lesson charges.

Answer (b) $\mathbf{N} = \dots\dots\dots$ [1]

(c) Evaluate the matrix $\mathbf{P} = \mathbf{MN}$.

Answer (c) $\mathbf{P} = \dots\dots\dots$ [1]

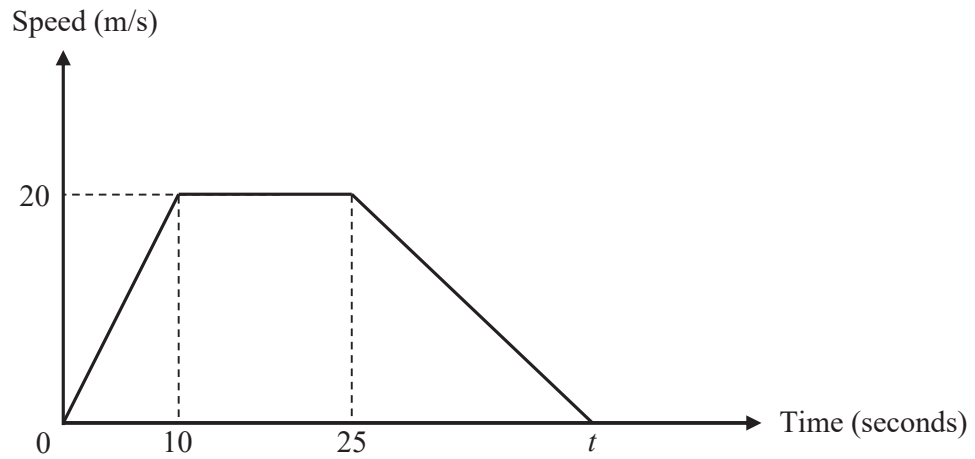
(d) State what the elements of \mathbf{P} represent.

[1]

(e) By matrix multiplication, find the total amount of money the studio receives in this 8-week block of lessons.

Answer (e) \$.. $\dots\dots\dots$ [1]

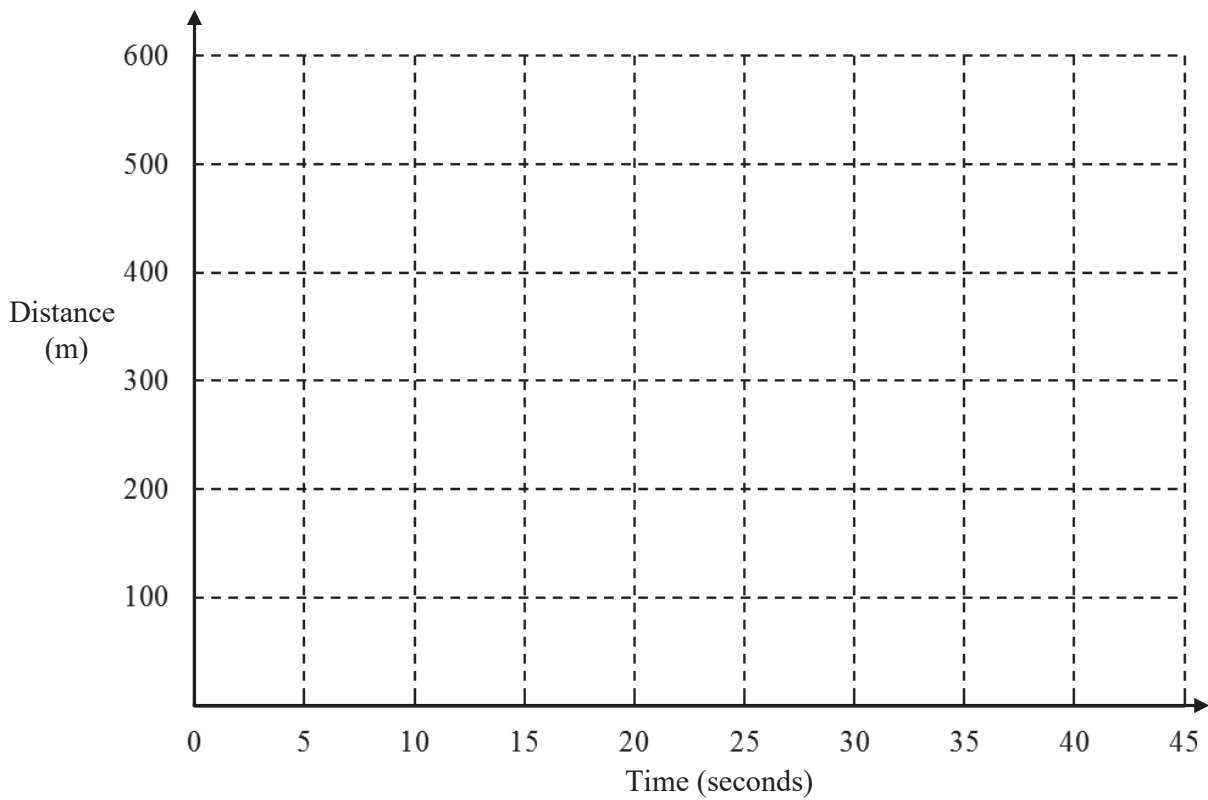
20 The diagram shows the speed-time graph for a car's journey.



(a) If the car travelled a total distance of 600 m, find the value of t .

Answer (a) $t = \dots\dots\dots$ [2]

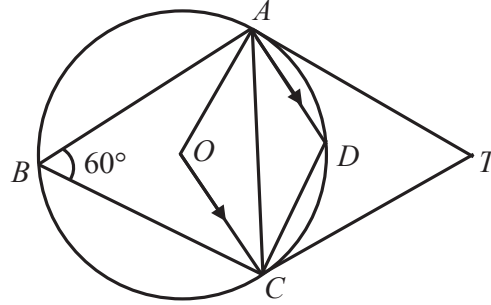
(b) Use the grid below to sketch the distance-time graph for the journey.



[3]

21

14



O is the centre of the circle passing through A , B , C and D .
 The tangents at A and C meet at T .
 AD is parallel to OC .
 Angle $ABC = 60^\circ$.

- (a) Find, giving reasons for each answer,
- (i) angle CAD ,

Answer (a)(i) Angle $CAD = \dots\dots\dots$ [3]

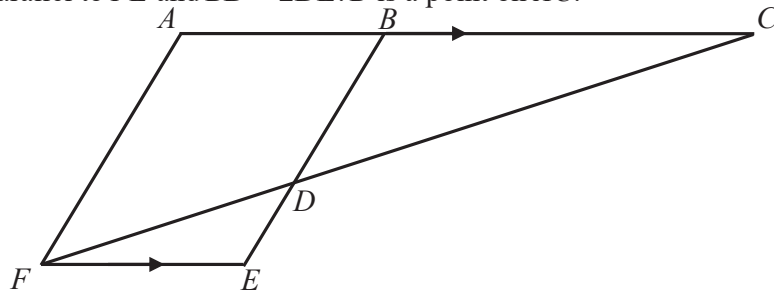
- (ii) angle DAT

Answer (a)(ii) Angle $DAT = \dots\dots\dots$ [2]

- (b) Determine whether triangle ACT is equilateral.

[3]

- 22 In the diagram, lines BE and CF intersect at D .
 AC is parallel to FE and $BD = 2DE$. B is a point on AC .



- (a) Prove a pair of similar triangles.

Answer (a)

..... [2]

- (b) Given that angle $FAB =$ angle FED , prove that AF is parallel to BE .

..... [2]

- (c) Find the value of

(i) $\frac{\text{area of triangle } BCD}{\text{area of triangle } DEF}$,

Answer (c)(i) [1]

(ii) $\frac{\text{area of triangle } BCD}{\text{area of } ABEF}$.

Answer (c)(ii) [2]

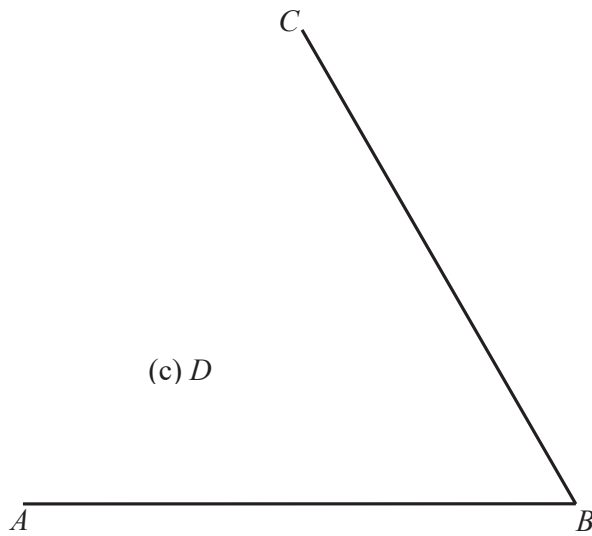
23 Three points A , B and C are shown below.

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

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

(c) Mark clearly, a possible point D , equidistant from B and C and nearer to AB than to CB . [1]

Answer (a), (b) and (c)



End of Paper

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Answer **all** the questions.

1 (a) Given that $a = \sqrt[3]{\frac{b}{(c+1)^2}}$, express c in terms of a and b . [3]

- (b) One round of a toy car track measures 5.2 m, correct to the nearest 0.1 m. The time taken for a toy car to complete 4 rounds is 8 s, correct to the nearest second.

Find

- (i) the greatest length of the track, [1]

- (ii) the greatest possible speed of the toy car. [2]
-

2 Simplify the following,

(a) $\frac{3x+2}{(4x-1)(2x+3)} - \frac{2}{1-4x}$, [2]

(b) $\frac{2x^2 - 5xy + 2y^2}{4x^2 - y^2 - 8x + 4y}$. [4]

- 3** Tap A can fill a pool in x hours.
Tap B can fill the same pool 45 minutes faster than Tap A .

(a) Write down, in terms of x , the fraction of the pool filled in one hour by using only

(i) Tap A , [1]

(ii) Tap B . [1]

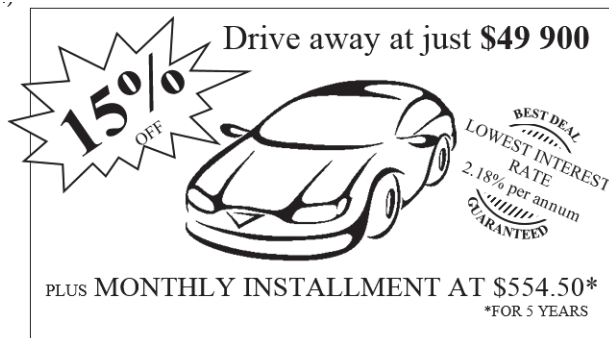
Together, both taps can fill up the pool in 3 hours.

(b) Form an equation in x and show that it reduces to $4x^2 - 27x + 9 = 0$. [3]

(c) Solve the equation $4x^2 - 27x + 9 = 0$, giving your answers correct to 2 decimal places. [3]

(d) Determine the time for Tap B to fill up the pool. Give your answer in hours and minutes, to the nearest minute. [2]

- 4 (a) Chargeable income is taxed at a flat rate of \$3350 on the first \$80 000 earned and at 11.5% on the remaining amount above \$80 000. Calculate the chargeable income of an individual whose income tax amounts to \$5650. [2]
- (b) The above is an advertisement from a car dealer. The car can be paid in full or under hire purchase. In order to purchase the car under hire purchase, a buyer needs to take up a car loan in addition to a fixed initial down payment.
- (i) Find the total monthly installments. [1]
- (ii) Show that the car loan required is \$30 000. [2]
- (iii) Calculate the original selling price of the car. [2]



Drive away at just **\$49 900**

15% OFF

BEST DEAL
LOWEST INTEREST RATE
2.18% per annum
GUARANTEED

PLUS MONTHLY INSTALLMENT AT \$554.50*
*FOR 5 YEARS

- 5 (a) The amount spent, during recess, by 300 Secondary 3 students is shown in the table below.

Amount, \$ x	$2.50 \leq x < 3$	$3 \leq x < 3.50$	$3.50 \leq x < 4$	$4 \leq x < 4.50$	$4.50 \leq x < 5$
Frequency	63	97	88	38	14

(i) Calculate

(a) the mean amount spent, [1]

(b) the standard deviation. [2]

The amount spent, during the same recess, by 300 Secondary 4 students has a mean of \$4.25 and a standard deviation of \$0.42.

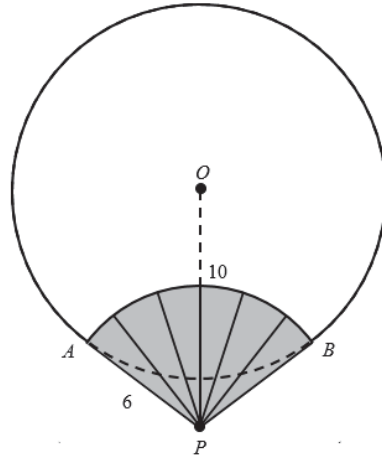
(ii) Compare and comment, in two different ways, on the amount spent by the students of the 2 levels. [2]

- 5 (b) A fan is made from a circular piece of paper with centre O . The shaded region represents the handle of the fan, which is shaped as a sector of a circle with centre P and radius 6 cm. AP and BP are tangents to the circle with centre O , at points A and B respectively. The centres O and P are 10 cm apart.

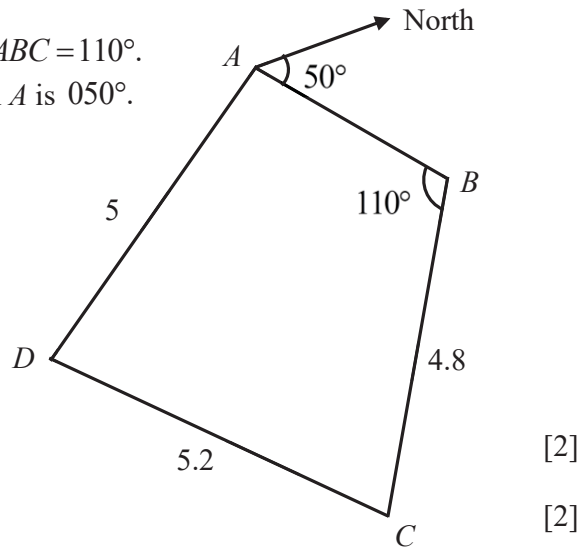
(i) Show that the radius of the circle with centre O is 8 cm. [1]

(ii) Find the area of the shaded region. [2]

(iii) Find the length of the major arc AB . [3]



- 6 A , B , C and D are points on level ground.
 $BC = 4.8$ m, $CD = 5.2$ m, $DA = 5$ m and $\angle ABC = 110^\circ$.
 C is due East of A and the bearing of B from A is 050° .

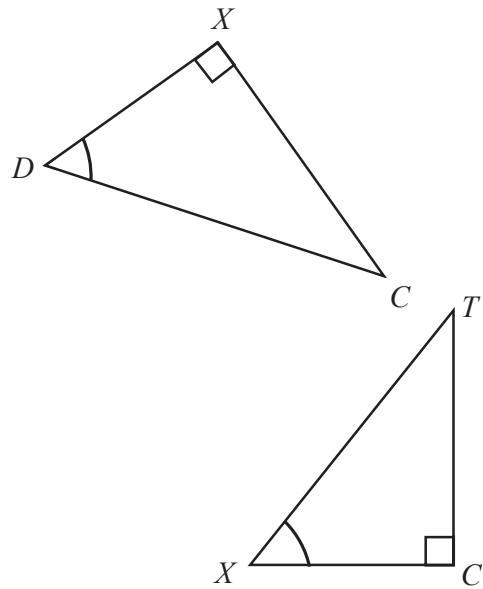


- (a) Calculate
- (i) the bearing of B from C , [2]
 - (ii) AC . [2]
- (b) Show that $\angle ADC = 86.913^\circ$, when correct to 3 decimal places. [2]
-

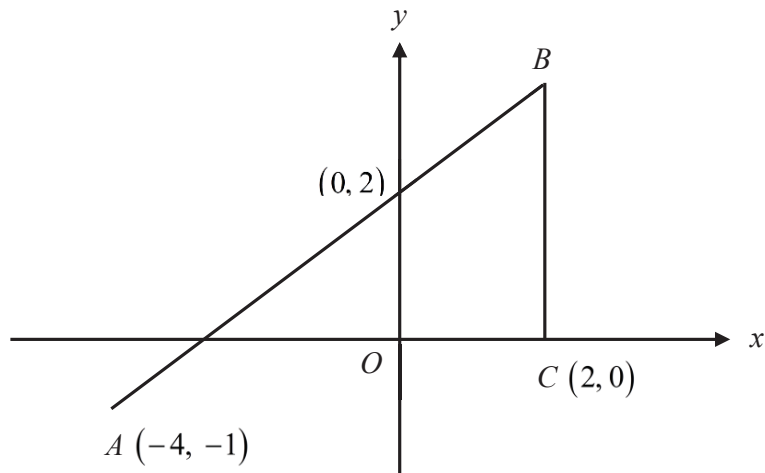
(b) $7.0171^2 = 5^5 + 5.2^2 - 2(5)(5.2) \cos \angle ADC$

(c) Find the area of triangle ADC . [2]

(d) Determine the height of the lamp post. [3]



- 7 In the diagram below, AB cuts the y -axis at $(0, 2)$ and BC is perpendicular to the x -axis. Points A and C have coordinates $(-4, -1)$ and $(2, 0)$ respectively.



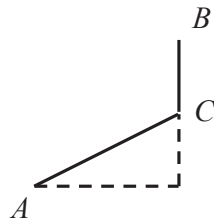
- (a) Show that the coordinates of B are $\left(2, 3\frac{1}{2}\right)$. [2]

7 (b) Find

(i) the equation of the line parallel to AB and passes through C , [2]

(ii) AC , [2]

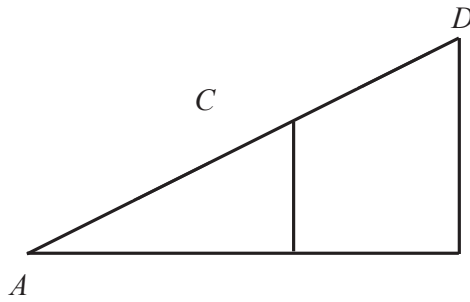
(iii) the value of $\sin \angle ACB$. [1]



7 D is on AC produced such that $AC : AD = 3 : 5$.

(c) Find the coordinates of D .

[2]



(d) Find the shortest distance from B to AD .

[3]

- 8 (a) M is the point $(0, 5)$ and $\overrightarrow{MN} = \begin{pmatrix} 8 \\ 10 \end{pmatrix}$.

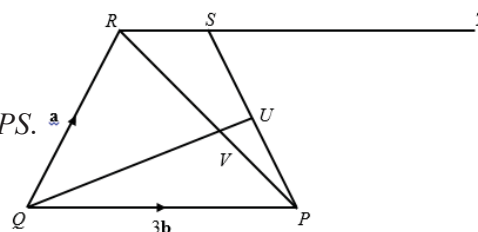
(i) Write down the position vector of M . [1]

(ii) Find $|\overrightarrow{ON}|$. [3]

- (b) In the diagram, $\overrightarrow{QR} = \mathbf{a}$, $\overrightarrow{QP} = 3\mathbf{b}$ and $\overrightarrow{RS} = \frac{1}{3}\overrightarrow{QP}$.

QU and PR intersect at V and U is the mid-point of PS .

T is on RS produced such that $ST = 3RS$.



(i) Express each of the following, as simply as possible, in terms of \mathbf{a} and/or \mathbf{b} ,

(a) \overrightarrow{PR} , [1]

(b) \overrightarrow{PS} , [1]

(c) \overrightarrow{QU} . [1]

- (ii) Find \overline{QT} and hence, make 2 conclusions about points Q , U and T . [3]

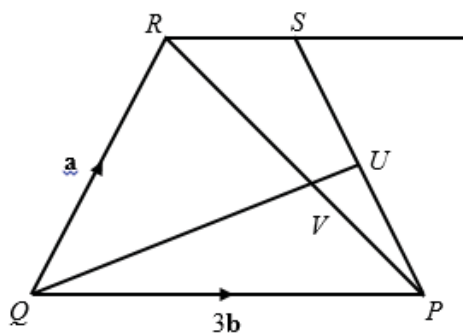
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- (iii) Given that $QU = 10VU$ and $PV:VR = 3:5$, find

- (a) the ratio of area of $\triangle PVU$: area of $\triangle PVQ$: area of $\triangle PRQ$, [2]

- (b) the value of $\frac{\text{area of triangle } PRQ}{\text{area of triangle } PRS}$, [1]

- (c) the value of $\frac{\text{area of } RSUV}{\text{area of triangle } PVQ}$. [1]



9 Answer the whole of this question on a sheet of graph paper.

The variables x and y are connected by the equation

$$y = 2x^3 + \frac{9}{2}x^2 - 1.$$

Some corresponding values of x and y are given in the table below.

x	-2.5	-2	-1.5	-1	-0.5	0	0.5	1
y	-4.125	1	p	1.5	-0.125	-1	0.375	5.5

- (a) Calculate the value of p . [1]
- (b) Using a scale of 2 cm to represent 0.5 units, draw a horizontal x -axis for $-2.5 \leq x \leq 1$.
Using a scale of 2 cm to represent 1 unit, draw a vertical y -axis for $-5 \leq y \leq 6$.
On your axes, plot the points given in the table and join them with a smooth curve. [3]
- (c) By drawing a tangent, find the gradient of the curve at $(0.5, 0.375)$. [2]
- (d) By drawing a suitable straight line, find the range of values of x for $2x^3 + \frac{9}{2}x^2 > 3$. [2]
- (e) (i) On the same axes, draw the line $y = x + 1$ for $-2.5 \leq x \leq 1$. [1]
- (ii) Write down the x -coordinate of the points where this line intersects with the curve. [1]
- (iii) These values of x are the solutions to the equation $4x^3 + Ax^2 + Bx + C = 0$. Find the value of A , of B and of C . [3]

- 10 Alice is shopping for a new washing machine so as to reduce her monthly water usage. She currently spends \$40 a month on water services. Laundry takes up about 19% of her water usage.

(a) Estimate Alice's monthly expenditure on water for her laundry. [1]

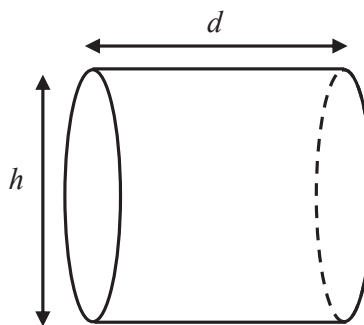


“3-Tick” Washing Machine Drum

Height (h): 400 mm

Depth (d): 500 mm

Maximum Washing Load: 8 kg



(b) Determine the volume, in m^3 , of the drum of the washing machine. [2]

- 10 Alice estimates that her washing load is equivalent to 100 T-shirts and 2 bath towels on average in a week and 1 single duvet in a month. The water consumption of the “3-Tick” washing machine is directly proportional to the washing load in the drum.
- (c) Determine if Alice should buy the new washing machine. Justify your answer with calculations. [7]

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