NORTH VISTA SECONDARY SCHOOL
Preliminary Examination 2024
Secondary 4 Express/ 5 Normal Academic

90

CANDIDATE NAME

CLASS

INDEX NUMBER

MATHEMATICS 4052/01

Paper 1 **19 August 2024**

2 hours 15 minutes

Candidates answer on the Question Paper.

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.

Answer **all** 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	
Category	**Question**
Accuracy	
Brackets	
Fractions	
Units	
Others	
Marks Deducted	

This document consists of 20 printed pages.

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 = $4\pi r^2$

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

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

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

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

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

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

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

Answer **all** the questions.

1 Calculate $\dfrac{13.5+14.04}{-0.31+\sqrt[3]{15.625}}$, giving your answer correct to one significant figure.

Answer ……... [1]

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2 Alex buys a shirt at a price of £14.75.
Paul buys a shirt at a price of $21.99.
The exchange rate is $1 = £0.73.
Calculate how much more Paul pays than Alex.

Answer …...…….……... [2]

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3 **(a)** Simplify $5(3^3 \times 5^4)^2$.

Give your answer in the form $3^a \times 5^b$.

Answer …...…….……... [1]

(b) $$2^{100} - 4 \times 2^{97} = 2^k$$

Use laws of indices to find the value of *k*.
Show your working.

Answer k = ……..……... [2]

4 **(a)** A number p has exactly 12 factors. Two of the factors are 4 and 15.
Find the value of p.

Answer p = ……... [1]

(b) **(i)** Express 525 as the product of its prime factors.

Answer ……..…… [1]

(ii) The LCM of 15, x and 35 is 525.
Find two possible values of x between 15 and 100.

Answer x = ……. , …… [2]

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5 Jessica invests \$4540 at a rate of r % per year compound interest.
At the end of 10 years, she has earned \$1328.54 in interest.
Calculate the value of r.

Answer r = ……...…… [3]

6 Ayden claims that a regular polygon can be formed with the ratio

interior angle to exterior angle = 5: 4.

Explain why Ayden is wrong.

……...……

……...……

……...…… [2]

---

7 The expression $x^2 + ax + 17$ can be written in the form $(x-6)^2 + b$.

(a) Find the value of *a* and of *b*.

Answer a = ……..

b = …….. [2]

(b) Explain why when $x = 6$, the expression $x^2 + ax + 17$ has its minimum value.

……...…….

……...……. [1]

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8 A shopkeeper makes a loss of 24% when he sells an article for $136.
Calculate the selling price of the article in order for the shopkeeper to make a profit of 40%.

Answer $……...……. [2]

9 A bag contains some yellow and blue balls.
The ratio of the yellow balls to the blue balls is 1 : 4.
5 yellow balls are removed from the bag and 10 blue balls are added to the bag.
The new ratio of yellow balls to blue balls is 1 : 6.
Find the original number of yellow balls in the bag.

Answer …..…….…… [3]

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10 It is given $P(-4, 2)$, $Q(2, 10)$ and $R(-4, -5)$.

(a) Write down the equation of the line *PR*.

Answer ……... [1]

(b) The line $5y + 10 = mx$ has the same gradient as *QR*.
Find the value of *m*.

Answer m = ……... [2]

11 Each term in this sequence is found by subtracting the same number from the previous term.

78, a, b, c, 42, ……

(a) Find the values of a, b and c.

Answer a = …….

b = …….

c = ……. [2]

(b) Write down an expression, in terms of n for the nth term.

Answer …..……..…… [1]

(c) Write an inequality in n and solve it to find the first negative term of this sequence.

Answer …..……..…… [2]

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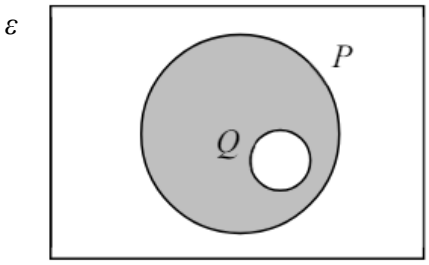
12 **(a)** Write down the set represented by the shaded region.



Answer …..……..…… [1]

12 **(b)** ε = {integer x : $1 \leq x < 15$ }
A = {perfect squares}
B = {prime numbers}

(i) Find $\mathrm{n}(A \cup B)'$.

Answer …..…….…… [1]

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

Answer …..…….…… [1]

(iii) Given that $C \subset (A \cap B')$ and n(C) > 0, list the elements in one possible set of C.

Answer …..…… [1]

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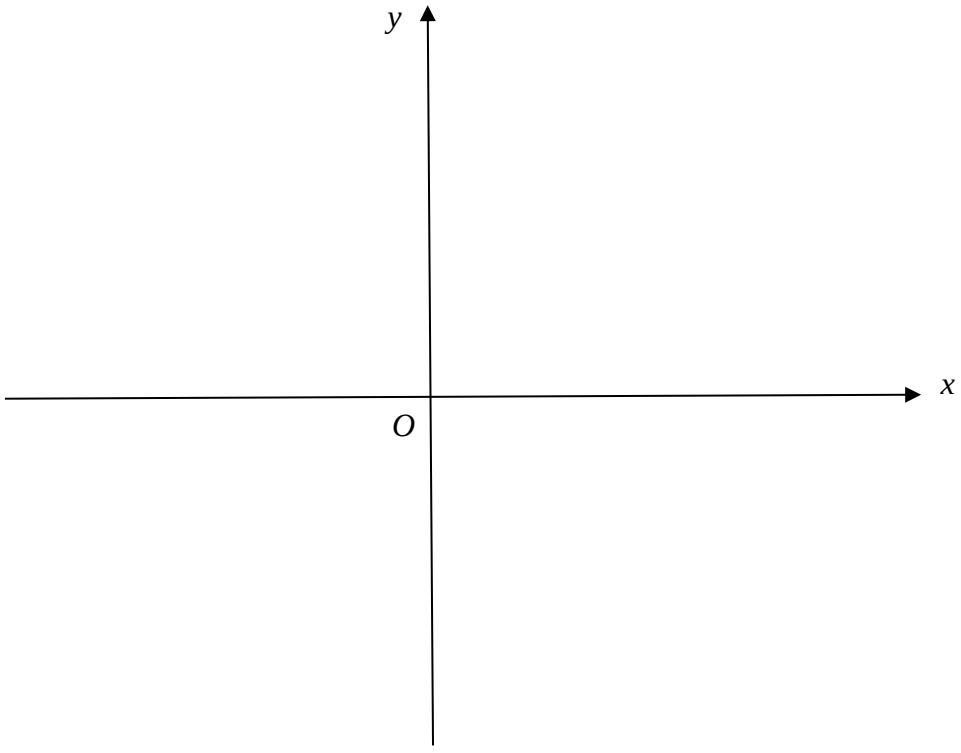
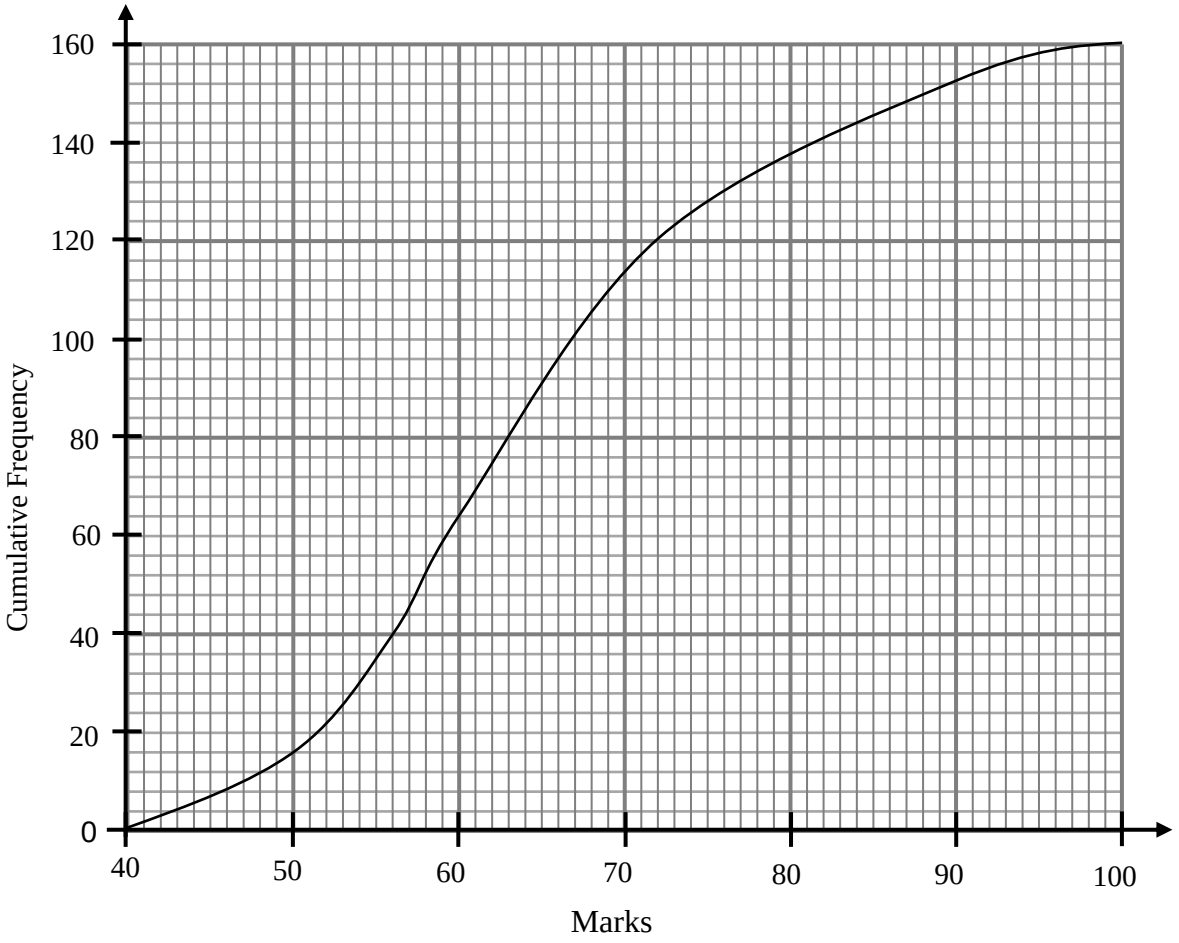
13 Sketch the graph of $y = (4 - x)(2 + x)$.
State clearly the coordinates of the points where the graph crosses the axes and the turning point on the curve. [3]



14 The diagram shows the marks obtained, out of 100, by 160 local students in a Mathematics test. The cumulative frequency curve shows the distribution of the marks.



(a) Use the curve to find

(i) the median mark,

Answer ……... [1]

(ii) the interquartile range of the distribution.

Answer ……... [2]

(b) A group of 160 foreign students took the same test and had the same median as the group of local students but a higher interquartile range.
Describe how the cumulative frequency curve for the group of foreign students may differ from the curve for the group of local students.

……...……...……..

……...……...……...… [1]

[Turn over

15 Write as a single fraction in its simplest form $\frac{x}{x+9}-\frac{4x+3}{x^2-81}$.

Answer ……...…… [2]

---

16 **(a)** Expand and simplify $(2x+3y)(7x-5y)$.

Answer ……...…… [2]

(b) Factorise completely.

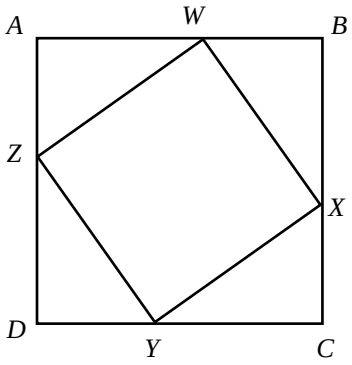
(i) $x^3y^3-xy^3$

Answer ……...…… [2]

(ii) $5ax-3ay-10cx+6cy$

Answer ……...…… [2]

17 Destin folded a square paper napkin, *ABCD*, along the lines *WX*, *XY*, *YZ* and *WZ* as shown. He ensured that $AW = BX = CY = DZ$.



Prove that triangle *AWZ* is congruent to triangle *BXW*.

……..…….

……...……...…….

……...……...……..……... [2]

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18 **(a)** *y* is directly proportional to the cube root of $(x + 1)$.

It is given that $x = 7$ when $y = 1$. Find the value of *y* when $x = 124$.

Answer $y =$ ……... [2]

18 **(b)** *F* is inversely proportional to the square of *d*.

Explain what happens to *F* when *d* is halved.

……..……

……. [2]

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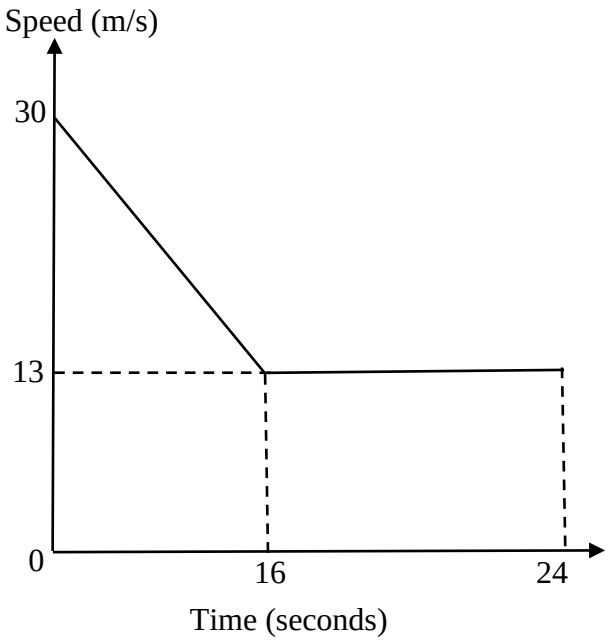
19 The diagram below shows the speed–time graph of part of a car's journey.



Calculate

(a) the deceleration of the car in the first 16 seconds,

Answer …..…….……m/s^2 [1]

(b) the average speed of the car during the 24 seconds.

Answer ……....……m/s [2]

20 The following table shows the amount of flour, butter and sugar in grams needed in making a pandan cake and a marble cake.

	Flour	**Butter**	**Sugar**
Pandan Cake	250 g	250 g	100 g
Marble Cake	400 g	200 g	90 g

(a) The amount of ingredients used in making a pandan cake and a marble cake can be represented by the matrix

$$\mathbf{A} = \begin{pmatrix} 250 & 250 & 100 \\ 400 & 200 & 90 \end{pmatrix}.$$

(i) Evaluate **AB** where $\mathbf{B} = \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$.

Answer **AB =** [2]

(ii) Explain what the elements in **AB** represent.

……...

……... [1]

(b) The cost of 100 g of flour is \$0.20, 100 g of butter is x dollars and 100 g of sugar is \$0.30.

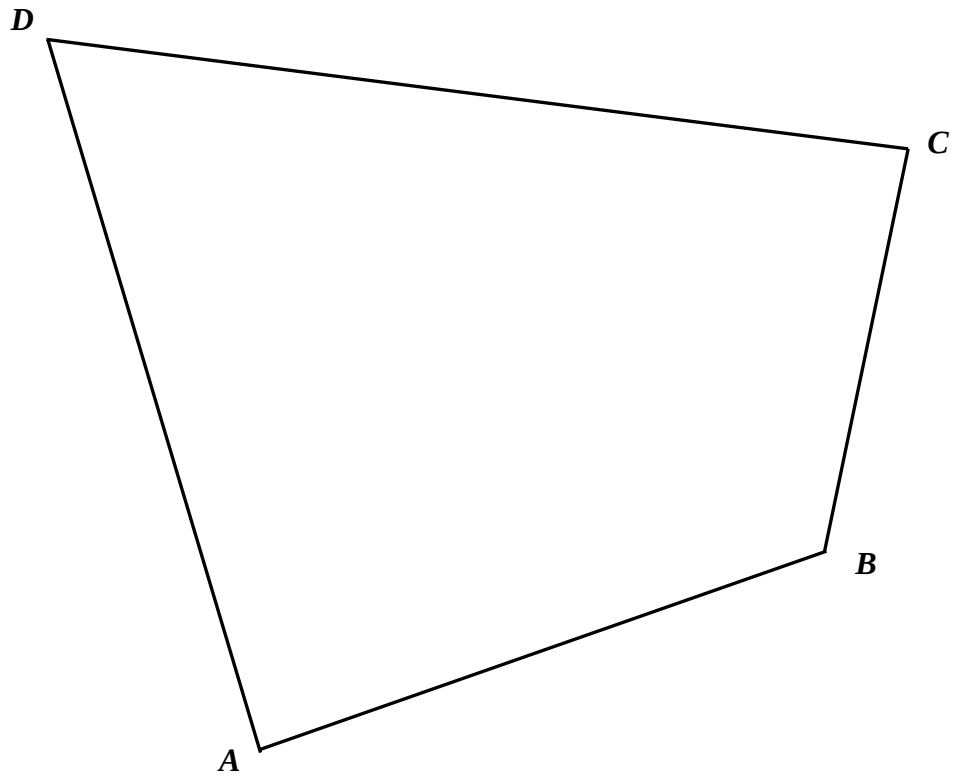
Represent this cost in a 3×1 column matrix **D**.

Answer **D =** [1]

(c) Given that the cost of baking a pandan cake is \$4.25, calculate the value of x.

Answer x = ……..…….... [1]

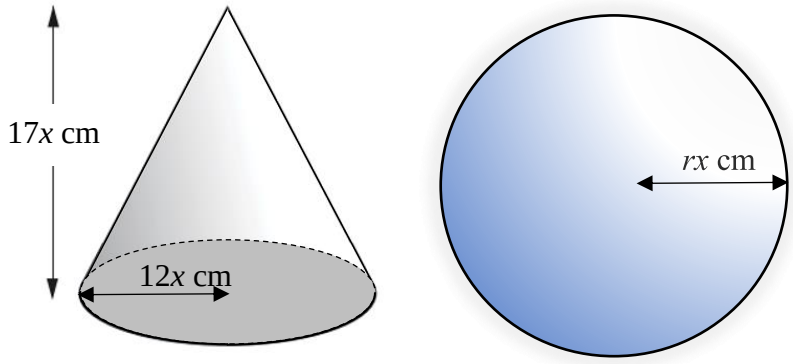
21 A plot of land *ABCD* is given below.



A playground *E*, inside the quadrilateral *ABCD*, is equidistant from *DA* and *CD* and closer to *B* than to *A*.

By construction, using compass and ruler, mark and label a possible position of the playground *E*. [3]

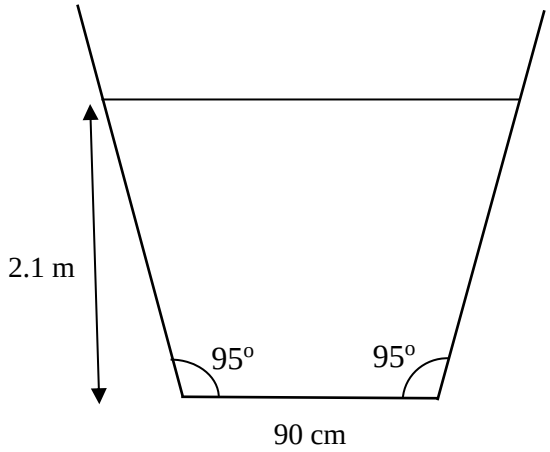
22 The diagram below shows a solid circular cone and a solid sphere.
The cone has radius $12x$ cm and height $17x$ cm.
The sphere has radius rx cm.
The cone has the same total surface area as the sphere.



Calculate the value for r.

Answer r = ... [4]

23 The diagram shows the symmetrical cross-section of a canal containing water.
The angle between the base and each side of the canal is 95°.
The width of the base is 90 cm, and the depth of the water is 2.1 m.
The canal is 100 m long.



(a) Calculate the volume of water in the canal.

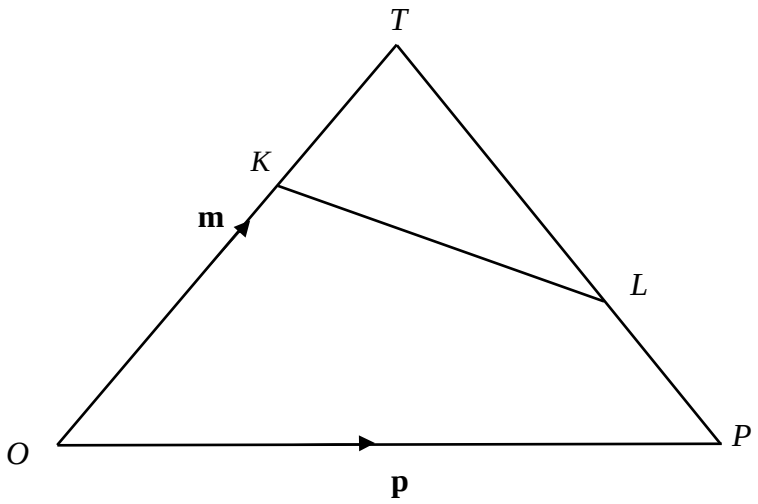
Answer ……..m^3 [4]

(b) Water is pumped out of the canal at a rate of 0.3 m^3 per minute.
Calculate the time taken to empty the canal completely.
Give your answer in hours and minutes, correct to the nearest minute.

Answer ……hours ……minutes [1]

24 The diagram shows triangle *OPT*.

$\overrightarrow{OP}$ = **p** and $\overrightarrow{OT}$ = **m**.
OK : *KT* = 2 : 1 and *TL* : *LP* = 2 : 1.



(a) Find, in terms of **m** and **p**, in its simplest form

(i) $\overrightarrow{PL}$,

Answer ……..… [1]

(ii) $\overrightarrow{KL}$.

Answer ……..… [1]

24 **(b)** *KL* is extended to the point *M*.

$\overrightarrow{KM} = -\frac{2}{3}\mathbf{m} + \frac{4}{3}\mathbf{p}$.

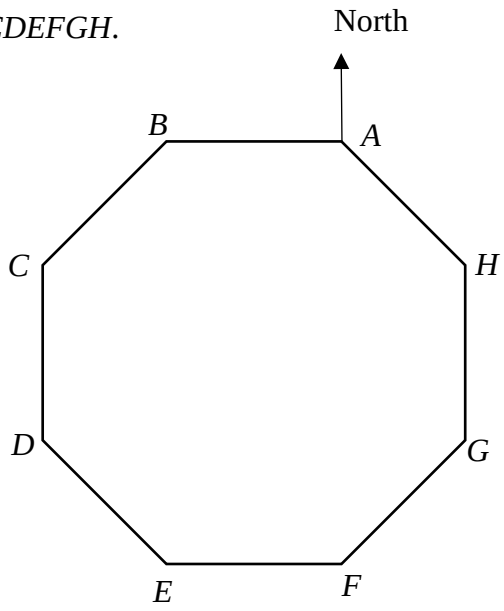
Show that *M* lies on *OP* extended. [3]

Answer

(c) Find the ratio of area of triangle *KTL* : area of triangle *OTP*.

Answer ……..…….…. [2]

25 The diagram shows the route of the Vistarian Roadrun.
The route is in the shape of a regular octagon, *ABCDEFGH*.
B is due west of *A* and *AB* = 0.65 km.



(a) Find the bearing of *H* from *A*.

Answer …… [2]

(b) Calculate the distance of *BH*.

Answer ……km [3]

[Turn over

25 (c) Calculate the area of triangle *BHG*.

Answer ……km^2 [2]

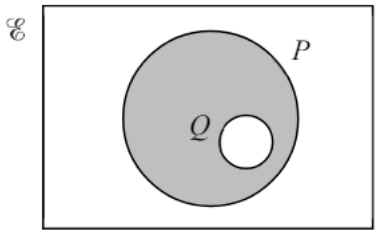
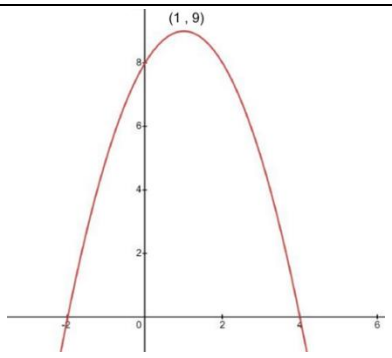
~End of Paper~

4E5N Mathematics
Prelim Paper 1/2024

Qn	Answer	AO	Marks
1	$12.57 \approx 10$ ….B1	AO1	**1**
2	$\frac{14.75}{0.73} = 20.2054$.....*M*1 $21.99 - 20.2054 \approx \$1.78$.....*A*1(with *units*) *or* $21.99 \times 0.73 = 16.0527$.....*M*1 $16.0527 - 14.75 = £1.30$.....*A*1(with *units*)	AO1	**2**
3(a)	$5(3^3 \times 5^4)^2$ $= 5(3^6 \times 5^8)$ $= 3^6 \times 5^9$.....*B*1	AO1	**1**
3(b)	$2^{100} - 4 \times 2^{97} = 2^k$ $2^{100} - 2^2 \times 2^{97} = 2^k$. $2^{100} - 2^{99} = 2^k$.....*M*1 $2^{99}(2-1) = 2^k \Rightarrow k = 99$.....*A*1	AO2	**2**
4(a)	Factors of 60 :1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60 $p = 60$.....*B*1	AO1	**1**
4(b)(i)	$525 = 3 \times 5^2 \times 7$ ……..B1	AO1	**1**
4(b)(ii)	$15 = 3 \times 5 \times 1$ $35 = 1 \times 5 \times 7$ $x = 1 \times 5^2 \times 1$ or $x = 3 \times 5^2 \times 1$ $525 = 3 \times 5^2 \times 7$ $x = 25, 75$ ……B1, B1	AO2	**2**
5	$4540+1328.54 = 4540(1+\frac{r}{100})^{10}$.....*M*1 $(1+\frac{r}{100})^{10} = 1.2926299$ $(1+\frac{r}{100}) = 1.2926299^{0.1}$.....*M*1 $r = 2.6000 \approx 2.60(3sf)$.....*A*1	AO1	**3**
6	Size of each exterior angle = $\frac{180}{9} \times 4 = 80^o$ …..B1	AO3	**2**

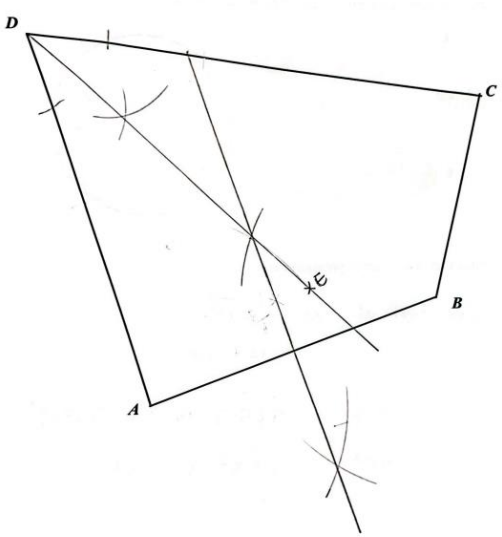
	Since the number of sides = $\frac{360^o}{80^o} = 4.5$ is not a positive integer, therefore it is not possible to form a regular polygon…..B1 OR Let n be number of sides. $(n-2)\times 180 : 360$ $(n-2) : 2$ $2n-4 : 5$ $2n-4=5$ $n=4.5$ OR Exterior + Interior angle = 180 degrees $\frac{(n-2)\times 180}{n} = \frac{5}{9}(180)$ n = 4.5		
7(a)	$x^2+ax+17=(x-6)^2+b$ $x^2+ax+17=x^2-12x+36+b$ Comparing $a=-12$.....*B*1 $17=36+b \Rightarrow b=-19$.....*B*1	AO2	**2**
7(b)	$x^2+ax+17=(x-6)^2+b$ Since the coefficient of $x^2 > 0$, $x^2+ax+17$ is minimum when $(x-6)^2=0$ therefore x = 6.	AO3	**1**
8	New Selling price $= \frac{136}{76}\times 140$.....*M*1 = \$250.53.....*A*1	AO2	**2**
9	Let the number of yellow balls be x Number of blue balls is $4x$ $\frac{x-5}{4x+10} = \frac{1}{6}$.....*M*1 $6(x-5)=4x+10$ $6x-30=4x+10$.....*M*1 $2x=40$ $x=20$ Number of yellow balls = 20.....A1	AO2	**3**

	OR 1 : 4 20 : 80 15 : 90 1 : 6 Ans: 20 OR 1 : 6 15 : 90 20 : 80 1 : 4 Ans: 20 OR Before After 1 : 4 1 : 6 4 : 16 3 : 18 1 unit = 5 4 units = 20 OR Let initial yellow balls be x Let initial blue balls be y $4x = y$ …. (1) $6(x – 5) = y + 10$ … (2) $x = 20$ OR Let initial yellow balls be x Let new yellow balls be y $x – 5 = y$ … (1) $4x + 10 = 6y$ … (2) $x = 20$		
10(a)	$x = -4$ ……B1	AO1	**1**
10(b)	$5y + 10 = mx$ $y = \frac{m}{5}x - 2$ $\frac{m}{5} = \frac{5}{2}$.....*M*1 $m = 12.5$.....*A*1	AO2	**2**
11(a)	78, *a*, *b*, *c*, 42,…..	AO2	**2**

	Common difference = $\frac{78-42}{4}=9$ $a=78-9=69$ $b=69-9=60$ $c=60-9=51$.....*B*2 / *B*1 for any 2 correct		
11(b)	General term = $87-9n$ ……B1	AO2	**1**
11(c)	$87-9n<0$.....*M*1 *o.e* $-9n<-87$ $n>9\frac{2}{3}\Rightarrow n=10$ *First* negative term = $87-90=-3$.....*A*1	AO2	**2**
12(a)	 $P\cap Q'$	AO1	**1**
12(b) (i)	ε = {integer x : $1\le x<15$ } A = {1,4,9} B = {2,3,5,7,11,13} $(A\cup B)'$ = {6, 8, 10, 12, 14} $n(A\cup B)'=5$…..B1	AO1	**1**
12(b) (ii)	B' = {1,4,6,8,9,10,12,14} $A\cap B'=\{1,4,9\}$……..B1 (no mark award for missing curly bracket)	AO1	**1**
12(b) (iii)	C = {1}, {4}, {9}, {1,4}, {1,9} or {4,9} any other possible answers……B1	AO1	**1**
13	 Shape with correct y – intercept (0,8) + x intercepts (-2,0) & (4,0) ……. B2 Coordinates of turning point (1,9) …….. B1	AO1	**3**
14(a)	63……..B1	AO1	**1**

14(b)	72 – 56 = 16……M1, A1	AO1	**2**
14(c)	The spread of marks for the group of foreign students is wider since the interquartile range is higher. **The cumulative frequency curve will be less steep** than the original curve and **passes through (63, 80)** since both groups have the same median.	AO3	**1**
15	$\frac{x}{x+9}-\frac{4x+3}{x^2-81}$ $=\frac{x(x-9)-(4x+3)}{(x+9)(x-9)}$ or $\frac{x(x-9)}{(x+9)(x-9)}-\frac{4x+3}{(x+9)(x-9)}$ *M*1 $=\frac{x^2-9x-4x-3}{(x+9)(x-9)}$ $=\frac{x^2-13x-3}{(x+9)(x-9)}$.....*A*1	AO1	**2**
16(a)	$(2x+3y)(7x-5y)$ $=14x^2-10xy+21xy-15y^2$.....*M*1 $=14x^2+11xy-15y^2$.....*A*1	AO1	**2**
16(b) (i)	$x^3y^3-xy^3$ $=xy^3(x^2-1)$.....*B*1 $=xy^3(x+1)(x-1)$.....*B*1	AO1	**2**
16(b) (ii)	$5ax-3ay-10cx+6cy$ $=a(5x-3y)-2c(5x-3y)$.....*M*1 $=(5x-3y)(a-2c)$.....*A*1	AO1	**2**
17	$AW=BX$ (Given) $\angle WAZ=\angle XBW=90°$ (int angle of a square) $AD-DZ=AB-AW$ ($AW=DZ$ *given*, $AD=AB$ sides of square) $AZ=BW$.....*B*1(for all statements and reasons) By SAS, triangle AWZ is congruent to triangle BXW …..B1	AO3	**2**
18(a)	$y=k\sqrt[3]{x+1}$ $1=k\sqrt[3]{7+1}$.....*M*1 $k=0.5$ $y=0.5\sqrt[3]{124+1}=2.5$.....*A*1	AO1	**2**

18(b)	$F = \frac{k}{d^2}$ $New\ \mathrm{F} = \frac{k}{(0.5d)^2}$.....*B*1 $= 4\left(\frac{k}{d^2}\right) = 4F$ New value of *y* becomes 4 times of the original value……..B1 Other good answers : F increases to 400% of the original value F increases by 300% F increases by 3 times F is increased by a factor of 4 Acceptable answers: F is multiplied by 4	AO2	**2**
19(a)	$1\frac{1}{16} m/s^2$ *or* $1.0625 m/s^2$	AO1	**1**
19(b)	*Ave* Speed $= \frac{0.5(30+13)16+13\times 8}{24}$.....*M*1(correct distance) $= \frac{448}{24}$ $= 18\frac{2}{3} m/s$.....*A*1	AO2	**2**
20(a)	$AB = \begin{pmatrix} 250 & 250 & 100 \\ 400 & 200 & 90 \end{pmatrix}\begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix} = \begin{pmatrix} 600 \\ 690 \end{pmatrix}$……..B2	AO1	**2**
20(b)	The elements in AB represent the **total** amount of flour, butter and sugar (or **ingredients**) used in making a pandan cake and a marble cake **respectively**…..B1	AO3	**1**
20(c)	$D = \begin{pmatrix} 0.2 \\ x \\ 0.3 \end{pmatrix}$……..B1	AO1	**1**
20(d)	$\frac{250}{100}\times 0.2 + \frac{250}{100}\times x + 0.3 = 4.25$ $x = \$1.38$.....*B*1	AO1	**1**

21	 Perpendicular Bisector – B1 Angle bisector - B1 With correct position of E – B1	AO1	**3**
22	$slant$ height = $\sqrt{(12x)^2+(17x)^2} = \sqrt{433}x$.....$M1$ $\pi(12x)^2 + \pi(12x)(\sqrt{433}x) = 4\pi(rx)^2$.....$M1$ $144\pi x^2 + 12\sqrt{433}\pi x^2 = 4\pi x^2 r^2$ $4\pi x^2 r^2 = (144+12\sqrt{433})\pi x^2$.....$M1$ $r^2 = \dfrac{(144+12\sqrt{433})}{4} = 98.42595$ $r = 9.92(3sf)cm$.....$A1$ (-9.92rejected)	AO2	**4**
23(a)	$\tan 5^o = \dfrac{x}{2.1}$.....$M1$ Length of water level = $0.9 + 2(2.1\tan 5^o)$.....$M1$ Area of trapezium = $\dfrac{1}{2}(0.9+0.9+2(2.1\tan 5^o))\times 2.1 = 2.2758$ m^2....$M1$ Volume of water = $3.9464\times 100 = 227.5825 \approx 228$m^3.....$A1$	AO2	**4**
23(b)	$\dfrac{227.5825}{0.3} \div 60 = 12.6434h$ $= 12$ hours 38.60 mins $= 12$ hours 39 mins.....B1	AO1	**1**
24(a) (i)	$\overrightarrow{PL} = \dfrac{1}{3}\overrightarrow{PT}$ $\overrightarrow{PL} = \dfrac{1}{3}(m-p)$.....$B1$	AO1	**1**

24(a) (ii)	$\overrightarrow{KL} = \overrightarrow{KO} + \overrightarrow{OP} + \overrightarrow{PL}$ $\overrightarrow{KL} = -\frac{2}{3}m + p + \frac{1}{3}m - \frac{1}{3}p$ $\overrightarrow{KL} = \frac{2}{3}p - \frac{1}{3}m$.....*B*1	AO2	**1**
24(b)	$\overrightarrow{OM} = \overrightarrow{OK} + \overrightarrow{KM}$ $\overrightarrow{OM} = \frac{2}{3}m - \frac{2}{3}m + \frac{4}{3}p$ $\overrightarrow{OM} = \frac{4}{3}p$.....*B*1 $\overrightarrow{OM} = \frac{4}{3}\overrightarrow{OP}$.....*B*1 Since $\overrightarrow{OM} = \frac{4}{3}\overrightarrow{OP}$ and O is a common point, therefore M lies on OP extended.B1	AO3	**2**
24(c)	$\frac{Area\ KTL}{Area\ OTP} = \frac{Area\ KTL}{Area\ KPT} \times \frac{Area\ KPT}{Area\ OTP}$ $\frac{Area\ KTL}{Area\ OTP} = \frac{2}{3} \times \frac{1}{3} = \frac{2}{9}$.....*B*2(*o.e*)	AO2	**1**
25(a)	*Size* of each int angle = $\frac{(8-2)\times 180^o}{8} = 135^o$.....*M*1 Bearing of H from A = $360^o - 90^o - 135^o = 135^o$.....*A*1	AO2	**2**
25(b)	$BH^2 = 0.65^2 + 0.65^2 - 2(0.65)^2 \cos 135^o$.....*M*1 $BH = \sqrt{1.44250}$.....*M*1 $BH = 1.2010 \approx 1.20km$.....*A*1	AO1	**3**
25(c)	*Area* of $BHG = \frac{1}{2} \times 0.65 \times 1.2010 \times \sin 112.5$.....*M*1 *Area* of $BHG = 0.36061 \approx 0.361km^2$.....*A*1	AO2	**2**

ASSESSMENT OBJECTIVES

The assessment will test candidates' abilities to:

AO1 **Use and apply standard techniques**

- recall and use facts, terminology and notation
- read and use information directly from tables, graphs, diagrams and texts
- carry out routine mathematical procedures

AO2 **Solve problems in a variety of contexts**

- interpret information to identify the relevant mathematics concept, rule or formula to use
- translate information from one form to another
- make and use connections across topics/subtopics
- formulate problems into mathematical terms
- analyse and select relevant information and apply appropriate mathematical techniques to solve problems
- interpret results in the context of a given problem

AO3 **Reason and communicate mathematically**

- justify mathematical statements
- provide explanation in the context of a given problem
- write mathematical arguments

Approximate weightings for the assessment objectives are as follows:

AO1	45%
AO2	40%
AO3	15%

NORTH VISTA SECONDARY SCHOOL
Preliminary Examination 2024
Secondary 4 Express/ 5 Normal Academic

/ **90**

CANDIDATE NAME

CLASS

INDEX NUMBER

MATHEMATICS

4052/02

Paper 2

20 August 2024

2 hours 15 minutes

Candidates answer on the Question Paper.

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.

Answer **all** the 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. Gives 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	
Category	**Question**
Accuracy	
Brackets	
Fractions	
Units	
Others	
Marks Deducted	

This document consists of 23 printed pages.

Mathematical Formulae

Compound Interest

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

Mensuration

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

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

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

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

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

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

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

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

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

1 **(a)** Solve the inequality $-5 < 3x - 2 < 13$.

Answer ...……...…….. [2]

(b) Solve these simultaneous equations.

$$\frac{1}{2}x + y = 5$$

$$2x - 3y = 13$$

You must show your working.

Answer x = ...……..… y = ……...…… [3]

1 **(c)** $p = \sqrt[3]{\dfrac{r+q}{4r-1}}$

(i) Find p when $r = 7$ and $q = -15$.

Answer p = ……...…… [1]

(ii) Rearrange the formula to make r the subject.

Answer r = ...……..……...…….. [3]

1 **(d)** Solve $\frac{15}{2x-1} = x+3$.

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

2 **(a)** The table shows the amount of 'Food Waste Output' and 'Food Waste Recycled' in Singapore from 2008 to 2010.

Year	**2008**	**2009**	**2010**
Food Waste Output (*Tonnes)	565 000	605 000	640 000
Food Waste Recycled (*Tonnes)	65 000	75 000	99 000

*1 tonne = 1000 kg

(i) Write the total amount of Food Waste Output from 2008 to 2010 in standard form.

Answer ..……...…….. tonnes [1]

(ii) Given that the percentage increase in Food Waste Recycled from 2009 to 2010 is the same as the percentage increase from 2010 to 2011, calculate the amount of Food Waste Recycled in 2011.

Answer ..……...…….. tonnes [2]

(iii) Per capita food waste is defined as the amount of Food Waste Output generated by each person. Given that the population in 2008 is 4.84 million, calculate the per capital food waste in kilograms per day.

Answer ..……...…….. kg / day [2]

2 **(a)** **(iv)** It is given that

Food Waste Output = Food Waste Disposed + Food Waste Recycled

The recycling rate is given by the formula

$$\text{Recycling Rate} = \frac{\text{Food Waste Recycled}}{\text{Food Waste Output}}.$$

In 2007, 509 000 tonnes of food waste was disposed, and the recycling rate was 8.6%. Calculate the Food Waste Output in 2007.

Answer ..……..…….. tonnes [2]

(b) A river of length 612 m is represented by 9 cm on Map A.

(i) The actual perimeter of a lake is 1700 m.
Find the perimeter of the lake on Map A.

Answer ….....……..…… cm [2]

(ii) The area of the lake on Map A is 36 cm^2.
Calculate the area of the lake on Map B which has a scale of 1: 5100.

Answer ….....……..…..… cm^2 [2]

[Turn over

3 A piece of wire of length 120 cm is cut into two parts.
One part of the wire is bent to form a square of side x cm.
The remaining part of the wire is bent to form a circle with radius, r cm.

(a) Show that the radius of the circle, r is given by $\frac{60-2x}{\pi}$ cm.

Answer

[2]

(b) If the area of the square is equal to the area of the circle, form an equation in x and show that it reduces to

$$(4-\pi)x^2 - 240x + 3600 = 0 .$$

Answer

[2]

3 **(c)** Solve the equation $(4-\pi)x^2 - 240x + 3600 = 0$, giving your solutions correct to two decimal places.

Answer x = ... or ..... [4]

(d) Explain why one of the solutions has to be rejected.

Answer Reject ……because……

……..……..

……..……..

..……...……...… [1]

4 **(a)** The heights of 12 students from Group A were recorded.
The results are shown in the stem-and-leaf diagram.

15	0	2			
16	1	2	4	6	8
17	1	1	3	4	
18	0				

Key: 15 | 0 means 150 cm

(i) Find the mean height.

Answer ….....……..…..… cm [1]

(ii) Find the standard deviation of the heights.

Answer ….....……..…..… cm [1]

(iii) The mean height of students from Group B is 168 cm and the standard deviation of heights is 9.5 cm.
Make a comment comparing the averages and a comment comparing the distribution of the heights of students from Group A and Group B.

1. ……

...…….

...…….

...…….

2. …….

...…….

...……

...…….. [2]

4 **(b)** The table shows the subjects studied by a group of 40 students.

	Geography	History
Biology	9	12
Physics	8	11

(i) One of the students is chosen at random from students who study Biology. Find the probability that this student also studies History.

Answer ….....……..…..…….. [1]

(ii) Two of the students are chosen at random from students who study Geography. Find the probability that both students study Biology but not Physics.

Answer ….....……..…..... [2]

(iii) Three of the students are chosen at random from the whole group. Find the probability only one of them studies History.

Answer ….....……..…..... [2]

5 **(a)** Complete the table of values for $y = \frac{1}{4}x^3 + \frac{3}{2}x^2 - 4$.

x	−6	−5	−4	−3	−2	−1	0	1	2
y		2.25	4	2.75	0	−2.75	-4	−2.25	4

[1]

(b) On the grid opposite, draw the graph of $y = \frac{1}{4}x^3 + \frac{3}{2}x^2 - 4$ for $-6 \le x \le 2$. [3]

(c) The equation $\frac{1}{4}x^3 + \frac{3}{2}x^2 - 4 = k$ has no solution. Use your graph to find 2 possible **integer** values of *k*.

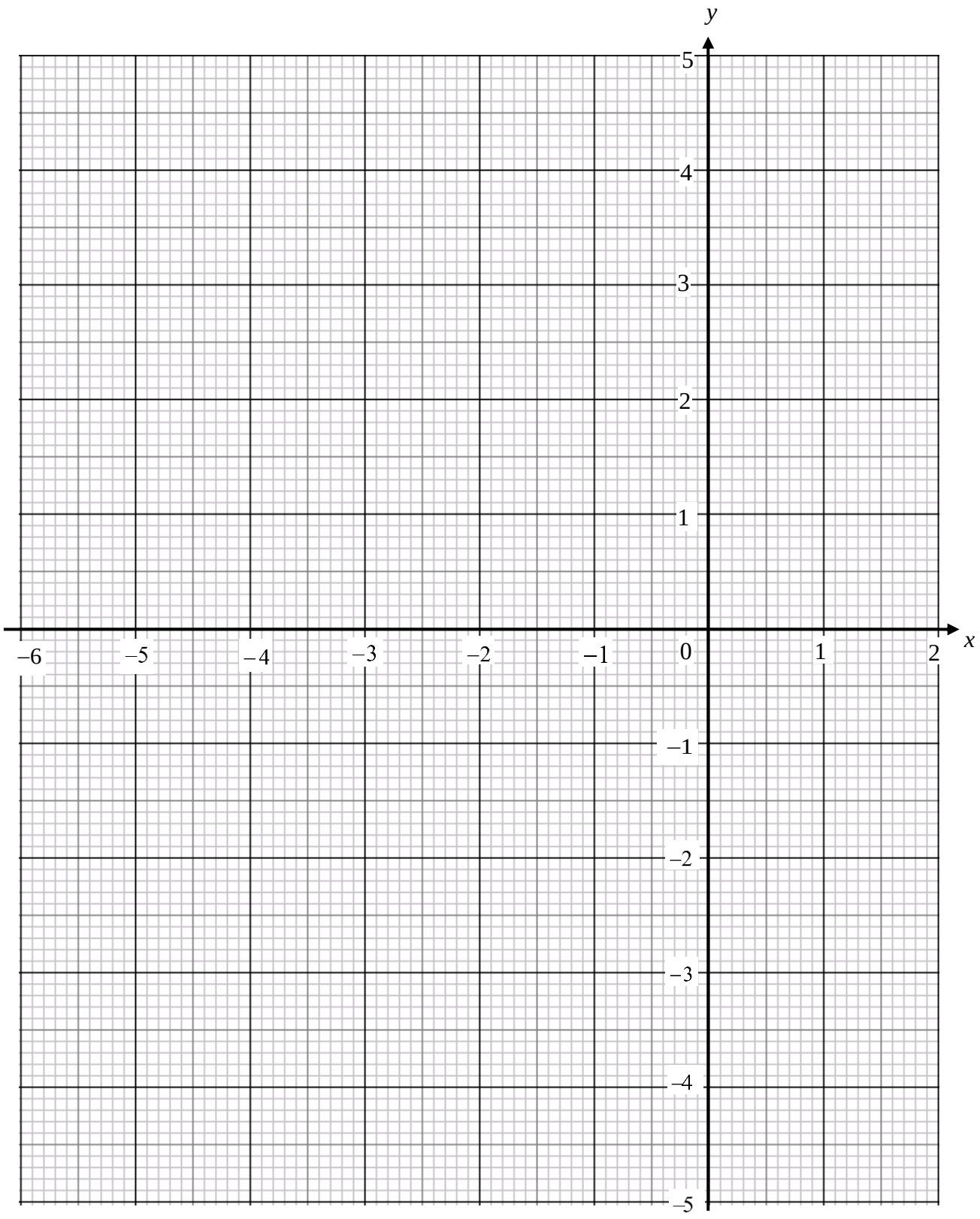
Answer $k =$……..... or …...…….. [2]

(d) By drawing a suitable line on the grid, solve the equation $x^3 + 6x^2 - 2x - 16 = 0$.

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

(e) By drawing a tangent, find the gradient of the curve at $(1, -2.25)$.

Answer ….....……...…...……... [2]


y
x
5
4
3
2
1
0
−1
−2
−3
−4
−5
−6
−5
−4
−3
−2
−1
1
2

6 **(a)** The first four terms in a sequence of numbers are given below.

$$T_1 = 2^2$$
$$T_2 = 2^4$$
$$T_3 = 2^6$$
$$T_4 = 2^8$$

(i) Find an expression for T_n.

Answer T_n =.....……..…..…….. [1]

(ii) The first four terms in second sequence of numbers are given below.

$$R_1 = 4^4$$
$$R_2 = 4^7$$
$$R_3 = 4^{10}$$
$$R_4 = 4^{13}$$

Find an expression for R_n.

Answer R_n =.....……..…..…….. [1]

(iii) The *n*th term of the third sequence of numbers is given by $Q_n = \frac{R_n}{T_n}$.

(a) Show that $Q_n = 2^{4n+2}$.

Answer

[1]

(b) Explain, with working, why 128 is not a term in the sequence Q_n.

.....……

.....……

.....……

……..…… [2]

6 **(b)** A is the point (4, 12) and B is the point (10, 4).

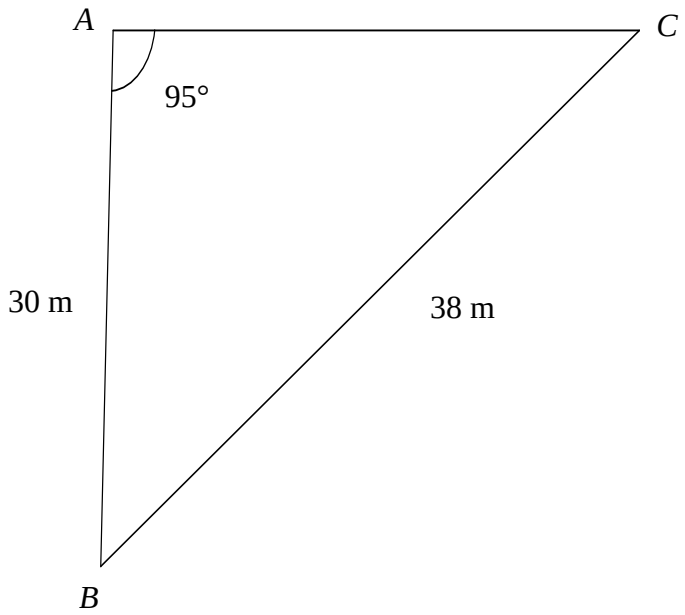
(i) Find $\left|\overrightarrow{AB}\right|$.

Answer …….……..……. [2]

(ii) Given that $\overrightarrow{AC} = \frac{1}{2}\overrightarrow{BA}$, find the coordinates of C.

Answer (.....…… , …..…..…) [2]

7



The diagram shows a section of a playground, *ABC*, bounded by three footpaths *AB*, *AC* and *BC*. *AB* = 30 m, *BC* = 38 m and angle *BAC* = 95°.

(a) Find angle *ABC*.

Answer Angle *ABC* = …..…..…….. [3]

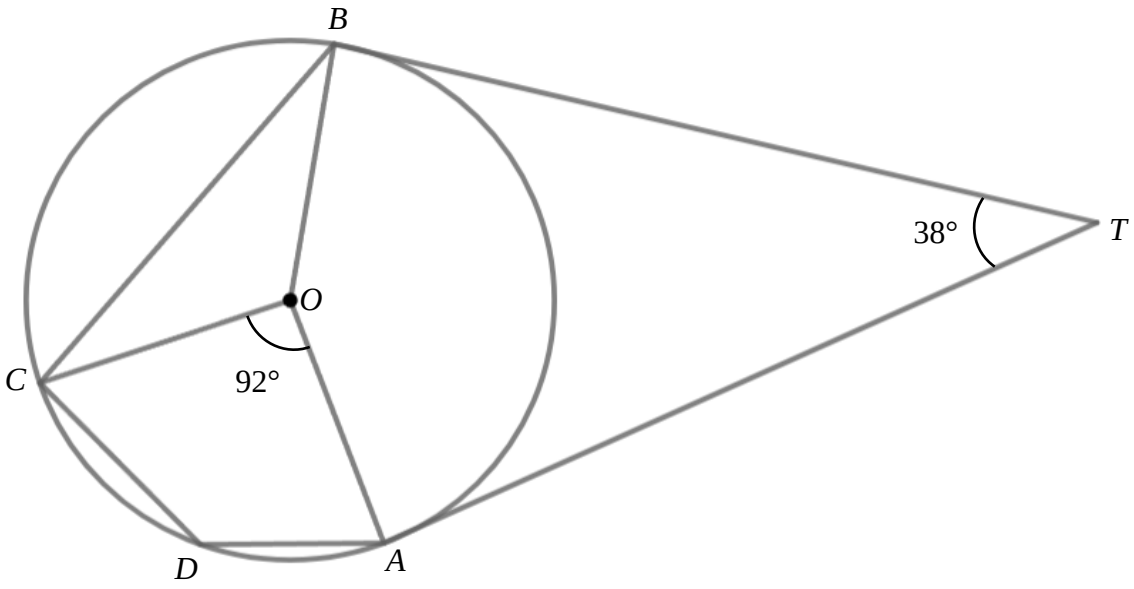
7 **(b)** A vertical pole of 2.5 m is placed at point *A*.
Calculate the greatest angle of depression of a point along *BC* from the top of the vertical pole.

Answer .....……..…..…….. [3]

(c) Ken runs from *B* to *C* at a speed of 4 m/s.
3 seconds after Ken left point *B*, Ali started to run from *A* towards *C*.
Determine the speed that Ali needs to run in order to reach point *C* at the same time as Ken.

Answer .....……..…..… m/s [4]

8



In the diagram, *A*, *B*, *C*, and *D* are points on a circle, centre *O*.
TA and *TB* are tangents to the circle at *A* and *B* respectively.
Angle *COA* = 92° and angle *BTA* = 38°.

(a) Find angle *CDA*.
Give reasons for each step of your working.

Answer Angle *CDA* = …...…...…….. [2]

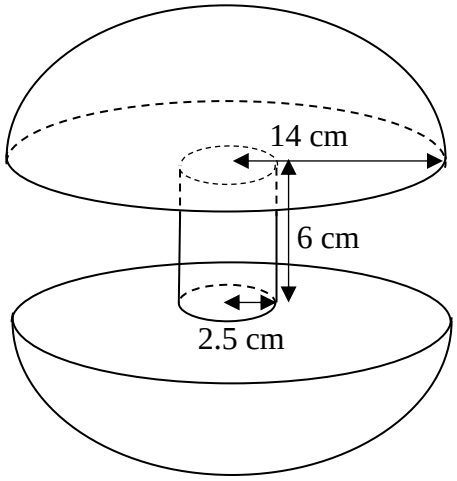
(b) Find angle *BCO*.
Give reasons for each step of your working.

Answer Angle *BCO* = …...…...…….. [3]

8 **(c)** The radius of the circle is 7 cm.
Find the area enclosed by *TA*, *TB* and major arc *BCDA*.

Answer …..…….…..… cm^2 [4]

9 A pottery artist in Singapore makes a clay sculpture consisting of two identical solid hemispheres and a solid cylinder as shown in the diagram below.
The hemisphere has a radius of 14 cm.
The cylinder has a radius of 2.5 cm and height of 6 cm.



The artist made another **geometrically similar** clay sculpture.
The radius of the hemisphere of the second sculpture is 7 cm.

(a) Given that the clay used has a density of $1.5\ \text{g/cm}^3$, show that the total mass of the two sculptures is 19.59 kg correct to 4 significant figures.

Answer

[4]

After completing the **two** sculptures, he has to deliver them to Australia within **2 weeks** via postage. The following tables show the mailing prices and other costs at the post office.

Destinations (Zones)	**Airmail Rate (Delivery in 2-9 days)**		**Surface Mail Rate (Delivery in 15-30 days)**	
	1st 5 kg	***Additional 1 kg or part thereof***	***1st 5 kg***	***Additional 1 kg or part thereof***
Zone A Malaysia	$16	$3	-	-
Zone B Brunei, Hong Kong, Indonesia, Philippines, Taiwan and Thailand	$30	$5	$18	$2
Zone C China, India, South Korea, rest of Asia	$30	$5	$18	$2
Zone D Australia, Japan and New Zealand	$40	$7	$20	$2

Carton Size	**Dimension (cm)**	**Price**
XS	20 × 15 × 9	$3.90
S	30 × 25 × 15	$4.90
M	35 × 25 × 15	$5.90
L	40 × 22 × 22	$6.90
XL	45 × 30 × 30	$7.90
XXL	55 × 32 × 32	$8.90

Items	**Dimensions**	**Price**
Packaging foam peanut (to fill empty space in the carton)	Small bag - 1500 cm^3	$2
	Medium bag - 7500 cm^3	$5
	Large bag - 60000 cm^3	$39

How to Pack and Seal Packages

1. Items may be packed in ***one carton or two separate cartons***.
2. ***Fill all empty space with foam peanuts*** to protect the contents.
3. The weight of the carton box and foam peanuts is ***negligible***.

9 **(b)** The cost of the clay he uses is $41.50 per pack. Each pack contains 5 kg of clay. Given that the **cost of delivery** should be kept **as low as possible**, decide on the carton size(s) and suggest a sensible selling price of the sculptures.

Justify any decisions you make and show your calculations clearly. [6]

Answer

[More working space for Qn 9 on the next page.]

Working space for Qn 9

End of Paper

North Vista Secondary
Secondary 4 Express Mathematics (4052)
2024
Paper 2 Marking Scheme

Qn	Solutions		Mark	AO	Total
1(a)	$-5 < 3x - 2 < 13$ $-3 < 3x < 15$ $-1 < x < 5$	$-3 < 3x$ and $3x < 15$ $-1 < x$ and $x < 5$ $-1 < x < 5$	M1 A1	**AO1**	**2**
1(b)	$\frac{1}{2}x + y = 5$ --- (1) $2x - 3y = 13$ --- (2) $(1) \times 4$ $2x + 4y = 20$ --- (3) $(2) - (3)$ $-7y = -7$ $y = 1$ When $y = 1$, $2x - 3(1) = 13$ $x = 8$ $\therefore x = 8,\ y = 1$		M1 A1 A1	**AO1**	**3**
1(c)(i)	When $r = 7$ and $q = -15$,			**AO1**	**1**

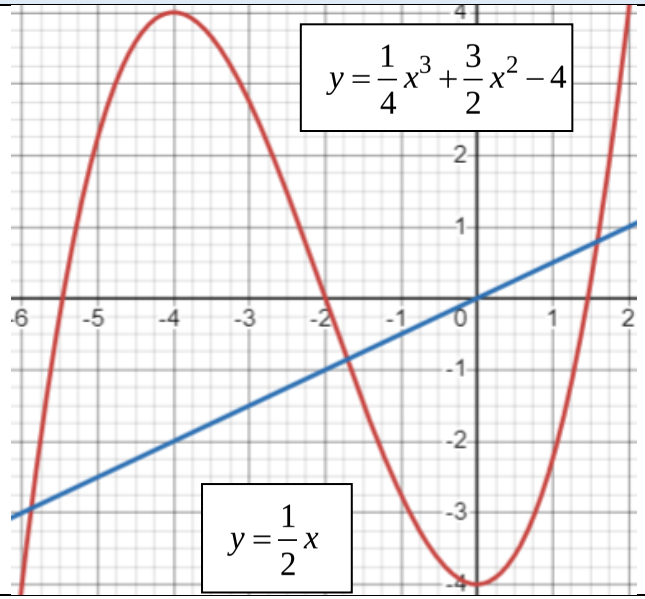
Qn	Solutions	Mark	AO	Total
	$p=\sqrt[3]{\dfrac{r+q}{4r-1}}$ $=\sqrt[3]{\dfrac{7-15}{4(7)-1}}$ $=-\dfrac{2}{3}$	B1		
1(c)(ii)	$p=\sqrt[3]{\dfrac{r+q}{4r-1}}$ $p^3=\dfrac{r+q}{4r-1}$ $p^3(4r-1)=r+q$ $4p^3r-p^3=r+q$ $4p^3r-r=p^3+q$ $r(4p^3-1)=p^3+q$ $r=\dfrac{p^3+q}{4p^3-1}$	M1 M1 A1	**AO1**	**3**
1(d)	$\dfrac{15}{2x-1}=x+3$ $(2x-1)(x+3)=15$ $2x^2+5x-18=0$ $(2x+9)(x-2)=0$ $x=-4\dfrac{1}{2}$ *or* $x=2$	M1 M1 A1	**AO1**	**3**
2(a)(i)	Total Food Waste Output		**AO1**	**1**

Qn	Solutions	Mark	AO	Total
	$= 565\ 000 + 605\ 000 + 640\ 000$ $= 1.81 \times 10^6$ tonnes	B1		
2(a)(ii)	Percentage increase (2009-2010) $= \frac{99000 - 75000}{75000} \times 100$ $= 32\%$ Food Waste Recycled in 2011 $= \frac{132}{100} \times 99000$ $= 130680$ tonnes	M1 A1	**AO1**	**2**
2(a)(iii)	Per capital food waste $= \frac{565000 \times 1000}{4.84 \times 1000000 \times 365}$ $= 0.319823$ $= 0.320$ kg/day Per capital food waste $= \frac{565000 \times 1000}{4.84 \times 1000000 \times 366}$ $= 0.318949$ $= 0.319$ kg/day	M1 A1	**AO1**	**2**
2(a)(iv)	Food Waste Output $= \frac{509000}{100 - 8.6} \times 100$ $= 556892.779$ $= 557000$ tonnes	M1 A1	**AO1**	**2**
2(b)(i)	Perimeter of the lake on map A $= \frac{1700}{612} \times 9$ $= 25$ cm	M1 A1	**AO1**	**2**
2(b)(ii)	Actual area of lake $= 36 \times (68)^2$ $= 166464\ \text{m}^2$	M1	**AO2**	**2**

Qn	Solutions	Mark	AO	Total
	Area of lake on Map B $= \frac{166464}{51^2}$ $= 64 \text{ cm}^2$	 A1		
3(a)	$2\pi r = 120 - 4x$ $r = \frac{120 - 4x}{2\pi}$ $= \frac{2(60 - 2x)}{2\pi}$ $= \frac{60 - 2x}{\pi}$ (shown)	M1 A1	**AO2**	**2**

Qn	Solutions	Mark	AO	Total
3(b)	$x^2 = \pi\left(\frac{60-2x}{\pi}\right)^2$ $x^2 = \frac{(60-2x)^2}{\pi}$ $\pi x^2 = 3600 - 240x + 4x^2$ $(4-\pi)x^2 - 240x + 3600 = 0$ (shown)	M1 A1	**AO2**	**2**
3(c)	$x = \frac{-(-240) \pm \sqrt{(-240)^2 - 4(4-\pi)(3600)}}{2(4-\pi)}$ $= \frac{240 \pm \sqrt{45238.93421}}{2(4-\pi)}$ $= 263.68$ or 15.90	M1 M1 A1, A1	**AO1**	**4**
3(d)	Reject $x = 263.68$ because - the perimeter of the square ($4x$) must be less than the length of the wire - the radius of the circle cannot be negative	 B1	**AO3**	**1**
4(a)(i)	Mean = 166 cm	B1	**AO1**	**1**
4(a)(ii)	Standard deviation $= \sqrt{\frac{331532}{12} - (166)^2}$ $= 8.47$ cm	 B1	**AO1**	**1**

Qn	Solutions	Mark	AO	Total
4(a)(iii)	1. Since the **mean height** of Group B **(168 cm)** is **greater mean height** of Group A (**166 cm**), the **students in Group B are generally taller on average**. 2. Since standard deviation of heights of Group B (**9.5 cm**) is **greater** standard deviation of heights of Group A (**8.47 cm**), the **heights of students in Group B have a wider spread / less consistent.**	B1 B1	**AO3**	**2**
4(b)(i)	$\frac{12}{21}=\frac{4}{7}$	B1	**AO1**	**1**
4(b)(ii)	$\frac{9}{17}\times\frac{8}{16}$ $=\frac{9}{34}$	M1 A1	**AO1**	**2**
4(b)(iii)	$\left(\frac{23}{40}\times\frac{17}{39}\times\frac{16}{38}\right)\times 3$ $=\frac{391}{1235}$	M1 A1	**AO1**	**2**
5(a)	–4	B1	**AO1**	**1**

Qn	Solutions	Mark	AO	Total
5(b)		P2 (9 points plotted correctly) P1 (7-8 points plotted correctly) C1 (Smooth curve through at least 7 points) Tolerate 1mm for plotting and drawing curve through points	**AO1**	**3**
5(c)	$k=-5$ or $k=5$	B2	**AO2**	**2**
5(d)	$x^3+6x^2-2x-16=0$ $\frac{x^3}{4}+\frac{3x^2}{2}-\frac{1}{2}x-4=0$ $\frac{x^3}{4}+\frac{3x^2}{2}-4=\frac{1}{2}x$ Draw the line $y=\frac{1}{2}x$. (Must label equation of line on graph) $x=-5.85,-1.7,1.6\ (\pm 0.1)$	M1 M1 A1	**AO2**	**3**
5(e)	$3.75\ (\pm 0.5)$	M1 – tangent line A1	**AO2**	**2**
6(a)(i)	$T_n=2^{2n}$ (or $T_n=4^n$)	B1	**AO2**	**1**

Qn	Solutions	Mark	AO	Total
6(a)(ii)	$R_n = 4^{3n+1}$ (or $R_n = 2^{2+6n}$)	B1	**AO2**	**1**
6(a)(iii)(a)	$Q_n = \dfrac{4^{3n+1}}{2^{2n}}$ $= \dfrac{2^{2(3n+1)}}{2^{2n}}$ $= 2^{6n+2-2n}$ $= 2^{4n+2}$ (shown)	 B1	**AO2**	**1**
6(a)(iii)(b)	$2^{4n+2} = 128$ $2^{4n+2} = 2^7$ $4n+2 = 7$ $n = 1.25$ 128 is not a term of sequence Q_n as n = 1.25 is not a **positive integer**. (or positive whole number)	 M1 A1	**AO3**	**2**
6(b)(i)	$\overrightarrow{AB} = \begin{pmatrix}10\\4\end{pmatrix} - \begin{pmatrix}4\\12\end{pmatrix}$ $= \begin{pmatrix}6\\-8\end{pmatrix}$ $\left\lvert\overrightarrow{AB}\right\rvert = \sqrt{6^2 + (-8)^2}$ $= 10$ units or *OR* $\left\lvert\overrightarrow{AB}\right\rvert = \sqrt{(4-10)^2 + (12-4)^2}$ $= 10$ units $\left\lvert\overrightarrow{AB}\right\rvert = \sqrt{(10-4)^2 + (4-12)^2}$ $= 10$ units	 M1 A1	**AO1**	**2**

Qn	Solutions	Mark	AO	Total
6(b)(ii)	$\overrightarrow{AC} = \frac{1}{2}\overrightarrow{BA}$ $\overrightarrow{OC} - \begin{pmatrix} 4 \\ 12 \end{pmatrix} = \frac{1}{2}\begin{pmatrix} -6 \\ 8 \end{pmatrix}$ $\overrightarrow{OC} = \begin{pmatrix} -3 \\ 4 \end{pmatrix} + \begin{pmatrix} 4 \\ 12 \end{pmatrix}$ $= \begin{pmatrix} 1 \\ 16 \end{pmatrix}$ $C\ (1, 16)$	M1 A1	AO1	2
7(a)	$\frac{\sin \angle ACB}{30} = \frac{\sin 95°}{38}$ $\angle ACB = \sin^{-1}\left(\frac{30 \sin 95°}{38}\right)$ $= 51.856°$ $\angle ABC = 180 - 95 - 51.856$ $= 33.144$ $= 33.1°$	M1 M1 A1	AO2	3
7(b)	Let the shortest distance from A to BC be h and greatest angle of depression be θ. $\sin 33.144 = \frac{h}{30}$ $h = 30 \times \sin 33.144$ $= 16.402$ m	M1[ECF on $\angle ABC$]	AO2	3

Qn	Solutions	Mark	AO	Total
	$\tan\theta = \frac{2.5}{16.402}$ $\theta = 8.6663°$ $= 8.7°$ (1 d.p.) Note: Students who found the length of *AC* in 7(b) will be awarded **M2 in 7c only if *AC* is used to calculate the speed of Ali,** otherwise, **M2 is not awarded** for working to find *AC* in 7b	M1 A1		
7(c)	$\frac{AC}{\sin 33.144} = \frac{38}{\sin 95}$ $AC = \frac{38\sin 33.144}{\sin 59}$ $= 20.855$ m Time taken by Ken $= \frac{38}{4}$ $= 9.5$ s Speed of Ali $= \frac{20.855}{9.5-3}$ $= 3.2085$ m/s $=3.21$ m/s (3 s.f.)	M1 [ECF on $\angle ABC$] M1 M1 A1	**AO2**	**4**
8(a)	Reflex $\angle COA = 360 - 92$($\angle$s at a point) $= 268^o$ $\angle CDA = \frac{268}{2}$(angle at centre = 2 angle at circumferene) $= 134^o$	M1		**2**

Qn	Solutions	Mark	AO	Total
	Alternative Method $\angle CBA = \frac{92}{2}$ (angle at centre = 2 angle at circumferene) $= 46^o$ $\angle CDA = 180 - 46$ (angless in opp segments) $= 134^o$	A1 (M1) (A1)		
8(b)	$\angle OBT = \angle OAT = 90^o$ (tangent $\perp$ radius) $\angle AOB = 360 - 90 - 90 - 38$($\angle$ sum of quad) $= 142^o$ $\angle BOC = 360 - 92 - 142$($\angle$s at a point) $= 126^o$ $\angle BCO = \frac{180 - 126}{2}$ (base angles of isos triangle) $= 27^o$ Alternative Method $\angle OBT = \angle OAT = 90^o$ (tangent $\perp$ radius) $\angle AOB = 360 - 90 - 90 - 38$($\angle$ sum of quad) $= 142^o$ $\angle OBA = \frac{180 - 142}{2}$ (base angles of isos triangle) $= 19^o$ $\angle CBA = \frac{92}{2}$ (angle at centre = 2 angle at circumferene) $= 46^o$	M1 M1 A1 (M1) (M1)	**AO1**	**3**

Qn	Solutions	Mark	AO	Total
	$\angle BCO = 46 - 19$ $= 27^o$ Alternative Method to find $\angle AOB$ $\angle OBT = \angle OAT = 90^o$ (tangent $\perp$ radius) $\angle BTO = \angle AT) = \frac{38}{2} = 19^o$ (tangents from ext point) $\angle AOT = 180 - 90 - 19$ ($\angle$ sum of triangle) $= 71^o$ $\angle AOB = 71 \times 2$ (tangents from ext point) $= 142^o$ Note: Maximum of 1 marks awarded in 8(b) for 2 or more incorrect or missing reasons.	(A1)		
8(c)	$\tan 19° = \frac{7}{BT}$ $BT = \frac{7}{\tan 19°}$ $= 20.329$ cm Area of quad $TBOA = 2 \times \frac{1}{2} \times 20.329 \times 7$ $= 142.306\ \text{cm}^2$ Area of major sector $OBCA = \frac{92 + 126}{360} \times \pi \times 7^2$ $= 93.218\ \text{cm}^2$	M1 M1 M1	**AO2**	**4**

Qn	Solutions	Mark	AO	Total
	Requied area $= 142.306 + 93.218$ $= 235.524$ $= 236\ \text{cm}^2$	A1		
9(a)	Volume of 1st sculpture $= \frac{4}{3} \times \pi \times 14^3 + \pi \times 2.5^2 \times 6$ $= 11611.85\ \text{cm}^3$ Volume of 2nd sculpture $= \left(\frac{1}{2}\right)^3 \times 11611.85$ $= 1451.481\ \text{cm}^3$ Mass of 2 sculptures $= (11611.85 + 1451.481) \times 1.5$ $= 19594\ \text{g}$ $= 19.594\ \text{kg}$ (show at least 5 sf) $= 19.59\ \text{kg}$ (shown) Notes: **A1 not awarded** for students **did not show** the value of the total mass to **at least 5 sig fig** before rounding off to 4 sig fig. Alternative Method	M1 M1 M1 A1 (M1)	**AO2**	**4**

Qn	Solutions	Mark	AO	Total
	Volume of 1st sculpture $= \frac{4}{3} \times \pi \times 14^3 + \pi \times 2.5^2 \times 6$ $= 11611.85\ \text{cm}^3$ Mass of 1st sculpture $= 11611.85 \times 1.5$ $= 17417.775\ \text{g}$ Mass of 2nd sculpture $= \left(\frac{1}{2}\right)^3 \times 17417.775$ $= 2177.221\ g$ Mass of 2 sculptures $= 17417.775 + 2177.221$ $= 19594\ \text{g}$ $= 19.594\ \text{kg}$ (show at least 5 sf) $= 19.59\ \text{kg}$ (shown)	(M1) (M1) (A1)		
9(b)	Packs of clay for 2 sculptures $= \frac{19.5975}{5}$ $= 3.9195$ $= 4$ Total cost of clay for 2 sculptures $= 4 \times 41.50$ $= \$166$ Total cost of postage for 2 sculptures $= 40 + (20 - 5) \times 7$ $= \$145$ <u>Carton size: XXL</u> Volume of empty space in carton $= (55 \times 32 \times 32) - (11611 + \frac{11611}{8})$ $= 43257.625\ \text{cm}^3$	M1[cost of clay] M1[Airmail cost] M1[empty space in carton]	**AO3**	**6**

Qn	Solutions	Mark	AO	Total
	Total cost of clay + delivery + carton + foam peanuts $=166+145+8.90+(6\times5)$ $=\$349.90$ <u>Carton sizes: S and XL</u> Volume of empty space in carton $=(30\times25\times15)+(45\times30\times30)-(11611+\frac{11611}{8})$ $=38687.625\ cm^3$ Total cost of clay + delivery + carton + foam peanuts $=166+145+4.90+7.90+(5\times5+2)$ $=\$350.80$ XXL carton should be used. Selling price = a value > total costs, with reasonable justification e.g. make a profit, cover labour cost, cover cost of materials and delivery. Notes: **A1 not awarded** for students **did not provide justification** for their proposed selling price.	M1[empty space in 2 cartons] M1 [Comparison of total cost of 2 options & decision on carton size] A1[selling price with justification]		