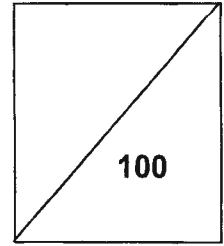




NORTH VISTA SECONDARY SCHOOL
END-OF-YEAR EXAMINATION 2021



NAME: _____ () **CLASS:** _____

SUBJECT : MATHEMATICS

DATE : 4 OCTOBER 2021

LEVEL/STREAM : SECONDARY 2 EXPRESS

TIME : 2 HOURS 30 MINUTES

READ THESE INSTRUCTIONS FIRST

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

Answer all questions.

If working is needed for any question it must be shown 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 **100**.

<i>For Examiner's Use</i>	
Category	Question No.
Accuracy	
Brackets	
Fractions	
Units	
Others	
Marks Deducted	

This paper consists of **29** printed pages.

[Turn Over

Mathematical Formulae*Compound Interest*

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

Section 1 (50 marks)
Answer **all** the questions.

- 1 Write the following numbers in order of size, starting with the **smallest**.

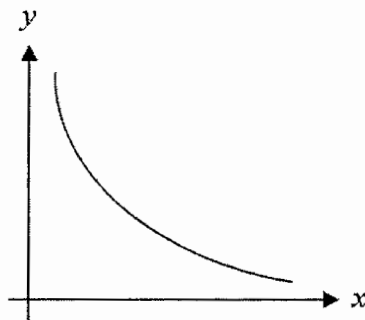
$$0.255, \quad \left(-\frac{1}{2}\right)^2, \quad 0.22\dot{5}, \quad \frac{2}{5}$$

Answer [1]

- 2 Write down the equation for the following graphs from the table below.

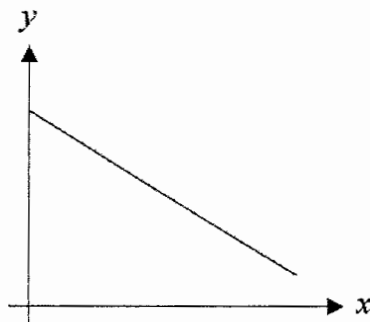
$y = 2 - x^2$	$y = x^2 - 2$	$y = \frac{2}{x}$
$y = 2 - x$	$y = x - 2$	$y = 2x$

(a)



Answer [1]

(b)

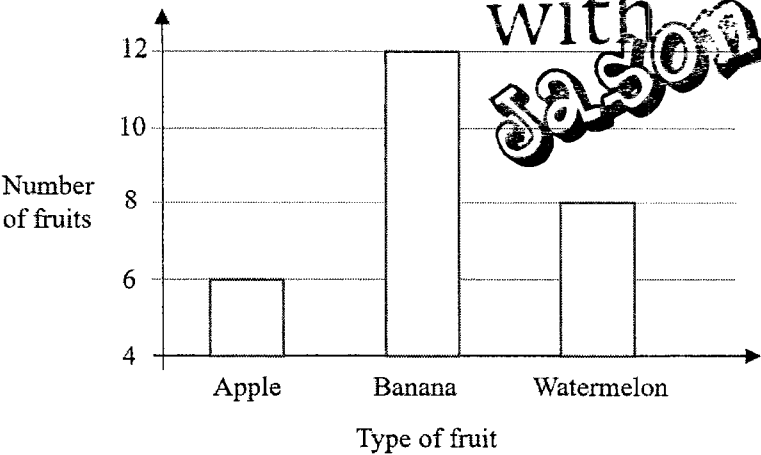


Answer [1]

[Turn Over]

4
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3 The graph shows the number of fruits sold by a fruit stall in a week.



(a) State one misleading feature of the graph.

Answer.....
..... [1]

(b) Explain how this feature affects the readers' interpretation of the graph.

Answer.....
..... [1]

4 It is given that a is 25% of b and b is 25% of c .
Is a 50% of c ? Explain your answer.

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

- 5 Mrs Ng distributed a packet of sweets to Abigail, Benjamin and Cyrus in the ratio 2 : 3 : 4. However, if the packet of sweets had been distributed equally among the three of them, Abigail would have received 5 sweets more in comparison with the previous distribution.

What is the total number of sweets in the packet?

Answer [2]

- 6 An area of 2 cm^2 on map A represents a land area of 50 m^2 .
- (i) Express the scale of the map in the form 1 : n .

Answer : [2]

- (ii) A bridge on map A is 3.75 cm long.
Find the actual length, in m of the bridge.

Answer m [1]

[Turn Over

6

Tuition
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Jason

- 7 The information on three trains, P, Q and R at a train station is as follows.

	First Train	Frequency
Train P	8.15 am	Every 15 minutes
Train Q	8.15 am	Every 18 minutes
Train R	8.15 am	Every 25 minutes

Find the next time that the train will leave the station together.

Answer [2]

- 8 a is inversely proportional to the square of b . When $a = 16$, $b = \frac{1}{2}$.

(a) Form an equation connecting a and b .

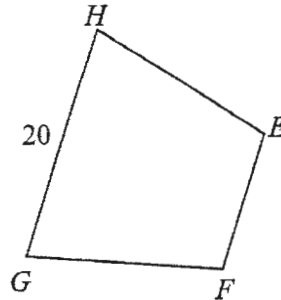
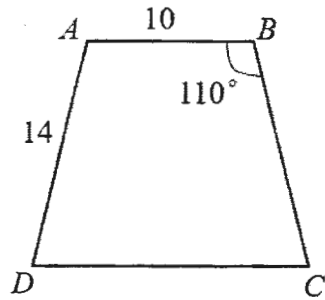
Answer [2]

(b) Find the value(s) of b when $a = 81$.

Answer [1]

- 9 In the diagram, trapezium $ABCD$ is congruent to trapezium $EFGH$.

It is given that $AB = 10$ cm, $AD = 14$ cm, $GH = 20$ cm, $\angle ABC = 110^\circ$.



Find

- (i) EH ,

Answercm [1]

- (ii) angle FGH .

Answer [1]

[Turn Over

10 Simplify

(a) $\frac{3x}{4} - \frac{4(2-3x)}{3},$

Answer [2]

(b) $\frac{3ab}{5c^2} \div \frac{24a^3}{30b^2c^3}.$

Answer [2]

11 Factorise completely. **Tuition**

(a) $6x - 2xy + 5ay - 15a$,

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Answer [2]

(b) $81x^2 - 36y^2$.

Answer [2]

[Turn Over

12

$$y = \frac{ax - 3x}{1 - a}$$

- (a) Find y when $x = 2$ and $a = -3$.

Answer [1]

- (b) Rearrange the formula to make x the subject.

Answer $x =$ [2]

- 13 (a) Solve the inequality $\frac{4 - 5x}{2} < \frac{4x + 1}{4}$.

Answer [2]

- (b) Hence write down the smallest prime number which satisfy the inequality $\frac{4 - 5x}{2} < \frac{4x + 1}{4}$.

Answer [1]

- 14 The positive integer p is given as $2^3 \times 3^7 \times 5^6$.
(a) Determine if p is a perfect cube. Explain your answer.

Answer
..... [2]

- (b) Find the smallest integer k such that pk is a perfect square.

Answer [1]

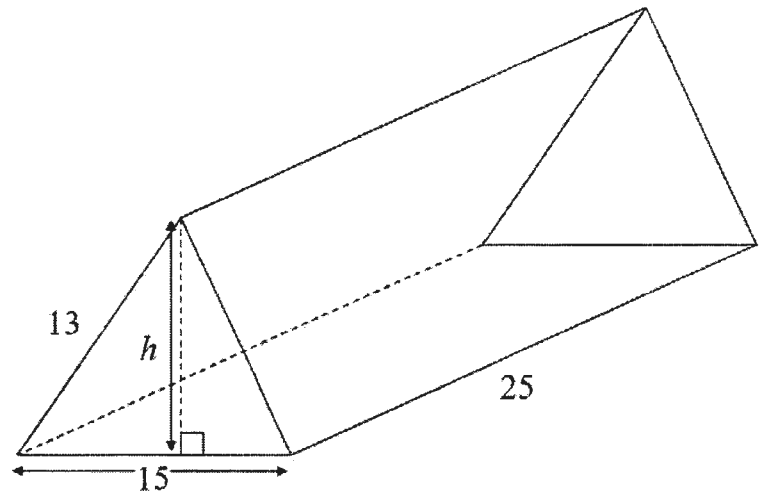
- 15 Solve these simultaneous equations.

$$\begin{aligned} \frac{x}{5} + \frac{y}{3} &= 1 \\ 2x - 5y &= 20 \end{aligned}$$

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

[Turn Over

- 16 The diagram shows a solid with dimensions shown.
All measurements are in centimetres.



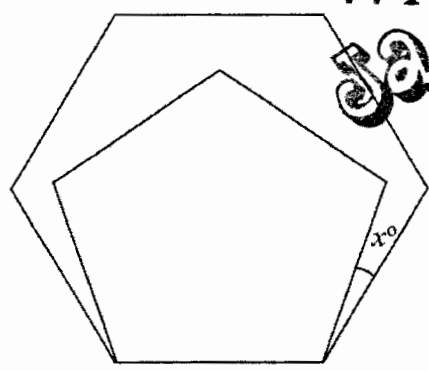
The volume of the solid is 2250 cm^3 . Find the value of h .

Answer [2]

13

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- 17 The diagram shows regular pentagon and hexagon. Find the value of x .



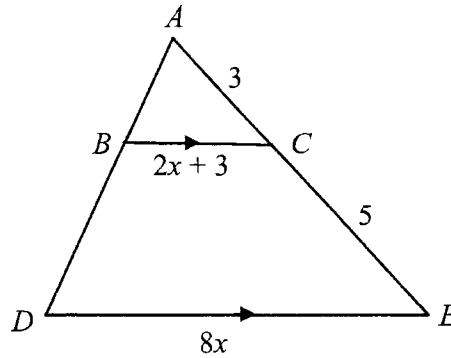
Answer [3]

[Turn Over

- 18 Triangle ABC is similar to triangle ADE .

$BC = (2x + 3)$ cm and $DE = 8x$ cm.

$AC = 3$ cm and $CE = 5$ cm.

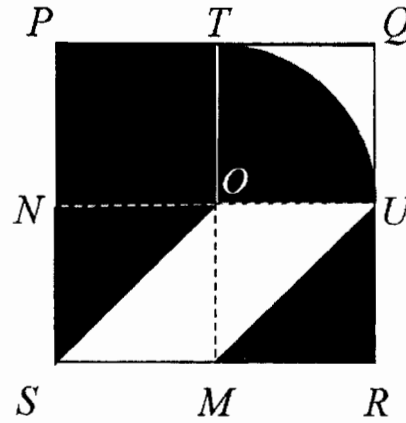


Find the value of x .

Answer [3]

Tuition
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- 19 The diagram shows a square $PQRS$. N is the midpoint of PS and M is the midpoint of RS . OUT is a quadrant of a circle, centre O . Express the shaded area as a percentage of the whole square.



Answer % [3]

[Turn Over

Section 2 (50 marks)
Answer **all** the questions.

20 John cycled for an average speed of x km/h for a distance of 90 km.

- (a) Write down an expression, in terms of x , for the time taken to cycle 90 km.

Answer h [1]

- (b) On his return journey, his average speed was 10 km/h slower.

Write down an expression, in terms of x , for the time taken to cycle the return journey.

Answer h [1]

- (c) John took 1.5 hours more for the return journey.

Form an equation in x and show that it reduces to $x^2 - 10x - 600 = 0$.

Answer

[3]

20 (d) Solve the equation, $x^2 - 10x - 600 = 0$.

Answer [2]

(e) Calculate the time taken for John’s return journey.

Answer h [1]

[Turn Over

- 21 The variables x and y are connected by the equation $y = -2 - \frac{5x}{2} + \frac{x^2}{4}$.

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

x	-2	0	2	4	6	8	10	12
y	4	-2	-6	-8	-8	-6	-2	p

- (a) Find the value of p .

Answer [1]

- (b) On the grid opposite, draw the graph of $y = -2 - \frac{5x}{2} + \frac{x^2}{4}$ for $-2 \leq x \leq 12$. [3]

- (c) The equation $-2 - \frac{5x}{2} + \frac{x^2}{4} = 0$ has two solutions.

Explain how it can be seen from your graph.

Answer

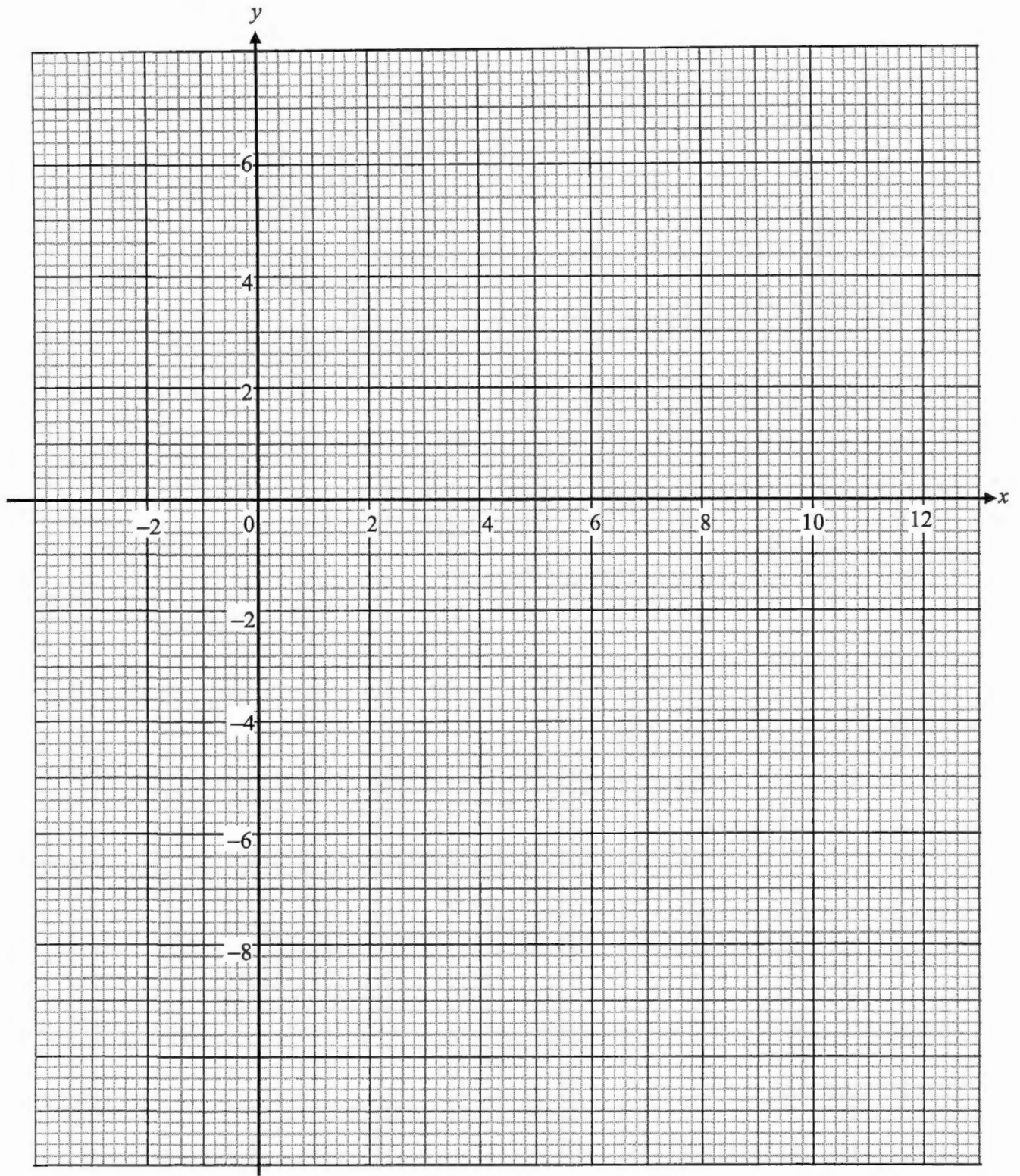
..... [1]

- (d) Using your graph, find the values of x when $y = -3$.

Answer [2]

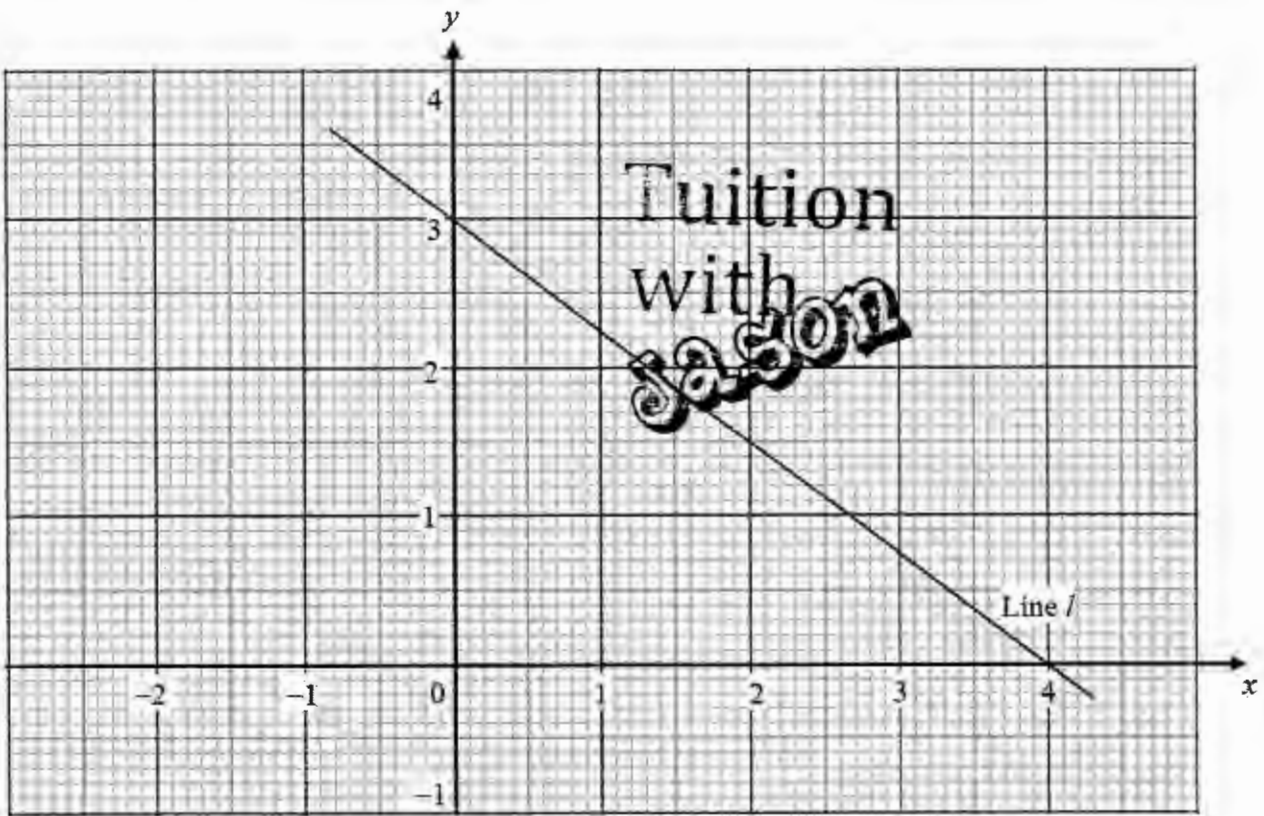
- (e) Write down the line of symmetry for $y = -2 - \frac{5x}{2} + \frac{x^2}{4}$.

Answer [1]



[Turn Over

22 A straight line l is drawn on the grid.



(a) Find the gradient of line l .

Answer [1]

(b) Write down the equation of line l .

Answer [1]

22 (c) (i) On the grid provided, draw the straight line $y = x + 1$ for $-1 \leq x \leq 3$. [2]

(ii) Hence, write down the coordinates of the point of intersection of line l and $y = x + 1$.

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

23 The time to complete a test involving 20 students from Class A is represented by the frequency table below.

Time (<i>secs</i>)	$10 \leq s < 20$	$20 \leq s < 30$	$30 \leq s < 40$	$40 \leq s < 50$	$50 \leq s < 60$
Frequency	2	3	6	4	5

(a) Calculate the mean time to complete the test.

Answer s [2]

(b) Explain whether the method used in (a) will give an accurate mean.

Answer
..... [1]

(c) State the median class interval of class A.

Answer [1]

- 23 (d)** The time taken to complete the test for 10 students in class B is recorded in the stem-and-leaf diagram below.

3	0	5	5	6
4	3	7	8	9
5	1	1		

Key: 3 | 1 stands for 31 seconds

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- (i)** Calculate the mean time taken for Class B.

Answer s [1]

- (ii)** Calculate the median time taken for class B.

Answer s [1]

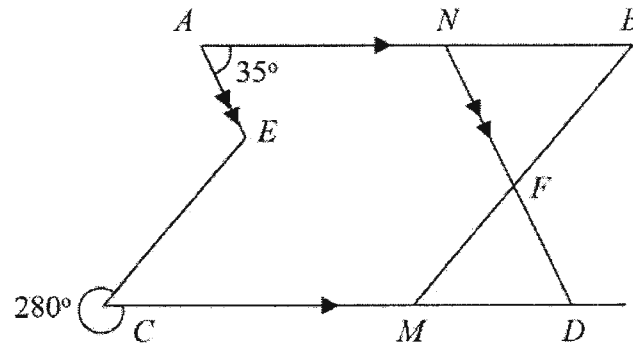
- (iii)** Make one comment comparing the speed of the students taking the test in Class A and Class B.

Answer

 [1]

[Turn Over

- 24 In the diagram below, N is a point on line AB and M is a point on line CD .
 AB is parallel to CD and AE is parallel to ND . Angle $EAN = 35^\circ$ and reflex angle $ECD = 280^\circ$.



- (a) Find, giving reasons for each step,
 (i) angle NDM ,

Answer [1]

- (ii) reflex angle AEC .

Answer [2]

24 (b) It is further given that angle $MFD = 65^\circ$.

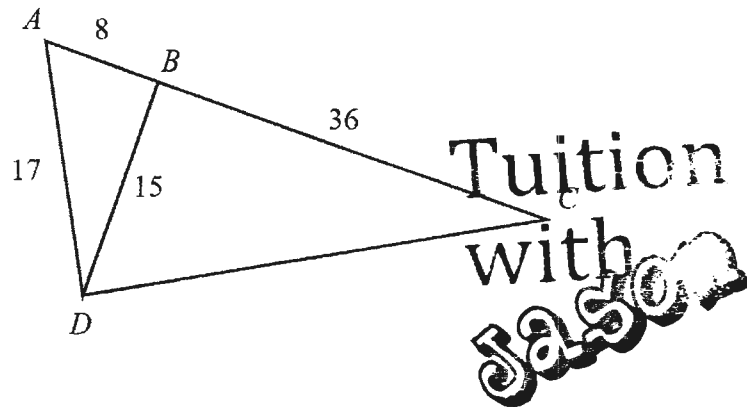
Determine if CE is parallel to BM . Show your reasons clearly.

Answer

.....
.....
..... [3]

[Turn Over

- 25 The diagram shows a triangular plot of land ACD . ABC is a straight line. It is given that $BC = 36$ km, $AD = 17$ km, $AB = 8$ km and $BD = 15$ km.



- (a) Show that angle $CBD = 90^\circ$.

Answer

.....

 [2]

- (b) Write down the value of $\sin \angle DAB$.

Answer [1]

- (c) Find angle BDC .

Answer [2]

25 (d) (i) Find the area of triangle BCD .

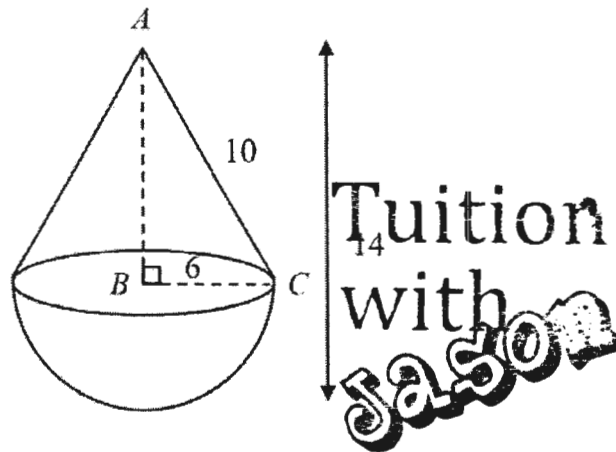
Answer km^2 [1]

(ii) Hence, find the shortest distance from B to line DC .

Answer km [2]

[Turn Over

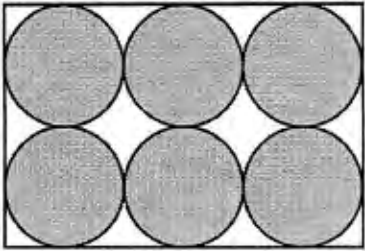
- 26 A toy is made up of a cone and hemisphere as follows. The radius height of the toy is 6 cm, the slant height of the cone is 10 cm and the total height of the toy is 14 cm.



- (a) Calculate the total volume of one such toy.

Answer cm^3 [3]

- 26 (b) To ship the toy, it is placed side by side in a rectangular container. The diagram shows the plan view of a box holding six of the toy. The height of the box fits the toy at 14 cm.



To prevent damage, the empty space in the box is packed with styrofoam. There are two types of styrofoam available. (Assume the space between the styrofoam is negligible)

Type A	Type B
Cube with length 0.5 cm 100 such cube costs \$0.02	\$2 per 1000 cm³

Which type of styrofoam is the most cost efficient way of packing the toy? Justify your answer with calculations.

Answer

.....

.....

..... [5]

End of Paper

[Turn Over

North Vista Secondary School
Secondary 2 Express
End-of-Year Examinations

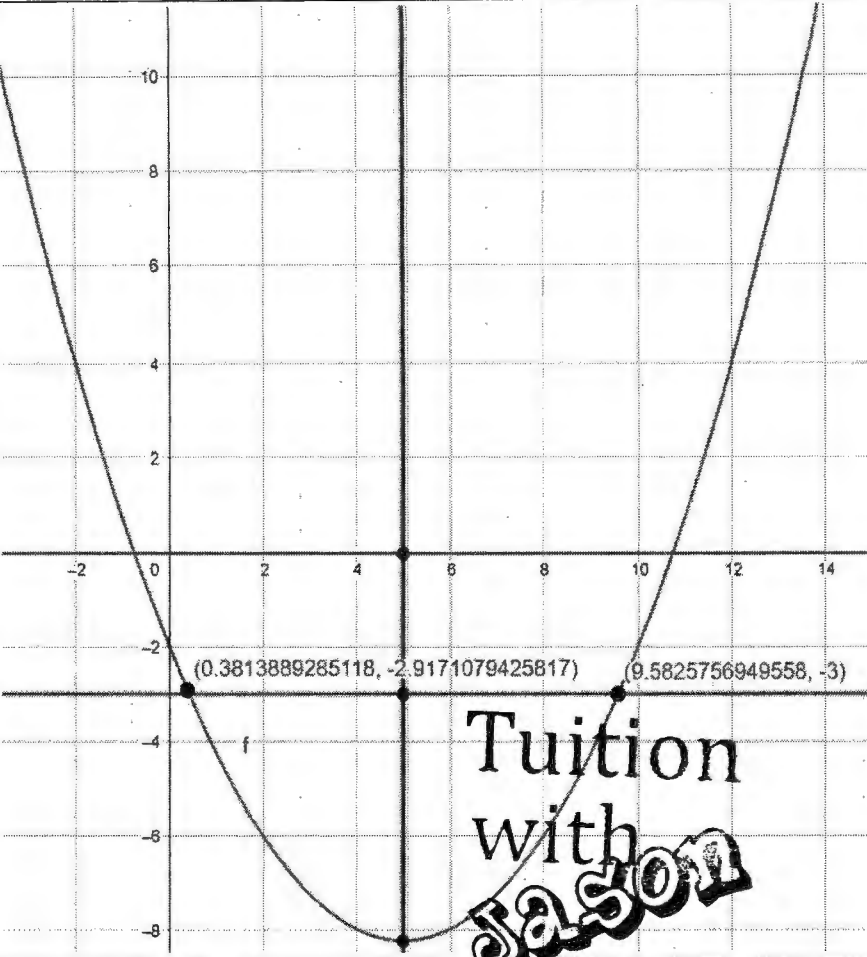
Marker's Report

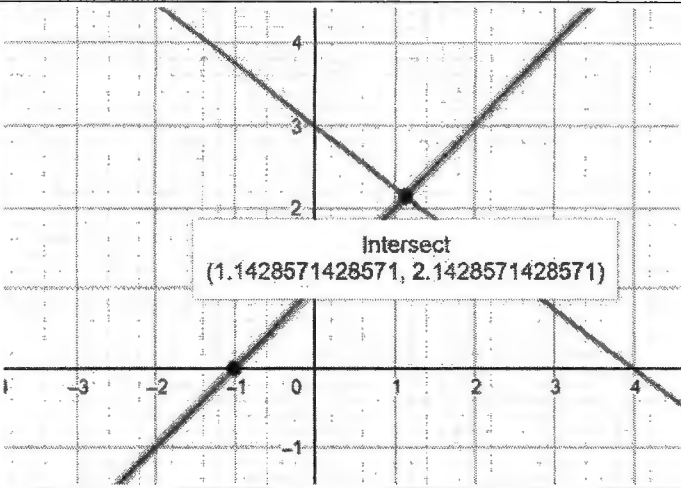
	Section 1	
1	$0.22\dot{5}$, $\left(-\frac{1}{2}\right)^2$, 0.255 , $\frac{2}{5}$	B1
2(a)	$y = \frac{2}{x}$	B1
2(b)	$y = 2 - x$	B1
3	Aspect: The vertical axes does not start from zero. Misinterpretation: The number of apples sold is 6 whereas bananas sold is twice that of apples. However, in the graph, it looks like number of bananas sold is 4 times that of apples.	B1 B1
4	$a = 0.25b$ $b = 0.25c$ $a = 0.25(0.25c)$ $= 0.0625c$ a is 6.25% of c . Hence, it is not 50% of c .	M1 (express a as a quantity of c) A1 (express a as a percentage of c and conclude)
5	$5 \times 9 = 45$ sweets	M1, A1
6(i)	$2 \text{ cm}^2 : 50 \text{ m}^2$ $1 \text{ cm} : 5 \text{ m}$ $1 : 500$	M1 (conversion to map scale) A1 (conversion to same units)
6(ii)	Actual length = $3.75 \times 5 = 18.75 \text{ m}$ (exact)	B1
7	LCM (15,18,25) = 450	M1 (finding LCM)

	Next time = 3.45 pm or 1545 h	A1
8(a)	$k = 4$ $a = \frac{4}{b^2}$	M1 (value of k) A1
8(b)	$b = \frac{2}{9}$ or $-\frac{2}{9}$	B1 (both values)
9(i)	14 cm	
9(ii)	70°	
10(a)	$\frac{3x}{4} - \frac{4(2-3x)}{3}$ $= \frac{9x - 16(2-3x)}{12}$ $= \frac{57x - 32}{12}$	M1 (combine fraction) A1
10(b)	$\frac{3b^3c}{4a^2}$	B2, B1, 0
11(a)	$6x - 2xy + 5ay - 15a$ $= 2x(3 - y) + 5a(y - 3)$ $= (3 - y)(2x - 5a)$	M1 (factorise) A1
11(b)	$81x^2 - 36y^2$ $= 9(9x^2 - 4y^2)$ $= 9(3x + 2y)(3x - 2y)$	M1 (factorise 9) A1
12(a)	$y = -3$	B1
12(b)	$y - ay = ax - 3x$ $x(a - 3) = y - ay$ $x = \frac{y - ay}{a - 3}$	M1 (cross multiply) A1

13(a)	$16 - 20x < 8x + 2$ $x > \frac{1}{2}$	M1 (cross multiply) A1
13(b)	2	B1
14(a)	No. The index of the prime factors are not multiples of 3 / divisible by 3.	M1, A1
14(b)	$k = 2 \times 3 = 6$	
15	Show substitution or elimination $y = -1\frac{1}{5}$ $x = 7$	M1 A1 A1
16	$\frac{1}{2} \times 15 \times h \times 25 = 2250$ $h = 12 \text{ cm}$	M1 (form equation) A1
17	Interior angles of pentagon = 108 Interior angles of hexagon = 120 $x = 120 - 108 = 12^\circ$	M1 M1 A1
18	$\frac{2x+3}{8x} = \frac{3}{8}$ $16x + 24 = 24x$ $x = 3$	M1 (form equation) M1 (cross multiply) A1
19	Let $SM = x$ Shaded area = $x^2 + x^2 + \frac{1}{4}\pi x^2 = 2x^2 + 0.25\pi x^2$ Area of square = $(2x)^2 = 4x^2$ Percentage = $\frac{2x^2 + 0.25\pi x^2}{4x^2} \times 100 = 69.6\%$	M1 M1 A1
Section B		
20(a)	$\frac{90}{x}$	B1

20(b)	$\frac{90}{x-10}$	B1
20(c)	$\frac{90}{x-10} - \frac{90}{x} = \frac{3}{2}$ $90x - 90(x-10) = \frac{3}{2}x(x-10)$ $1800 = 3x^2 - 30x$ $x^2 - 10x - 600 = 0 \text{ (shown)}$	M1 (form equation) M1 (correct expansion / combine fractions) M1 (simplify)
20(d)	$(x-30)(x+20) = 0$ $x = 30 \quad \text{or} \quad x = -20$	M1 A1 (both values)
20(e)	Time taken = $\frac{90}{30-10} = 4.5 \text{ h}$	B1
21(a)	$p = 4$	B1

21(b)		B3, B2, B1, 0 Correct points with smooth curve Deduct marks for no label of graph
21(c)	There are only two intercepts on the x-axis.	B1
21(d)	$0.2 \leq x \leq 0.65$ and $9.3 \leq x \leq 9.8$	B1, B1
21(e)	$x = 5$	B1
22(a)	Gradient = $-\frac{3}{4}$	B1
22(b)	$y = -\frac{3}{4}x + 3$	B1

22(c)		B2, B1, 0 Correct points with straight line (in given range)
22(d)	(1.15, 2.15) Accepted range $1.05 \leq x \leq 1.3$ and $2.05 \leq y \leq 2.3$	B1
23(a)	$\frac{15(2) + 25(3) + \dots + 55(5)}{20}$ $= \frac{770}{20}$ $= 38.5 \text{ s}$	M1 (either) A1
23(b)	No. the m calculated uses the mid-value of the class interval. OR No. The data collected is not the exact value.	B1
23(c)	$30 \leq s < 40$	B1
23(d)(i)	42.5 s	B1
23(d)(ii)	$\frac{43 + 47}{2} = 45 \text{ s}$	B1
23(d)(iii)	Since median/mean of class A < median/mean of class B, the students from class A completed the test faster than class B.	B1 (must compare mean with mean and median with median)
24(a)(i)	$BNF = 35^\circ$ (corr s) $NDM = 35^\circ$ (alt s)	B1

	OR $\angle NDM = 35^\circ$ (opp $\angle$ s of //gram)	
24(a)(ii)	$\angle AEY = 180 - 35 = 145^\circ$ (int $\angle$) $YEC = 180 - 80 = 100^\circ$ (int) reflex $AEC = 145 + 100 = 245^\circ$	M1 (either) A1
24(b)	$FMD = 180 - 65 - 35 = 80^\circ$ (sum of Δ) $ECM = 80^\circ$ (s at a pt) Since $FMD = ECM$, by the property of corresponding angles, $CE \parallel BM$. <u>Alternative method:</u> Extend line CE to meet line AB . Calculate that angle $ABM = \text{angle } ECM$, hence by properties of a parallelogram, opposite angles are equal.	M1 M1 A1 (with property)
25(a)	$AB^2 + BD^2 = 8^2 + 15^2$ $= 289$ $AD^2 = 17^2$ $= 289$ Since $AB^2 + BD^2 = AD^2$, by the <u>converse of Pythagoras Theorem</u> , $ABD = 90^\circ$, and $CBD = 90^\circ$ (adj angles on a str. line)	M1 A1 (any 2 points = 1m)
25(b)	$\frac{15}{17}$	B1
25(c)	$\tan BDC = \frac{36}{15}$ $BDC = 67.3^\circ$	M1 A1
25(d)(i)	270 km ²	B1
25(d)(ii)	$CD = 39$	

	$\frac{1}{2}(39)(h) = 270$ $h = 13.8 \text{ km}$ OR $\sin \angle BDC = \frac{h}{15}$ $h = 13.8 \text{ km}$	M1 (form equation – ecf for value of area) A1 OR M1 (ecf for value of angle BDC) A1
25(a)	$\frac{1}{3}\pi(6)^2(8) + \frac{2}{3}\pi(6)^3$ $= 753.9833$ $= 754 \text{ cm}^3$	M1, M1 A1
25(b)	Volume of rectangular container = $14(36)(24) = 12096$ Volume of empty space = $12096 - 6(753.9822) = 7572.1068$ <u>Type A</u> $\frac{7572.106}{0.5^3} \div 100 \times 0.02 = \\12.1153 <u>Type B</u> $\frac{7572.106}{1000} \times 2 = \\15.144 Therefore, Type A is better as it <u>costs lower</u>.	M1 M1 M1 (cost of Type A) M1 (cost of Type B) A1 (need to state reason)