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Answer all questions.

- 1 (a) Find the value of $\frac{2}{3} + \sqrt{0.56} + 6\%$ of 10.
Give your answer correct to 2 significant figures.

Answer (a) [1]

- (b) Oil flows through a pipe at the rate of $50 \text{ m}^3/\text{s}$. How long will it take to fill a tank of volume $1.3 \times 10^6 \text{ m}^3$, leaving your answer in standard form.

Answer (b) s [1]

-
- 2 If it takes 6 men 4 h to dig a hole 6 m deep, how long will it take 10 men to dig a hole 5 m deep?

Answer h [2]

3 p is directly proportional to q^3 . When q has a certain value, $p = 24$.

(a) Find the value of p when this value of q is doubled.

Answer (a) [1]

(b) Find the percentage increase in the value of p .

Answer (b) [1]

4 $-2\frac{1}{2}$, -1 , $\sqrt{2}$, 3.5 , $\sqrt[3]{2 \times 3 \times 5}$, $\frac{6}{\sqrt{30}}$, $\sqrt{36}$

From the numbers above, write down

(a) the integer(s)

..... [1]

(b) the irrational number(s)

..... [1]

- 11 (a) Simplify the following, leaving your answers as positive indices.

(i) $\frac{3a^{-\frac{1}{2}} \times 2a^{-\frac{1}{4}}}{12a^{-1}}$

(ii) $(ab^{-4})^5 \div 2a^{-1}b^{-5}$

Answer (a)(i) [1]

Answer (a)(ii) [2]

- (b) Solve the following :

$$4\left(\frac{1}{3}\right)^x = 36$$

Answer (b) [2]

12 (a) Factorise the following completely.

(i) $x^2 - 2xy - 35y^2$

(ii) $y^2 - x^2 + 6x - 9$

Answer (a)(i) [1]

Answer (a)(ii) [2]

(b) Make x the subject :

$$e + \sqrt{x+f} = g$$

Answer (b) $x =$ [2]

$$13 \quad A = \begin{pmatrix} a & 1 \\ 1 & -a \end{pmatrix} \quad B = \begin{pmatrix} -3 & 4 \end{pmatrix} \quad C = \begin{pmatrix} -2 \\ -3 \end{pmatrix}$$

(a) Find BC .

Answer (a) [1]

(b) Find the value(s) of a if $A^2 = 17 \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$.

Answer (b) [2]

- 14 The probability that an amateur golfer actually hits the ball is (regrettably for all concerned) only $\frac{1}{10}$. If three consecutive attempts are made, find the probability that the ball will be hit:

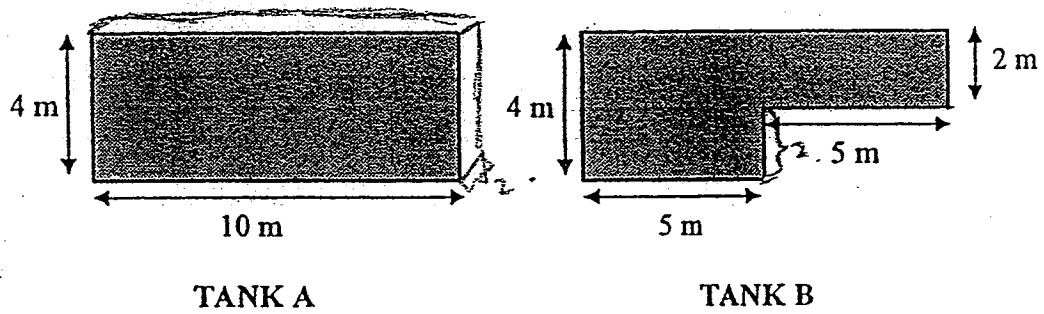
- (a) three times,
- (b) not at all,
- (c) at least twice.

Answer (a) [1]

Answer (b) [1]

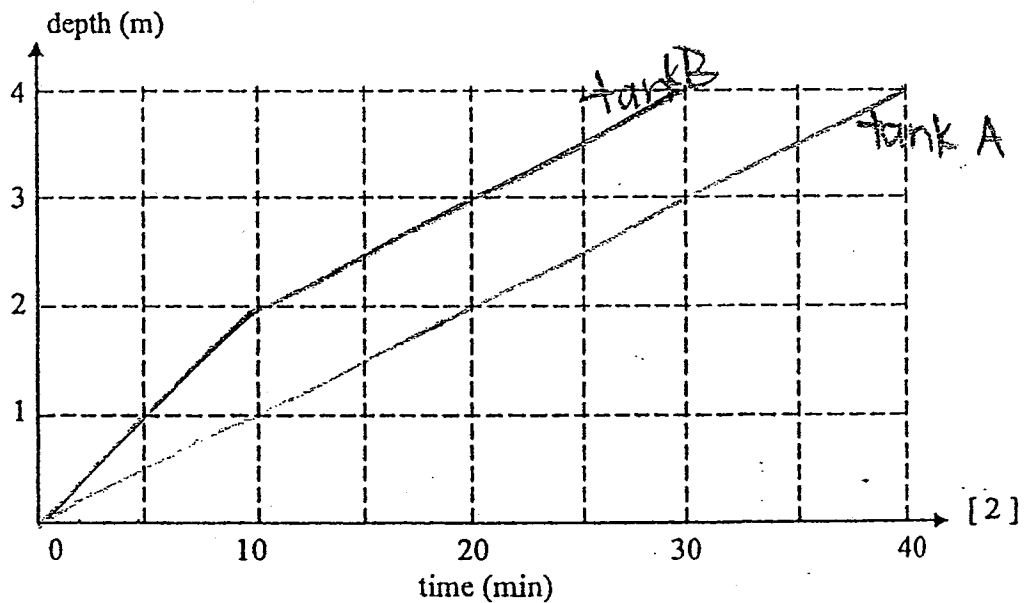
Answer (c) [1]

- 15 (a) The lengths and depths of two water storage tanks with uniform cross sectional area when completely filled are shown below. The widths of the tanks are 2 m each. Water is pumped into the tanks at 2 m^3 per minute.



The engineer building the tanks wishes to track the depth of water against time for the duration when the tanks are empty till they are completely filled.

Sketch on the diagram below, the relationship between depth (in metres) and time (in minutes) for the two tanks



(b) Which of the following equations correspond to the graphs below?

In each case $k > 1$.

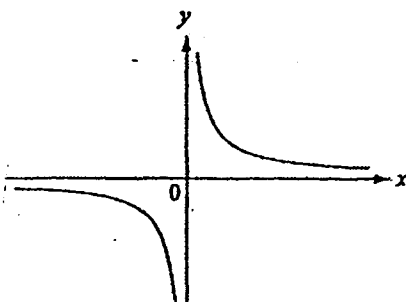
$$y = \frac{k}{x}$$

$$y = k^{-x}$$

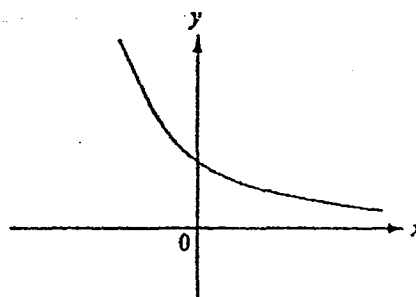
$$y = \frac{x}{k}$$

$$y = \frac{k}{x^2}$$

(i)



(ii)



Answer (b)(i) [1]

Answer (b)(ii) [1]

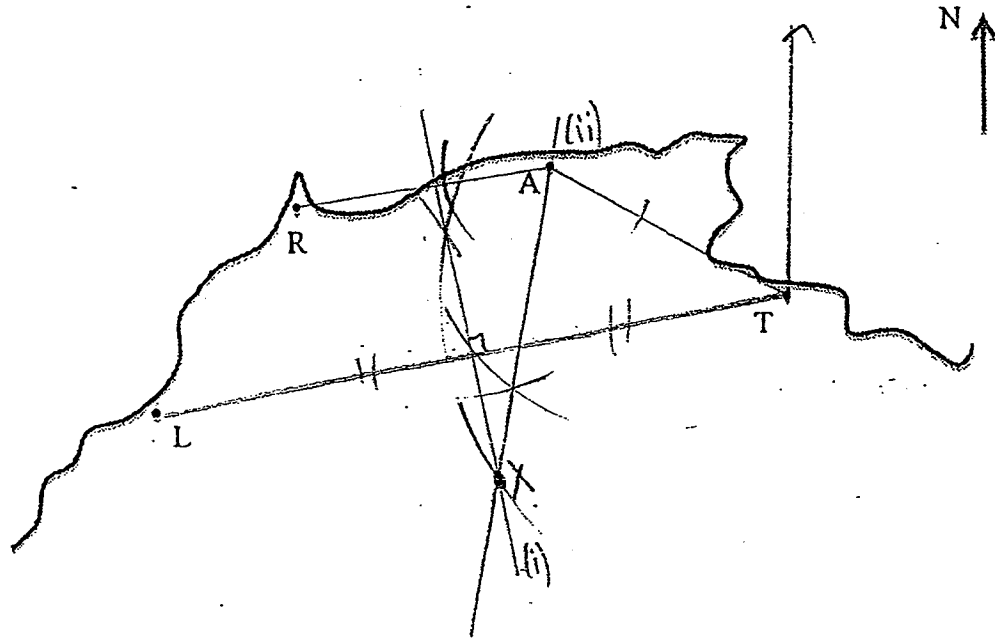
16 (a) Calculate the sum of interior angles of a decagon.

Answer (a) [1]

(b) If the sum of the interior angles of a decagon is greater than the sum of the interior angles of another polygon by 540° , find the number of sides of the polygon.

Answer (b) [2]

- 17 The map shows four cities on the north coast of Africa. The scale of the map is such that 1 cm on the plan represents 200 km on actual ground.



- (a) Using a protractor, find the bearing of L from T.

$$360^\circ - 102^\circ = 258^\circ$$

Answer (a) 258° [1]

- (b) Using a compass and a ruler only, construct

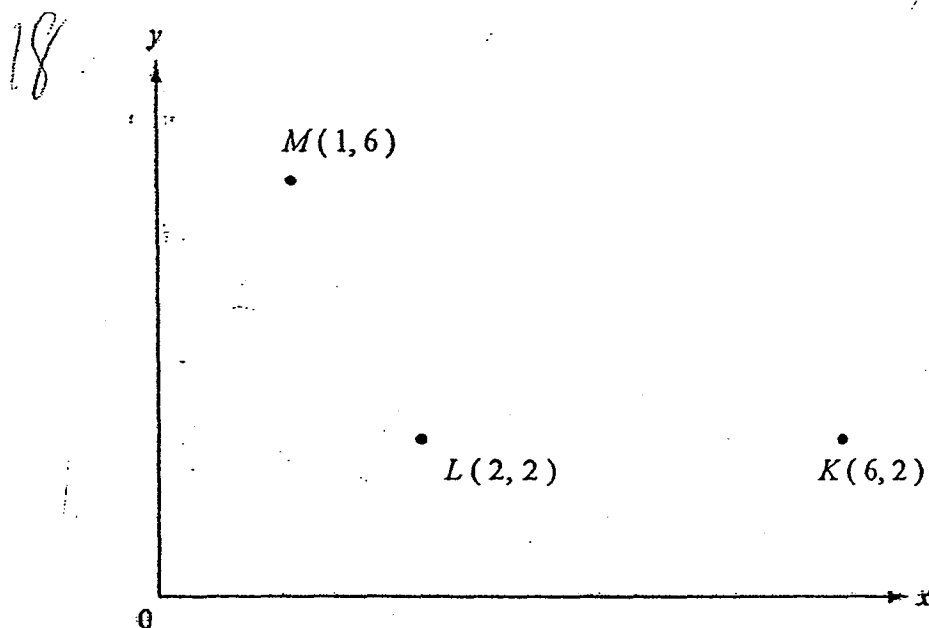
- (i) the perpendicular bisector of LT [1]
(ii) the angle bisector of angle RAT [1]

- (c) An ancient ruin is located at the intersection of the two bisectors in (b).

- (i) Mark and label the position of the ancient ruin with the letter X. [1]
(ii) Measure and write down the actual distance of the ancient ruin from A.

3 cm

Answer (c)(ii) 600 km [1]



The diagram shows points K , L and M on a co-ordinate grid.

- (a) Write down the equation of the straight line, which passes through L and K .

Answer (a) $y = 2$ [1]

- (b) Find the equation of the line MK .

Answer (b) [2]

(c) Find the area of triangle KLM .

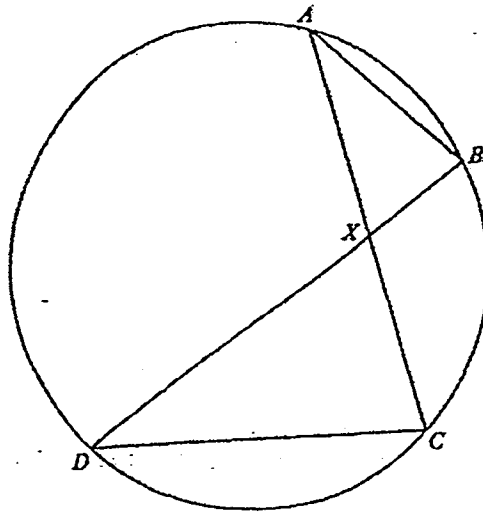
Answer (c) units² [1]

(d) Find the distance of the line ML .

Answer (d) units [1]

(e) Find the exact value of $\cos \angle MLK$.

Answer (e) [1]



A, B, C and D lie on a circle. AC and BD intersect at X .

- (a) Explain why triangles ABX and DCX are similar.

.....

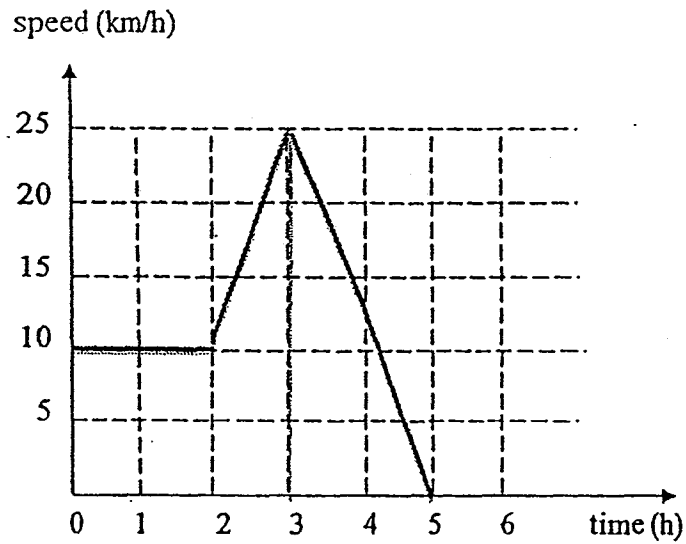
.....

..... [2]

- (b) Given $BX = 2$ cm, $CX = 4$ cm and the area of triangle ABX is 4.5 cm².
Calculate the area of triangle DCX .

Answer (b) cm² [2]

20.



Alden was driving from Town A to Town B. Alden's journey was illustrated by the speed-time graph shown above.

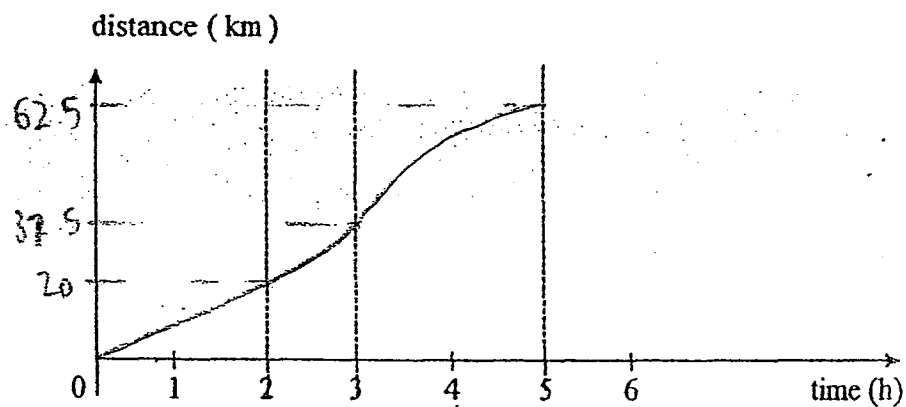
(a) How far is Town A from Town B?

Answer (a) km [2]

(b) Alden decelerated from $t = 3$ to $t = 5$. What was his deceleration?

Answer (b) km/h^2 [1]

(c) On the grid below, draw the distance-time graph for the 5 hours. [2]



21 Given that $-2 \leq x \leq 5$ and $-7 \leq y \leq 1$, where both x and y are integers, find

(a) the smallest value of $(x+y)(x-y)$

(b) the greatest value of $\frac{1}{xy^{-1}}$

Answer (a) [1]

Answer (b) [1]

22 Solve the simultaneous equations.

$$2x = 11 - y$$

$$\frac{x}{5} - \frac{y}{4} = 1$$

Answer $x =$

$y =$ [2]

- 23 (a) Kaito bought 2000 Euro Dollar (EUR) with Japanese Yen (JPY) at the rate of JPY 100 = Euro 0.721. After 1 month, he changes the 2000 Euro Dollar back to Japanese Yen at a rate of JPY 100 = EUR 0.699. How much profit in Japanese Yen did he make, correct your answer to the nearest Yen?

Answer (a) JPY [2]

- (b) Mary and Christina were each given \$40 000.
- (i) Mary invested her money in Bank A for 2 years at 3.5% per annum simple interest. Calculate the total amount of money she had in the bank account after 2 years.

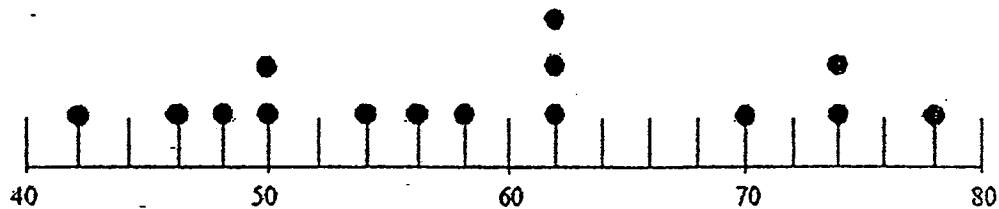
Answer (b)(i) \$ [1]

- (ii) Christina invested her money in Bank B, which pays compound interest at the rate of 3.45% per annum compounded half yearly for 2 years. Which bank gave better returns? Explain, showing your working clearly, the reason for your answer.

.....

..... [2]

- 24 The dot diagram below shows the marks obtained by a group of 15 students in the English Preliminary Examination. The total marks for the examination was 80 marks.



(a) Find

(i) the range

Answer (a)(i) marks [1]

(ii) the mode

Answer (a)(ii) marks [1]

(iii) the median

Answer (a)(iii) marks [1]

(iv) the mean

Answer (a)(iv) marks [1]

(v) the standard deviation

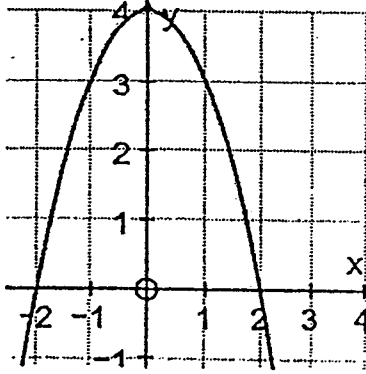
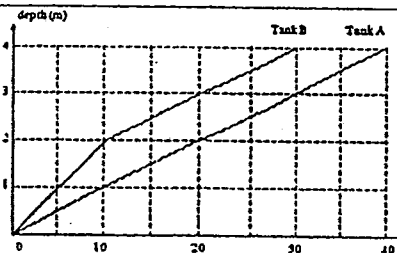
Answer (a)(v) marks [1]

- (b) The new mean mark will be 60 if the result of an additional student is considered. How many marks did the additional student obtain?

Answer (b) marks [1]

End of Paper

Answer key

1.	a.	2.0	b.	2.6×10^4	2.		2h									
3.	a.	192	b.	700%	4.	a.	$-1, \sqrt{36}$									
5.	a.	$210 = 2 \times 3 \times 5 \times 7$ $1120 = 2^5 \times 5 \times 7$				b.	$\sqrt{2}, \sqrt{30}$									
					6.		19.6 cm^2									
	b.	<table><tr><td>$a=1$</td><td>$b=9$</td><td>$c=6$</td></tr><tr><td>$d=3$</td><td>$e=5$</td><td>$f=4$</td></tr><tr><td>$g=2$</td><td>$h=7$</td><td>$i=8$</td></tr></table>			$a=1$	$b=9$	$c=6$	$d=3$	$e=5$	$f=4$	$g=2$	$h=7$	$i=8$	7.	a.	$y = -(x+2)(x-2)$
$a=1$	$b=9$	$c=6$														
$d=3$	$e=5$	$f=4$														
$g=2$	$h=7$	$i=8$														
				b.												
8.		a. 1917 b. 7200 km														
9.		-25%														
10.		a. 2 km^2 b. 1:50 000														
11.	a.	$\frac{1}{a^4}$ aii) $\frac{a^6}{2b^{15}}$ i) $\frac{1}{2}$ b) -2														
12.	a.	i) $(x-7y)(x+5y)$ ii) $(y+x-3)(y-x+3)$			13.	a.	-6									
	b.	$g^2 - 2eg + e^2 - f$				b.	± 4									
					14.		a. $\frac{1}{1000}$ b. $\frac{729}{1000}$ c. $\frac{7}{250}$									
15.	a.				16.	a.	1440^0									
						b.	7									
					18.	a.	$y=2$									
						b.	$5y = -4x + 34$									
						c.	8 unit ²									
						d.	4.12 unit ²									
						e.	$-\frac{1}{\sqrt{17}}$									
					19.	a.	$\angle ABX = \angle DCX$ ($\angle$ s in the same segment) $\angle BAX = \angle CDX$ ($\angle$ s in the same segment) Triangles ABX and triangles DCX are similar (AA similar)									
	b.	i) $y = \frac{k}{x}$ ii) $y = k^{-x}$				b.	18 cm^2									

1. (a) Solve $\frac{6}{x^2-1} + \frac{3}{1+x} = 1$. [3]

(b) Make p the subject of the formula $\frac{2-p}{k} = \frac{mp^2}{p+2}$. [3]

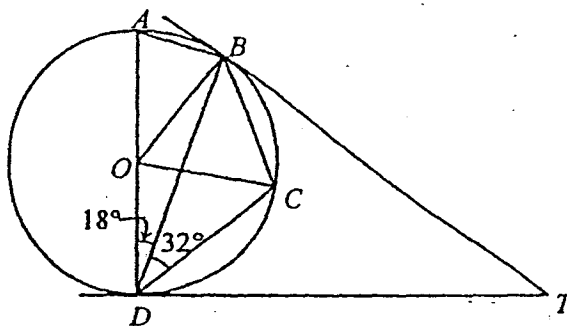
2. A cruise ship departs daily at 0842 from Port A for Port B , 300 km away. On weekdays (Monday to Friday), the average speed of the ship is x km/h. On weekends (Saturday and Sunday), the average speed is increased by 5 km/h.

(i) Write down, in terms of x , the time taken in hours for the ship to reach Port B on a weekday. [1]

(ii) Given that the ship arrives 40 minutes earlier on weekends, form an equation in x and show that it reduces to $x^2 + 5x - 2250 = 0$. [3]

(iii) Solve the equation $x^2 + 5x - 2250 = 0$, and hence find the arrival time at Port B on a Wednesday. [4]

3. (a) In the diagram, AD is a diameter of the circle with centre O . TB and TD are tangents to the circle at B and D respectively, $\angle ADB = 18^\circ$ and $\angle BDC = 32^\circ$.



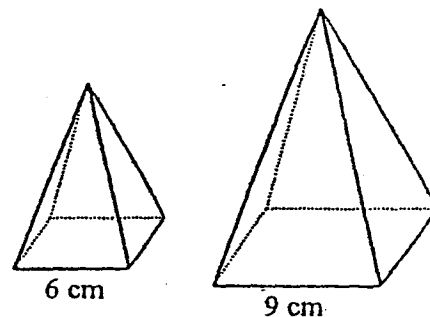
(i) Show that $\triangle OAB$ and $\triangle TDB$ are similar. [3]

(ii) Calculate

(a) reflex $\angle BOC$, [2]

(b) $\angle BCD$. [3]

3. (b) A solid metal sphere with radius 5 cm is melted completely and all the metal is used to form two geometrically similar solid pyramids. The bases of the pyramids are squares with sides 6 cm and 9 cm respectively. Calculate the height of the larger pyramid. [3]



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

The variables x and y are connected by the equation $y = 10 - x - \frac{5}{x}$. Some corresponding values of x and y are given in the following table:

x	0.2	0.5	1	2	3	4	5	6
y	-15.2	-0.5	4	5.5	5.33	4.75	4	3.17

- (a) Using a scale of 2 cm to represent 1 unit on the x -axis and 1 cm to represent 1 unit on the y -axis, draw the graph of $y = 10 - x - \frac{5}{x}$ for $0.2 \leq x \leq 6$. [3]
- (b) Use your graph to estimate the coordinates of the point on the curve at which the gradient is 2.5. [2]
- (c) By drawing an additional straight line on your graph, estimate the range of the values of x for which $16 - 3x > \frac{5}{x}$. [2]
- (d) The x -coordinates of the points of intersection of the curve $y = 10 - x - \frac{5}{x}$ and the line $y = 4 - 3x$ satisfy the equation $x^2 + Ax + B = 0$, where A and B are rational numbers. Find the value of A and of B . [2]

BEGIN THIS SECTION ON A FRESH SHEET OF PAPER.

5. In a game, a player tosses a fair coin and an unbiased 6-sided die. The rules of the game are as follows:

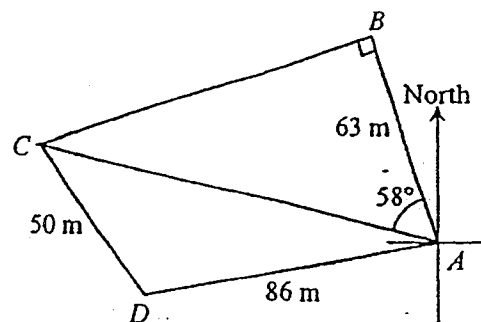
- If the coin shows a 'Head' :
 - if the face value of the die is prime, score = face value of die + 3
 - otherwise, score = face value of die + 1
- If the coin shows a 'Tail' :
 - if the face value of the die is prime, score = face value of die + 2
 - otherwise, score = face value of die

- (i) Copy and complete the following possibility diagram to represent all the possible scores of a player. [2]

		Die					
Coin	Score	1	2	3	4	5	6
	Head		5		5		
	Tail			5			6

- (ii) Using your possibility diagram, determine the probability that a player's score is
 (a) 3, (b) a composite number. [2]
- (iii) If 2 people play the game, what is the probability that at least one of them has a score greater than 5? [3]

6. In the diagram, A , B , C and D are four corners of a field. $AB = 63$ m, $AD = 86$ m and $CD = 50$ m. $\angle ABC = 90^\circ$, $\angle BAC = 58^\circ$ and the bearing of B from A is 340° .



- (a) Calculate
 (i) the bearing of B from C , [2]
 (ii) $\angle ADC$, [3]
 (iii) $\angle DAC$, [2]
- (b) There is a vertical tree at the point D . As a rabbit moves along the straight path from A to C , the greatest angle of elevation from the rabbit to the top of the tree is 37.5° . Calculate the height of the tree. [3]

7. (a) The following advertisement for a laptop was displayed outside a shop selling IT equipment :

BELL LAPTOP

Usual Price: \$2,999

Now:

\$2,099 (Cash)

OR

\$160 downpayment +
\$58 monthly instalment × 36 months



Calculate the rate of simple interest charged by the hire purchase scheme. [4]

- (b) The table below shows the personal income tax rates of Singapore from Year of Assessment (YA) 2012 onwards:

Chargeable Income (\$)	Rate (%)	Gross Tax Payable (\$)
First \$20,000	0	0
Next \$10,000	2	200
First \$30,000	-	200
Next \$10,000	3.50	350
First \$40,000	-	550
Next \$40,000	7	2 800
First \$80,000	-	3 350
Next \$40,000	11.5	4 600
First \$120,000	-	7 950
Next \$ 40,000	15	6 000
First \$160,000	-	13 950
Next \$ 40,000	17	6 800
⋮	⋮	⋮

(Source: <http://www.iras.gov.sg/irashome/page04.aspx?id=1190>)

Mr. Leong paid \$6857.50 for income tax in 2013. He was entitled to reliefs of \$27,000. Calculate Mr. Leong's annual income for 2013. [4]

8. (a) For the 2 Degree Ice Art Exhibition, three categories of tickets are available:

Child (4 – 12 years old) : \$26
 Adult : \$32
 Senior Citizen : \$8
 (60 years old and above)

The number of tickets of each category sold over a 2-day period is shown below:

	Child	Adult	Senior Citizen
Day 1	132	166	94
Day 2	103	180	79

The information is represented by the matrix $T = \begin{pmatrix} 132 & 166 & 94 \\ 103 & 180 & 79 \end{pmatrix}$.

- (i) Write down a matrix A such that the elements of product of the matrices A and T will represent the total number of Child, Adult and Senior Citizen tickets respectively, sold over the 2 days. [1]

During the last few weeks of the exhibition, child and adult tickets were sold at discounted rates as follows:

- Weekday : One-for-one promotion for adult tickets (\$32) and child tickets (\$26)
- Weekend : Child ticket - \$15, Adult ticket - \$20

Mr. Wong plans to bring his family to the exhibition during the last few weeks of its run. He will need to buy tickets for his wife and himself, their four children aged 5, 7, 9 and 11 years, and Mr. Wong's 63-year-old mother.

Let R be the matrix $\begin{pmatrix} 2 & 4 & 1 \end{pmatrix}$.

- (ii) (a) Write down a 3×2 matrix D such that the elements will represent the price of each type of ticket on a weekday and weekend respectively. [1]

- (b) Let $B = \begin{pmatrix} 1 \\ -1 \end{pmatrix}$. Evaluate the product RDB .

What is the significance of the element(s) in RDB ? [3]

- (b) In a group of 40 children, 25 have visited the Zoo, 18 have visited the Bird Park, x have visited both, and at least 3 have visited neither of these two attractions. Let

$\varepsilon = \{\text{children in the group}\},$

$Z = \{\text{children who have visited the Zoo}\},$

$B = \{\text{children who have visited the Bird Park}\}.$

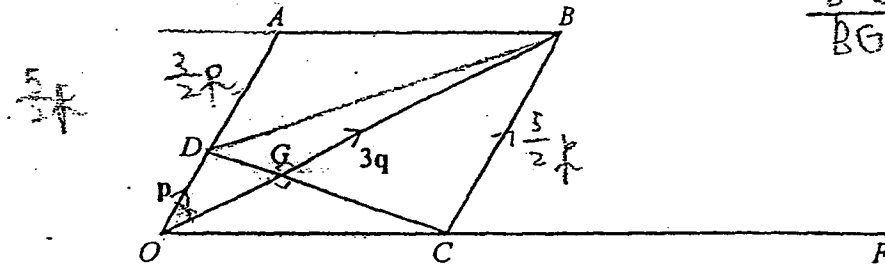
- (i) Express in set notation:

At least 3 children have visited neither the Zoo nor the Bird Park. [1]

- (ii) Describe in words: $(Z \cap B') \neq \phi$. [1]

- (iii) Explaining your working clearly, find the smallest possible value of x . [2]

10. In the diagram, $OABC$ is a parallelogram. D is on OA such that $OD : DA = 2 : 3$. It is also given that $\overrightarrow{OD} = p$ and $\overrightarrow{OB} = 3q$.



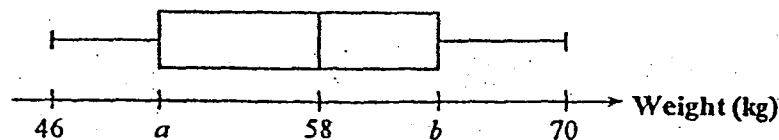
- (a) Express as simply as possible, in terms of p and q ,
- (i) $\overrightarrow{OA}$, (ii) $\overrightarrow{OC}$. [2]
- (b) Show that $\overrightarrow{DC} = \frac{1}{2}(6q - 7p)$. [2]
- (c) Given further that F is a point on OC produced such that $3OC = 2CF$, find $\overrightarrow{FA}$. [2]
- (d) Deduce two facts about $\overrightarrow{DC}$ and $\overrightarrow{FA}$. [2]
- (e) Giving your answer as a fraction in its lowest terms, calculate the numerical value of $\frac{\text{area of } \triangle DOG}{\text{area of } \triangle OBC}$. [2]

11. (a) The stem-and-leaf diagram below shows the weights of 17 students :

Stem	Leaf
4	6 7 9
5	0 2 5 6 6 8
6	1 2 3 3 4 7
7	0 0

Key: 4 | 6 means 46 kg

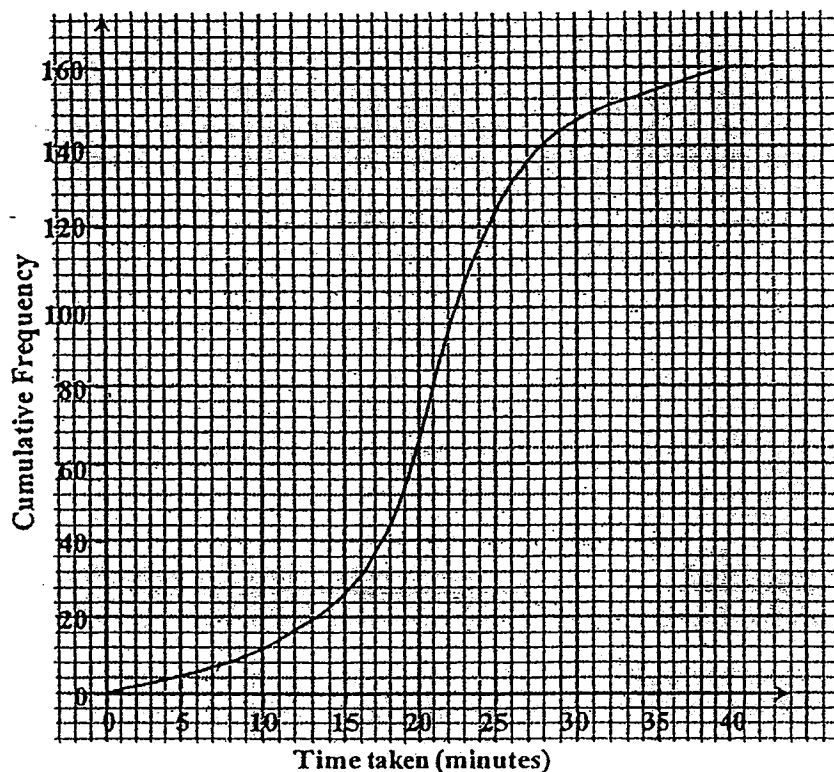
The information can also be represented using the following box-and-whisker plot:



- (i) Find the value of a and of b . [2]
- (ii) It was found that the weighing machine was faulty and all the measurements should be 2 kg more than those recorded. Explain how the mean and range should be adjusted to reflect the correct measurements. [2]

11. (b) A group of 160 students from School A participated in a survey on the amount of time they take to travel to school. The findings of the survey are illustrated by the cumulative frequency curve below:

DOG
ORC



- (i) Use the curve to estimate
- the value of T given that 10% of the students take more than T minutes to travel to school, [1]
 - the two possible values of p , given that 40 students take between p minutes and 21 minutes to travel to school. [2]
- (ii) The following is the frequency distribution table corresponding to the given cumulative frequency curve.

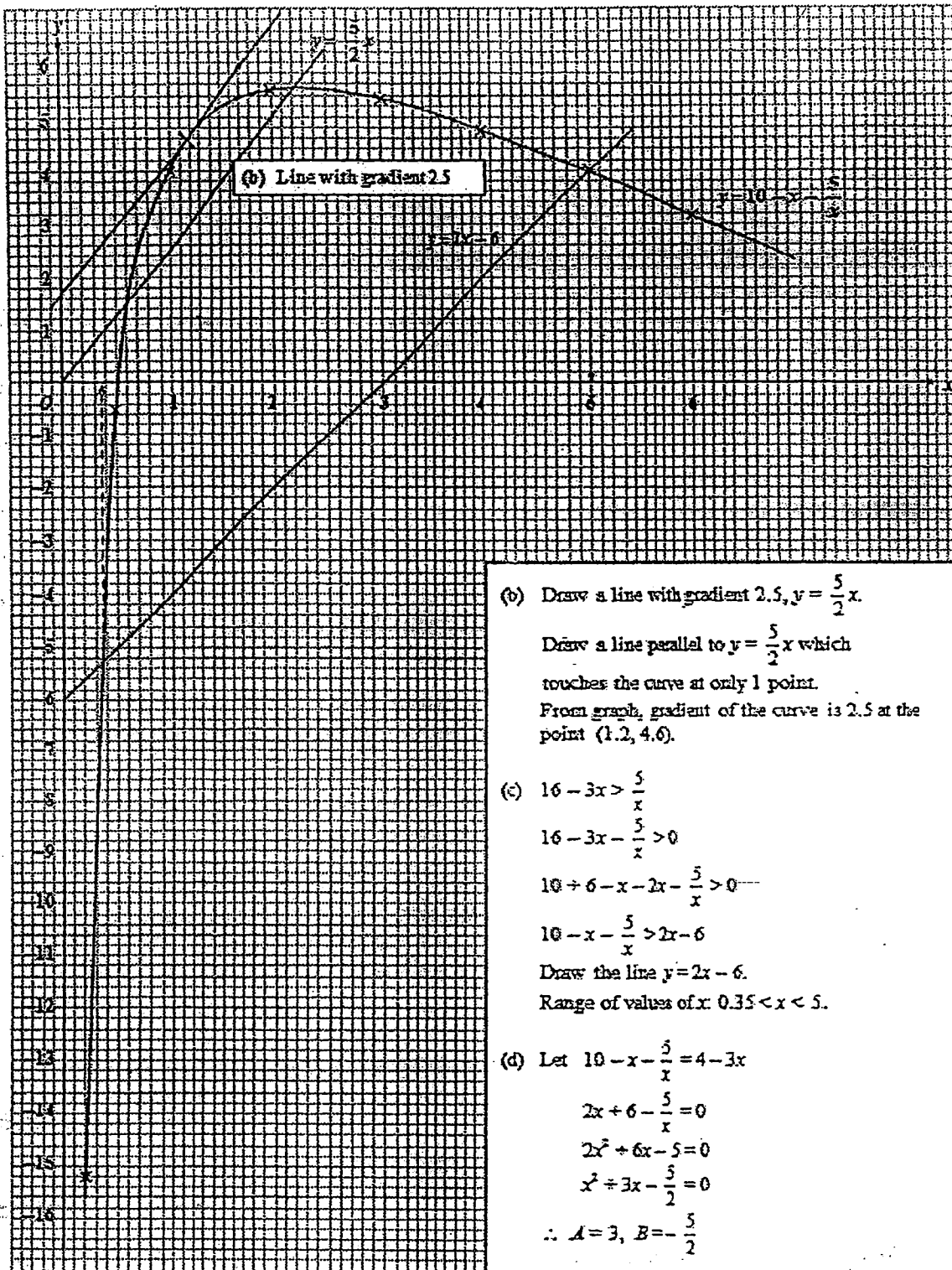
Time spent (t mins)	$0 < t \leq 10$	$10 < t \leq 20$	$20 < t \leq 30$	$30 < t \leq 40$
Frequency	12	54	80	14

Find the mean and standard deviation of the distribution. [4]

END

Answer key

1.	a.	$x = 4$ or $x = -1$ (N.A.)	2.	(i)	$\frac{300}{x}$ hrs.																												
	b.	$p = \pm \sqrt{\frac{4}{km+1}}$ or $\pm \frac{2}{\sqrt{km+1}}$		(iii)	Arrival time at Port B on a Wednesday is 1522.																												
3.	a.	ii) a) Reflex $\angle BOC = 296^\circ$ ($\angle$ s at a pt.) ii) b) $\angle BCD = 108^\circ$	5.	(i)	<table><tr><td></td><td colspan="6">Die</td></tr><tr><td>Score</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>Head</td><td>2</td><td>5</td><td>6</td><td>5</td><td>8</td><td>7</td></tr><tr><td>Tail</td><td>1</td><td>4</td><td>5</td><td>4</td><td>7</td><td>6</td></tr></table>		Die						Score	1	2	3	4	5	6	Head	2	5	6	5	8	7	Tail	1	4	5	4	7	6
		Die																															
Score	1	2	3	4	5	6																											
Head	2	5	6	5	8	7																											
Tail	1	4	5	4	7	6																											
b.	15.0 cm (3 s.f.)	(ii)	(a) $P(\text{score} = 3) = 0.$ (b) $P(\text{score is a composite number}) = \frac{5}{12}.$																														
6.	a.	(i) 070° (ii) 119.5° (1 d.p.) (iii) 21.5° (1 d.p.)	9.	(iii)	$P(\text{at least one score} > 5) = \frac{95}{144}$																												
	b.	height of the tree is 24.2 m (3 s.f.)		(iii)	2.86 cm^2 (3 s.f.)																												
7.	a.	2.56% (3 s.f.)		(iv)	1430 cm^3 (3 s.f.)																												
	b.	\$137,500		(v)	109 cm^2 (3 s.f.)																												
8.	a.	(i) $A = \begin{pmatrix} 1 & 1 \end{pmatrix}$ $D = \begin{pmatrix} 16 & 20 \\ 13 & 15 \\ 8 & 8 \end{pmatrix}$ (ii) (a.) (b) \$16 more		b.	(i) $n(Z \cap B') \geq 3$ (ii) There are some children who have visited the Zoo but not the Bird Park (iii) smallest possible value of $x = 6$																												
10.	a.	(i) $\vec{OA} = \frac{5}{2} \vec{OD} = \frac{5}{2} \vec{p}$ (ii) $\vec{OC} = 3\vec{q} - \frac{5}{2} \vec{p}$		d.	$\vec{DC} = \frac{1}{2}(6\vec{q} - 7\vec{p}) = \left(\frac{2}{5}\right)\left(\frac{5}{4}\right)[- (7\vec{p} - 6\vec{q})] = -\frac{2}{5} \vec{FA}$ • $\vec{DC}$ and $\vec{FA}$ are parallel and in opposite directions • $ \vec{DC} = \frac{2}{5} \vec{FA} $ (OR $DC = \frac{2}{5} FA$ OR equivalent)																												
	c.	$\vec{FA} = \frac{5}{4}(7\vec{p} - 6\vec{q})$		e.	$\frac{\text{area of } \triangle DOG}{\text{area of } \triangle OBC} = \frac{4}{35}$																												
11.	a.	(i) $a = 51, b = 63.5$ (ii) The mean of the correct measurements should be 2 kg more than before the adjustment, since each value is increased by 2 kg. The range is unchanged, since the smallest and largest values each will increase by the same amount, and range = largest value - smallest value.																															
	b.	(i) (a) $T = 29$, (b) $p = 17.5$ or 24.5 (ii) Mean $\bar{x} = 21$ min. Standard deviation = 7.52 min. (3 s.f.)																															



(b) Draw a line with gradient 2.5, $y = \frac{5}{2}x$.

Draw a line parallel to $y = \frac{5}{2}x$ which touches the curve at only 1 point.

From graph, gradient of the curve is 2.5 at the point (1.2, 4.6).

(c) $16 - 3x > \frac{5}{x}$

$$16 - 3x - \frac{5}{x} > 0$$

$$10 + 6 - x - 2x - \frac{5}{x} > 0$$

$$10 - x - \frac{5}{x} > 2x - 6$$

Draw the line $y = 2x - 6$.

Range of values of x : $0.35 < x < 5$.

(d) Let $10 - x - \frac{5}{x} = 4 - 3x$

$$2x + 6 - \frac{5}{x} = 0$$

$$2x^2 + 6x - 5 = 0$$

$$x^2 + 3x - \frac{5}{2} = 0$$

$$\therefore A = 3, B = -\frac{5}{2}$$