Register No.	Class

Name : _____

BENDEMEER SECONDARY SCHOOL
2021 END OF YEAR EXAMINATION
SECONDARY 3 EXPRESS
Elementary Mathematics Paper 1
4048/01

DATE : **5 October 2021**
DURATION : **1 hour 30 minutes**
TOTAL : **60 Marks**

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a 2B pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid/tape.

Answer **all** questions.
Write your answers in the spaces provided on the question paper.
All the diagrams in this paper are **not** drawn to scale.
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.

FOR EXAMINER'S USE
60

This document consists of **12** printed pages including this cover page.

[Turn over

MATHEMATICAL FORMULAE

Compound Interest

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

Mensuration

Curved surface area of cone = πrl

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

Answer **all** the questions

1. **(a)** When rounded off to the nearest thousand, x is 46 000. What is the smallest and largest possible integer value of x?

Answer (a) smallest = ... largest = ... [2]

(b) Convert 310 cm/s to km/h.

Answer (b) .....km/h [2]

2. Simplify $\frac{\left(\sqrt[3]{a}\right)^2 \times a^{-1}}{a}$, leaving your answer in positive index.

Answer ..... [2]

3. \$8000 is invested in a fund which gives interest of \$291.47 after 3 years. The interest is compounded yearly. Find the interest rate per annum.

Answer .....% [3]

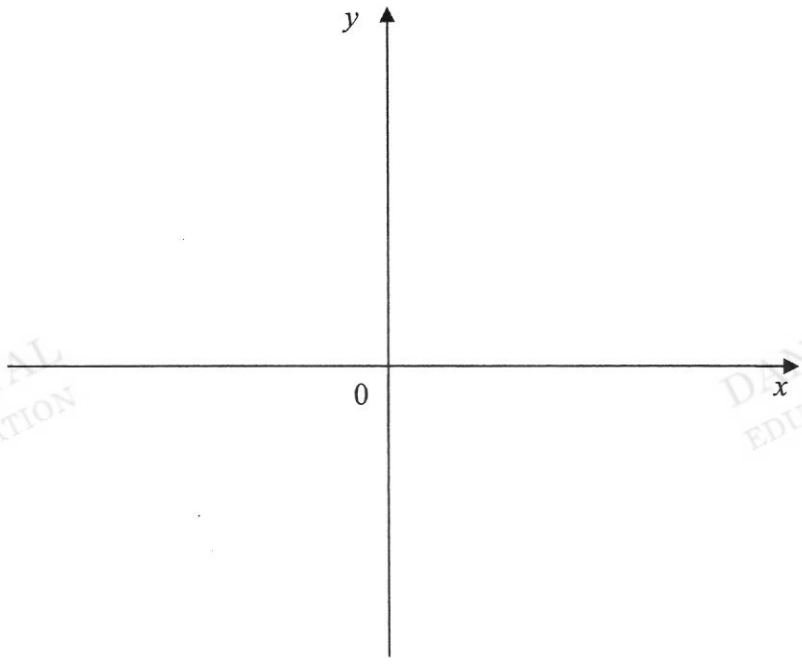
4. **(a)** Express $x^2 - 17x + 12$ in the form $(x - p)^2 - q$.

Answer (a) ..... [2]

(b) Hence, solve $x^2 - 17x + 12 = 0$

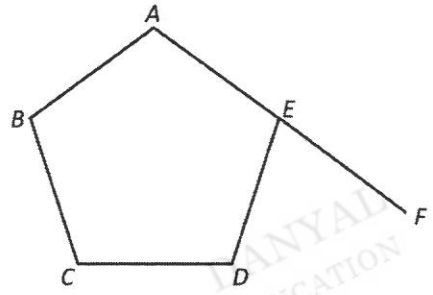
Answer (b) x = ... or ..... [3]

5. Sketch the graph of $y = (3 - x)(x + 8)$. Write down the coordinates of the turning point and intercepts clearly on the sketch. [3]



6. *ABCDE* is a regular pentagon and *AEF* is a straight line.
Find **(a)** $\angle ABC$

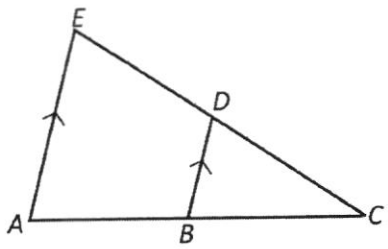
(b) $\angle DEF$



Answer (a) $\angle ABC$ = ...° [2]

(b) $\angle DEF$ = ...° [1]

7. In the diagram, AE is parallel to BD. Prove that ΔBCD and ΔACE are similar. [3]



8. The capacity of two geometrically similar bottles are 1000 ml and 8000 ml.

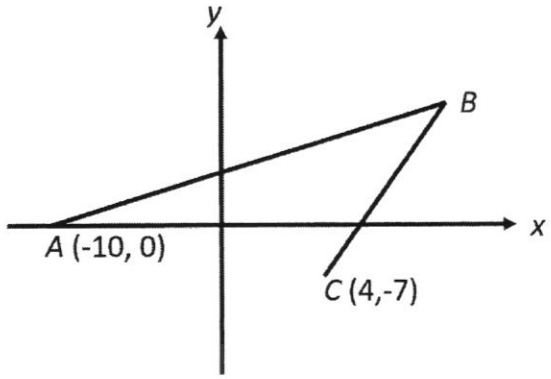
(a) Given that the ratio of the height of the smaller bottle to the height of the larger bottle is $1 : k$, find the value of k.

Answer (a) $k =$ ..... [2]

(b) Find the base area of the smaller bottle if the base area of the larger bottle is 183 cm^2.

Answer (b) .....cm^2 [2]

9. In the diagram, AB has equation $3y = x + 10$ and cuts the x-axis at $A(-10 , 0)$.



(a) Given that B has y-coordinate = 8, find the coordiantes of B.

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

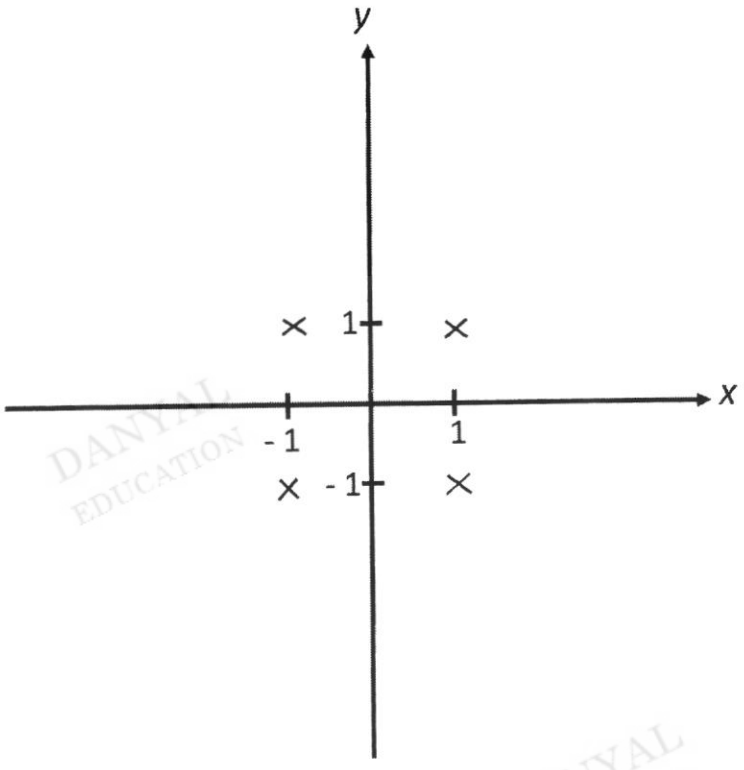
(b) C has coordinates (4 , -7). Find the equation of the line BC.

Answer (b) ..... [3]

(c) Find the coordinates of D such that $ABCD$ is a parallelogram.

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

10. **(a)** Sketch the graph $y = -\frac{1}{x}$. [2]



(b) If (-3 , h) is a point on the graph, find the value of h.

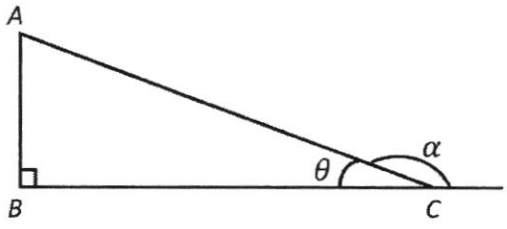
Answer (b) h = ... [1]

(c) Explain why the graph $y = -\frac{1}{x}$ does not pass through the origin.

Answer (c) .....

..... [1]

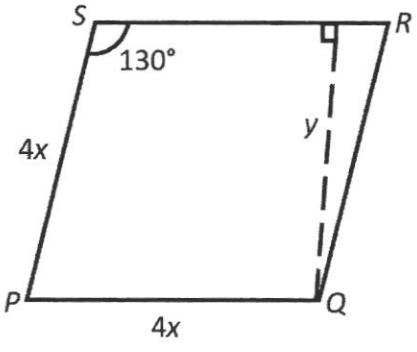
11. **(a)** In the diagram, $\tan\theta = \frac{7}{24}$, write down the value of $\sin\alpha$ and value of $\cos\alpha$.



Answer (a) $\sin\alpha$ = ...

$\cos\alpha$ = ... [3]

(b) In the diagram, *PQRS* is a rhombus of sides $4x$ cm and area 272 cm^2.
Find the value of x and of y. [Area of rhombus = base × perpendicular height]



Answer (b) x = ... cm [2]

y = ... cm [2]

12. The scale on a map is given as 1 : 50 000.

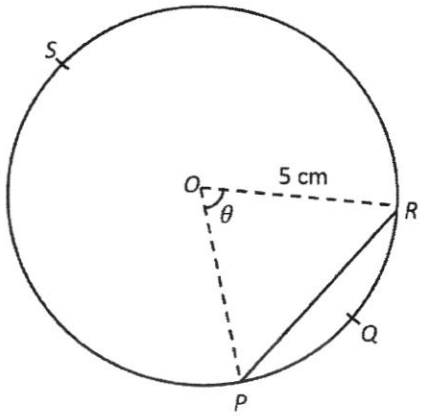
(a) The length of a road is 14 km. Find its length on the map in cm.

Answer (a) .....cm [2]

(b) The area of a field is 0.48 cm^2 on the map. Find its actual area in m^2

Answer (b) ..... m^2 [2]

13. The diagram shows a circle with centre, O and radius 5 cm.



(a) The area of the minor sector $OPQR$ is 17.5 cm^2. Show that $\theta = 1.4$ radian. [1]

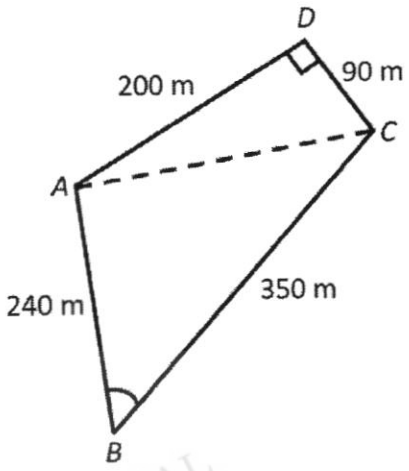
(b) Hence, find the perimeter of the major sector $OPSR$.

Answer (b) Perimeter = ... cm [2]

(c) Find the area of the minor segment PQR

Answer (c) Area = ... cm^2 [2]

14. $ABCD$ is a field on horizontal ground and AD is perpendicular to DC.



(a) Find $\angle ABC$.

Answer (a) $\angle ABC =$ ……^{0} [4]

(b) A model airplane, 20 m vertically above the ground, flies from A to C. Find the largest angle of elevation of the airplane from D.

Answer (b) ……^{0} [4]

End of Paper

Answers

1(a) 45 500 ; 46 499

1(b) 11.6 km/h

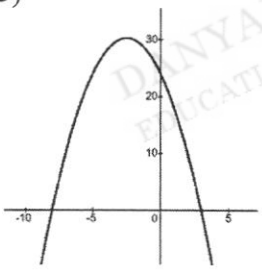
2) $\frac{1}{a^{\frac{4}{3}}}$

3) 1.20%

4(a) $\left(x-\frac{17}{2}\right)^2-60\frac{1}{4}$

4(b) 16.3 or 0.738

5)



To be indicated in sketch:
x-intercepts = -8 , 3
y-intercept = 24

TP = (-2.5 , 30.25)

6(a) 108° 6(b) 72°

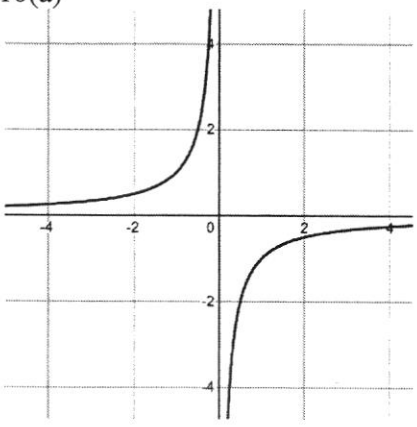
7) In ΔBCD and ΔACE,
$\angle BCD = \angle ACE$ (common angle)
$\angle CBD = \angle CAE$ (corresponding angle)
$\angle BDC = \angle AEC$ (corresponding angle)

Therefore, ΔBCD and ΔACE are similar
(3 pairs of equal corresponding angles)

8(a) $k = 2$ 8(b) 45.75 cm^2

9(a) B (14, 8) 9(b) $y = \frac{3}{2}x - 13$
9(c) D (-20 , -15)

10(a)



Passes through (-1 , 1)
and (1 , -1)

10(b) $h = \frac{1}{3}$ 10(c) $-\frac{1}{0}$ is undefined

11(a) $\frac{7}{25}$; $-\frac{24}{25}$

11(b) $x = 4.71$; $y = 14.4$

12(a) 28 cm 12(b) 120 000 m^2

13(b) 34.4 cm 13(c) 5.18 cm^2

14(a) 38.2° 14(b) 13.7^0

Register No.	Class

Name : _____

BENDEMEER SECONDARY SCHOOL
2021 END-OF-YEAR EXAMINATION
SECONDARY 3 EXPRESS
Elementary Mathematics Paper 2
4048/02

DATE : **8 October 2021**
DURATION : **2 hours**
TOTAL : **80 marks**

READ THESE INSTRUCTIONS FIRST

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Write in dark blue or black pen on both sides of the paper.
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At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 80.

FOR EXAMINER'S USE
80

This document consists of **17** printed pages including this cover page.

[Turn over

MATHEMATICAL FORMULAE

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Curved surface area of cone = πrl

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

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1. **(a)** Simplify $\frac{2x^2+13x+21}{x^2-9}$

Answer (a) ..... [3]

(b) Solve $2x^2 + x = 15$

Answer (b) x = ... or ..... [3]

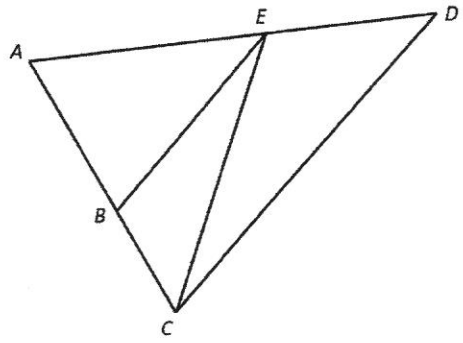
(c) **(i)** Express as a single fraction $\frac{1}{2-a} - \frac{1}{a+5}$

Answer (c)(i) ..... [2]

(ii) Solve $b^2 = \frac{64}{b}$

(ii) b = ... [2]

2. In the diagram, ΔABE and ΔACD are similar. $2AB = 3BC$ and $ED = 12$ cm.



(a) Find AD.

Answer (a) .....cm [2]

(b) Given that area of $\Delta ABE = 27$ cm^2, find

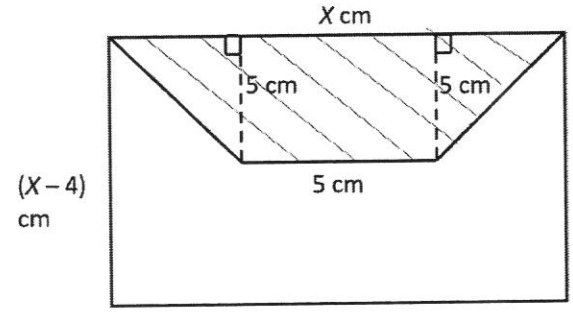
(i) area of $BCDE$

Answer (b)(i) .....cm^2 [3]

(ii) area of ΔBCE

Answer (b)(ii) .....cm^2 [2]

3. A rectangle has length x cm and breadth $(x-4)$ cm. The shaded part shows a trapezium which is cut out of the rectangle.



(a) Form an expression, in terms of x, to show the area of the trapezium.

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

(b) When the trapezium is cut out of the rectangle, $\frac{5}{8}$ of the rectangle is left. Form an equation in x and show that it reduces to $3x^2 - 32x - 100 = 0$. [3]

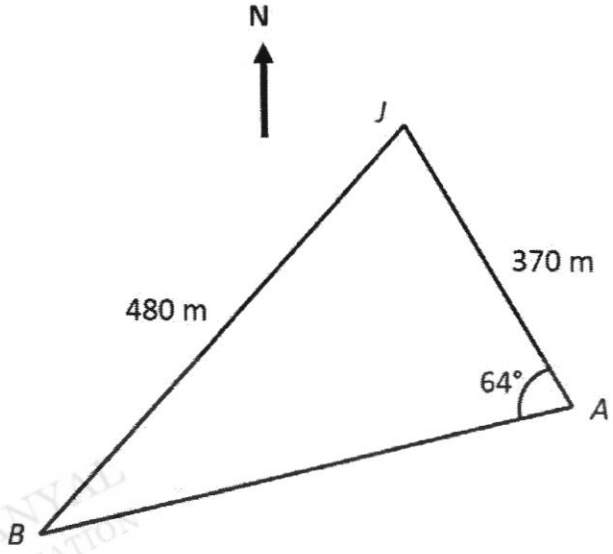
(c) Solve the equation $3x^2 - 32x - 100 = 0$.

Answer (c) $x =$ ..... or ..... [2]

(d) Hence, find the dimensions of the rectangle.

Answer (d) ..... [1]

4. A boat started at the jetty (J) and travelled 370 m to A at a bearing of 118^0 from J. It then made its way to B along the path AB.



(a) Find $\angle JBA$

Answer (a) .....° [2]

(b) Find the bearing of J from B

Answer (b) .....° [2]

(c) Another boat started at a point C, 370 m north of J. It travelled an arc with J as the centre to reach A.

(i) Find the distance travelled by this boat.

Answer (c)(i) .....m [2]

(c) **(ii)** Find the area bounded by CJ, AJ and the arc CA.

Answer (c)(ii) .....m^2 [2]

5. The cash price of a car is \$95 000. There are 2 plans to pay for the car.

Plan A	Plan B
• 5% deposit • Simple interest of 1.78% per annum of the remaining amount • Monthly instalments to be paid over 6 years.	• No deposit • Monthly instalments of \$1140 to be paid over 8 years.

(a) Calculate the monthly instalments under Plan A.

Answer (a) \$..... [3]

(b) Find the total amount paid under Plan A.

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

(c) Find the total amount paid under Plan B.

Answer (c) $..... [2]

(d) Ian prefers Plan A. What can be one of his reasons?

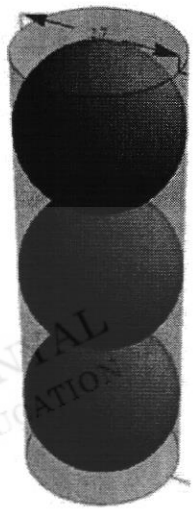
Answer (d) ..... [1]

(e) Tina prefers Plan B. What can be one of her reasons?

Answer (e) ..... [1]

6. The International Tennis Federation (ITF) defines the official diameter of a tennis ball as 6.54 – 6.86 cm. Pressurised tennis balls are usually packed in airtight cans containing three balls.

Source of image - https://tasks.illustrativemathematics.org/content-standards/tasks/512



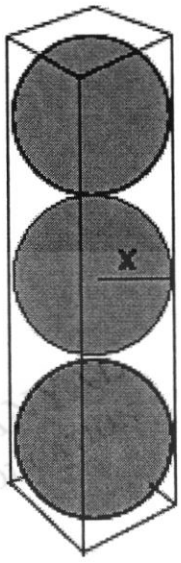
In this question, we take the diameter of a tennis ball to be 6.86 cm.

(a) Find the total surface area of the material used for the cylindrical can.

Answer (a) .....cm^2 [2]

(b) A manufacturer is thinking of changing the packaging of the can from a cylinder to a cuboid. Find the total surface area of the material used for the cuboid can.

Source of image - https://themathlab.com/geometry/section10/sphere/Tennisballcontainer.htm



Answer (b) .....cm^2 [2]

(c) 24 cans of tennis balls are packed in a carton box in 4 rows by 6 columns.
Does the manufacturer require carton boxes of a different size if the can is changed from a cylinder to a cuboid? Explain. [2]

(d) Besides cost, what else does the manufacturer have to consider if the packaging is changed?

Answer (d) ..... [1]

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

The variables x and y are connected by the equation $y = 2x^3 - \frac{1}{3}x - 2$.
Some corresponding values of x and y are given in the following table.

x	- 1.5	- 1	- 0.5	- 0.2	0.5	1	1.5	1.8	2
y	- 8.25	- 3.67	- 2.08	p	- 1.92	- 0.33	4.25	9.06	13.33

(a) Find the value of p, corrected to 2 decimal places.

Answer (a) $p =$ ..... [1]

(b) On the axes provided on Page 13, plot the points given in the table and join them with a smooth curve. [3]

(c) Use your graph to find the solution of $2x^3 - \frac{1}{3}x - 2 = 0$.

Answer (c) $x =$ ..... [1]

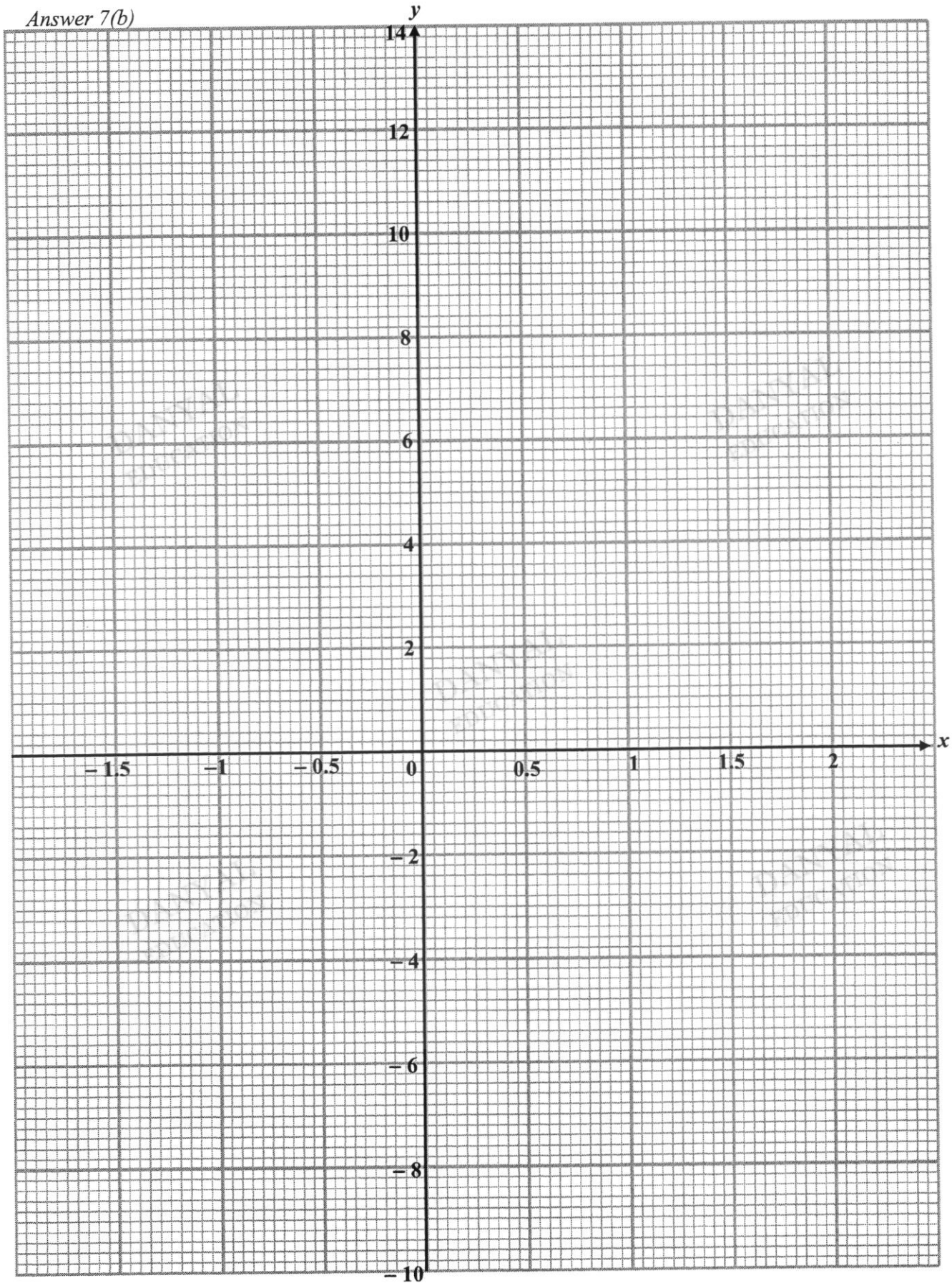
(d) By drawing a tangent, find the gradient of the curve at $x = 1.2$.

Answer (d) ..... [2]

(e) By drawing a suitable straight line, solve $2x^3 + \frac{2}{3}x - 7 = 0$.

Answer (e) $x =$ ..... [3]

Answer 7(b)



8. **(a)** Solve the inequalities and represent your solution on the number line.

$$\frac{11x+9}{4} < \frac{3+x}{2} \leq 13+6x$$

Answer (a) ..... [5]

[1]

(b) The line $2y = 9x - 18$ intersects the x-axis at P and the line $y - 2x = 5$ at Q.

(i) Find the coordinates of P and Q.

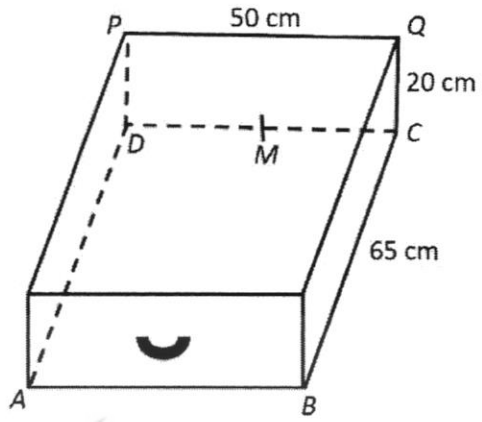
Answer (b)(i) P (..... , ...) [2]

Q (..... , ...) [2]

(ii) Find the distance PQ.

(b)(ii) Distance PQ = ... units [2]

9. **(a)** The diagram shows the interior of a drawer in which $ABCD$ is the horizontal rectangular plane and $PQCD$ is vertical.



(i) Find $\angle DAC$.

Answer (a)(i) .....° [1]

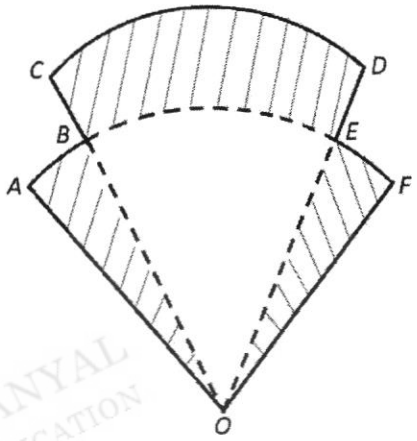
(ii) If M is the midpoint of DC, find the length of MB.

Answer (a)(ii) ..... cm [2]

(iii) Find the angle of depression of B from the midpoint of PQ.

Answer (a)(iii) .....° [2]

(b) The diagram shows a logo made up of 3 sectors. *OCD* has radius 8 cm and is subtended by an angle of 0.96 radian. *OAB* and *OEF* are identical sectors of radius 5 cm and each subtended by an angle of 0.44 radian.
The shaded regions are painted gold in colour.



(i) Find the perimeter of the logo.

Answer (b)(i) .....cm [2]

(ii) Find the percentage of the logo NOT painted in gold.

Answer (b)(ii) .....% [3]

End of Paper

Answers

1(a) $\frac{2x+7}{x-3}$ 1(b) $= 2\frac{1}{2}$ or $x = -3$

1(c) (i) $\frac{2a+3}{(2-a)(a+5)}$ (ii) $b = 4$

2(a) 30 cm (b)(i) 48 cm^2 (ii) 18 cm^2

3(a) $\frac{5(5+x)}{2}$ 3(c) $x = 13.2$ or -2.53

3(d) 13.2 cm by 9.19 cm

4(a) $\angle JBA = 43.9°$ 4(b) 010.1°

4(c) 762 m 4(d) 141 000 m^2

5(a) \$1387.34 5(b) \$104 638.70

5(c) \$109 440

5(d) Lower total amount / shorter loan period / other appropriate answers

5(e) No need to pay deposit / lower monthly instalment / other appropriate answers

6(a) 517 cm^2 6(b) 659 cm^2

6(c) No.
The space needed for the cuboid and cylindrical cans in the carton box is the same
The length, breadth and height needed for the cuboid and cylindrical cans is the same

6(d) Whether customers can recognize the new packaging / Ease of stacking or displaying on shelf / Other appropriate answers

7(a) $P = -1.95$

7(c) 1.05 ± 0.05

7(d) Gradient $= 8.31 \pm 2$

7(e) Equation of the line $y = -x + 5$

Solution from the graph: $x = 1.45 \pm 0.05$

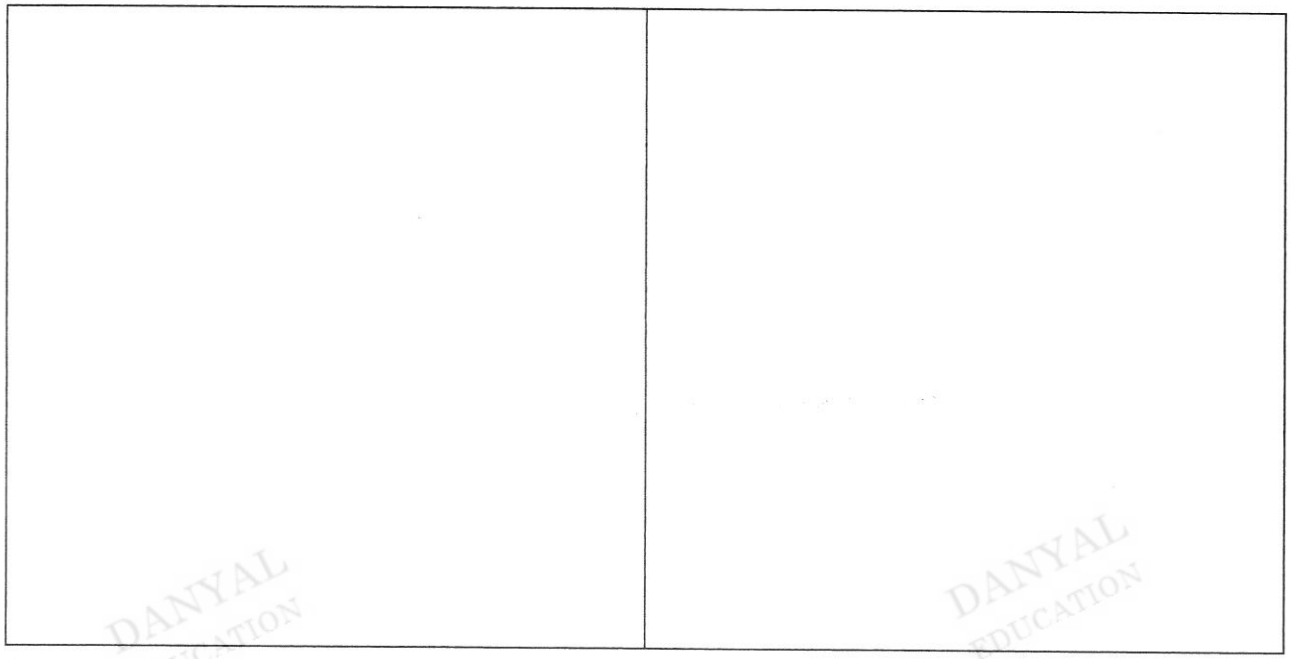
8(a) $-2\frac{1}{11} \leq x < -\frac{1}{3}$

8(b) (i) $P(2, 0)$; $Q(5.6, 16.2)$

8(b)(ii) 16.6 units

9a(i) 37.6° (ii) 69.6 cm (iii) 16.0°

9b(i) 28.08 cm (ii) 28.8%



Register No.	Class

Name : _____

BENDEMEER SECONDARY SCHOOL
2021 END OF YEAR EXAMINATION
SECONDARY 3 EXPRESS
Elementary Mathematics Paper 1
4048/01

DATE : **5 October 2021**
DURATION : **1 hour 30 minutes**
TOTAL : **60 Marks**

MARKING SCHEME

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a 2B pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid/tape.

Answer **all** questions.
Write your answers in the spaces provided on the question paper.
All the diagrams in this paper are **not** drawn to scale.
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.

FOR EXAMINER'S USE
60

This document consists of **12** printed pages including this cover page.

[Turn over

MATHEMATICAL FORMULAE

Compound Interest

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

Mensuration

Curved surface area of cone = πrl

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

Answer **all** the questions

1. **(a)** When rounded off to the nearest thousand, x is 46 000. What is the smallest and largest possible integer value of x?

Smallest = 45 500 ..... (B1)

Largest = 46 499 ..... (B1)

Answer (a) smallest = ... largest = ... [2]

(b) Convert 310 cm/s to km/h.

$\frac{310}{100000} \div \frac{1}{3600}$ M1

= 11.16 km/h A1

Answer (b) .....km/h [2]

2. Simplify $\frac{\left(\sqrt[3]{a}\right)^2 \times a^{-1}}{a}$, leaving your answer in positive index.

$\frac{\left(\sqrt[3]{a}\right)^2 \times a^{-1}}{a}$

$= \frac{a^{\frac{2}{3}} \times a^{-1}}{a}$ ..... (M1)

$= \frac{a^{-\frac{1}{3}}}{a}$

$= \frac{1}{a^{\frac{4}{3}}}$ ..... (A1)

Answer ..... [2]

3. \$8000 is invested in a fund which gives interest of \$291.47 after 3 years. The interest is compounded yearly. Find the interest rate per annum.

$8000 + 291.47 = 8000\left(1 + \frac{r}{100}\right)^3$ ..... (M1)

$\left(\frac{8291.47}{8000}\right)^{\frac{1}{3}} = 1 + \frac{r}{100}$ ..... (M1)

$r = 1.20\%$ per annum ..... (A1)

Answer .....% [3]

4. **(a)** Express $x^2 - 17x + 12$ in the form $(x - p)^2 - q$.

$x^2 - 17x + 12$

$= \left(x - \frac{17}{2}\right)^2 - \left(\frac{17}{2}\right)^2 + 12$ ..... (M1)

$= \left(x - \frac{17}{2}\right)^2 - 60\frac{1}{4}$ ..... (A1)

Answer (a) ..... [2]

(b) Hence, solve $x^2 - 17x + 12 = 0$

$x^2 - 17x + 12 = 0$

$\left(x - \frac{17}{2}\right)^2 - 60\frac{1}{4} = 0$

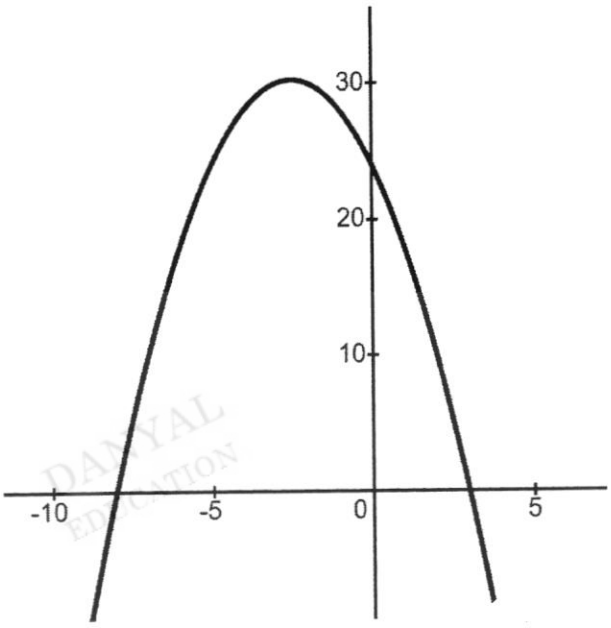
$\left(x - \frac{17}{2}\right)^2 = 60\frac{1}{4}$ ..... (M1)

$\left(x - \frac{17}{2}\right) = \pm\sqrt{60\frac{1}{4}}$ ..... (M1)

$x = 16.3$ or 0.738 ..... (A1)

Answer (b) x = ... or ..... [3]

5. Sketch the graph of $y = (3 - x)(x + 8)$. Write down the coordinates of the turning point and intercepts clearly on the sketch. [3]



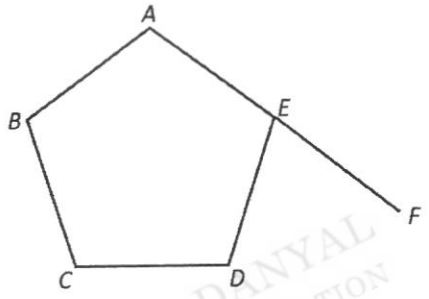
To be indicated in sketch:
x-intercepts = -8 , 3
y-intercept = 24
} (B1)

TP = (-2.5 , 30.25) ..... (B1)

Shape of curve ..... (B1)

6. *ABCDE* is a regular pentagon and *AEF* is a straight line.
Find **(a)** $\angle ABC$

(b) $\angle DEF$



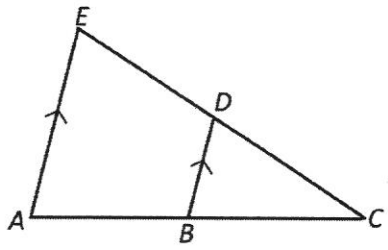
(a) $\angle ABC$
$= \frac{(5-2)180}{5}$ M1
$= 108°$ A1

(b) $\angle DEF = 72°$ B1

Answer (a) $\angle ABC =$ .....° [2]

(a) $\angle DEF =$ .....° [1]

7. In the diagram, AE is parallel to BD. Prove that ΔBCD and ΔACE are similar. [3]



In ΔBCD and ΔACE,
$\angle BCD = \angle ACE$ (common angle)
$\angle CBD = \angle CAE$ (corresponding angle)
$\angle BDC = \angle AEC$ (corresponding angle)

Any 2 statements ..... (B2)
Only 1 statement ..... (B1)
All statements must include angle properties

Therefore, ΔBCD and ΔACE are similar
(3 pairs of equal corresponding angles) ..... (B1)

8. The capacity of two geometrically similar bottles are 1000 ml and 8000 ml.

(a) Given that the ratio of the height of the smaller bottle to the height of the larger bottle is 1 : k, find the value of k.

1000 : 8000
$\sqrt[3]{1000} : \sqrt[3]{8000}$ ..... (M1)
1 : 2
Therefore, $k = 2$ ..... (A1)

Answer (a) k =..... [2]

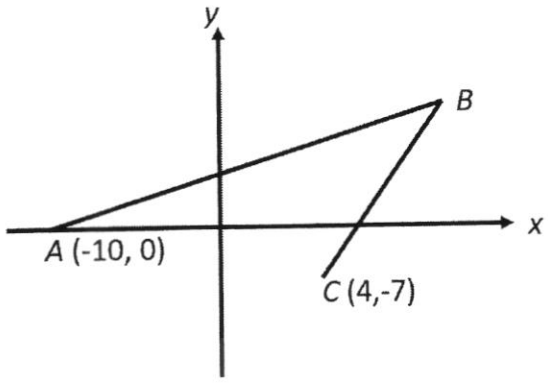
(b) Find the base area of the smaller bottle if the base area of the larger bottle is 183 cm^2.

$\frac{A}{183} = \left(\frac{1}{2}\right)^2$ ..... (M1)

$A = 45.75$ ..... (A1)

Answer (b) .....cm^2 [2]

9. In the diagram, AB has equation $3y = x + 10$ and cuts the x-axis at $A(-10\ ,\ 0)$.



(a) Given that B has y-coordinate = 8, find the coordiantes of B.

$3(8) = x + 10$
$x = 14$
$B\ (14, 8)$ ..... (B1)

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

(b) C has coordinates $(4\ ,\ -7)$. Find the equation of the line BC.

Gradient of BC
$= \dfrac{8 + 7}{14 - 4}$
$= \frac{3}{2}$ ..... (M1)

$\frac{y+7}{x-4} = \frac{3}{2}$ ..... (M1)

$2y + 14 = 3x - 12$
$2y = 3x - 26$

$y = \frac{3}{2}x - 13$ ..... (A1)

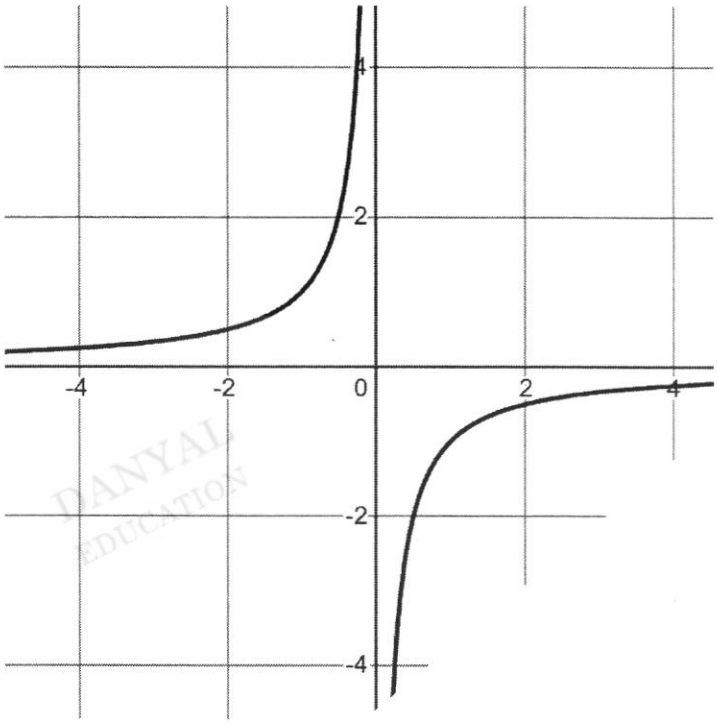
Answer (b) ..... [3]

(c) Find the coordinates of D such that $ABCD$ is a parallelogram.

$D\ (-20\ ,\ -15)$ ..... (B1)

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

10. **(a)** Sketch the graph $y = -\frac{1}{x}$. [2]



Correct shape …….. (B1)

Passes through (-1 , 1)
and (1 , -1) …… (B1)

(b) If (-3 , h) is a point on the graph, find the value of h.

$h = -\frac{1}{-3}$

$h = \frac{1}{3}$ …… (B1)

Answer (b) h = …… [1]

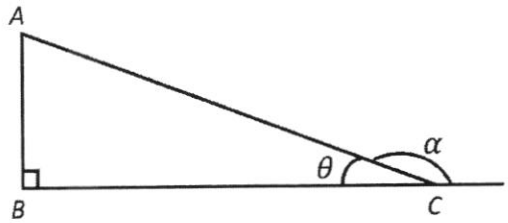
(c) Explain why the graph $y = -\frac{1}{x}$ does not pass through the origin.

$-\frac{1}{0}$ is undefined …… (B1)

Answer (c) ……

…… [1]

11. **(a)** In the diagram, $\tan\theta = \frac{7}{24}$, write down the value of $\sin\alpha$ and value of $\cos\alpha$.



$AC = \sqrt{24^2 + 7^2}$
$AC = 25$ ..... (M1)

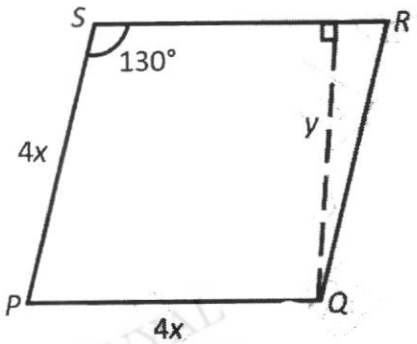
$\sin\alpha = \frac{7}{25}$ ..... (A1)

$\cos\alpha = -\frac{24}{25}$ ..... (A1)

Answer (a) $\sin\alpha$ = ...

$\cos\alpha$ = ... [3]

(b) In the diagram, $PQRS$ is a rhombus of sides $4x$ cm and area 272 cm^2.
Find the value of x and of y. [Area of rhombus = base × perpendicular height]



$\frac{1}{2}(4x)(4x)\sin 130 = \frac{272}{2}$ ..... (M1)
$x^2 \sin 130° = 17$
$x = 4.71083$
$x = 4.71$ ..... (A1)

$4(4.71083) \times y = 272$ ..... (M1)
$y = 14.4$ ..... (A1)

Answer (b) x = ... cm [2]

y = ... cm [2]

12. The scale on a map is given as 1 : 50 000.

(a) The length of a road is 14 km. Find its length on the map in cm.

1 cm rep 50 000 cm

1 cm rep 0.5 km ..... (M1)

28 cm rep 14 km ..... (A1)

Answer (a) .....cm [2]

(b) The area of a field is 0.48 cm^2 on the map. Find its actual area in m^2

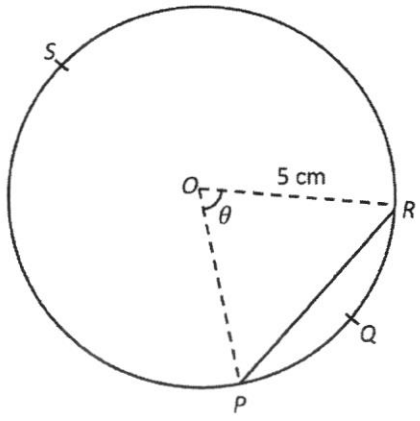
1 cm rep 500 m

1 cm^2 rep 250 000 m^2 ..... (M1)

0.48 cm^2 rep 120 000 m^2 ..... (A1)

Answer (b) ..... m^2 [2]

13. The diagram shows a circle with centre, O and radius 5 cm.



(a) The area of the minor sector $OPQR$ is 17.5 cm^2. Show that $\theta = 1.4$ radian. [1]

$\frac{1}{2} \times 5^2 \times \theta = 17.5$ ..... (B1)

$\theta = 1.4$ (shown)

(b) Hence, find the perimeter of the major sector $OPSR$.

Arc length $= 5(2\pi - 1.4)$
$= 24.4159$ ..... (M1)

Perimeter $= 24.4159 + 2(5)$
$= 34.4$ (3sf)..... (A1)

Answer (b) Perimeter = ... cm [2]

(c) Find the area of the minor segment PQR

Area of Triangle $OPR = \frac{1}{2}(5)(5) \sin 1.4$

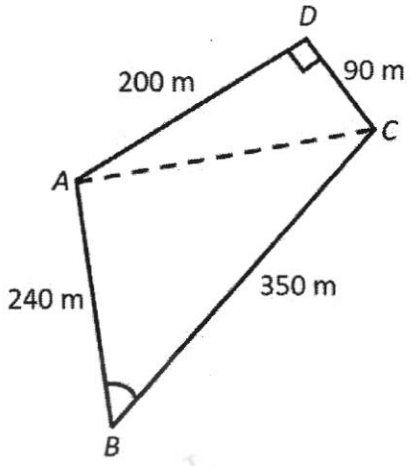
$= 12.31812$ ..... (M1)

Area of minor segment $= 17.5 - 12.31812$

$= 5.18$ (3sf) ..... (A1)

Answer (c) Area = ... cm^2 [2]

14. $ABCD$ is a field on horizontal ground and AD is perpendicular to DC.



(a) Find $\angle ABC$.

$AC = \sqrt{200^2 + 90^2}$
$AC = \sqrt{48100}$ ..... (M1)

$\sqrt{48100}^2 = 240^2 + 350^2 - 2(240)(350)\cos\angle ABC$ ..... (M1)

$\cos\angle ABC = \frac{180100-48100}{168000}$ ..... (M1)

$\angle ABC = 38.21321°$
$\angle ABC = 38.2°$ ..... (A1)

Answer (a) $\angle ABC =$ .....^{0} [4]

(b) A model airplane, 20 m vertically above the ground, flies from A to C. Find the largest angle of elevation of the airplane from D.

Area of ADC
$= \frac{1}{2} \times 200 \times 90$
$= 9000$ cm^2 ..... (M1)

Perpendicular distance from D to AC
$= \frac{9000\times2}{\sqrt{48100}}$
$= 82.072935$ ..... (M1)

Angle of elevation
$= \tan^{-1}\frac{20}{82.072935}$ ..... (M1)
$= 13.7^0$ ..... (A1)

Answer (b) .....^{0} [4]

End of Paper

Register No.	Class

Name : _____

BENDEMEER SECONDARY SCHOOL
2021 END-OF-YEAR EXAMINATION
SECONDARY 3 EXPRESS
Elementary Mathematics Paper 2
4048/02

DATE : **8 October 2021**
DURATION : **2 hours**
TOTAL : **80 marks**

MARKING SCHEME

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a 2B pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid/tape.

Answer **all** questions on the question booklet unless otherwise stated by the question.
All the diagrams in this paper are **not** drawn to scale.
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.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 80.

FOR EXAMINER'S USE
80

This document consists of **17** printed pages including this cover page.

[Turn over

MATHEMATICAL FORMULAE

Compound Interest

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

Answer **all** the questions.

1. **(a)** Simplify $\frac{2x^2+13x+21}{x^2-9}$

$= \frac{(2x+7)(x+3)}{(x-3)(x+3)}$ ..... M1 for $(2x+7)(x+3)$,
M1 for $(x-3)(x+3)$

$= \frac{2x+7}{x-3}$ A1

Answer (a) ..... [3]

(b) Solve $2x^2 + x = 15$

$2x^2 + x - 15 = 0$ M1
$(2x-5)(x+3) = 0$ M1
$x = 2\frac{1}{2}$ or $x = -3$ A1

Answer (b) x = ... or ..... [3]

(c) **(i)** Express as a single fraction $\frac{1}{2-a} - \frac{1}{a+5}$

$\frac{1}{2-a} - \frac{1}{a+5}$

$= \frac{a+5-(2-a)}{(2-a)(a+5)}$ M1

$= \frac{2a+3}{(2-a)(a+5)}$ A1

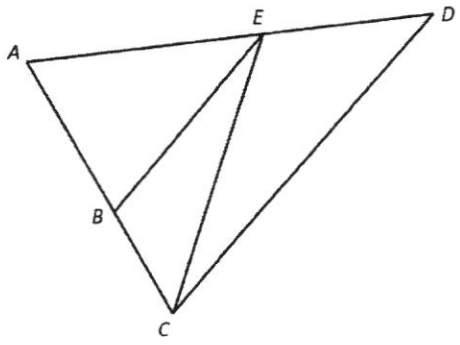
(ii) Solve $b^2 = \frac{64}{b}$

$b^3 = 64$ M1
$b^3 = 4^3$
$b = 4$ A1

Answer (c)(i) ..... [2]

(ii) b = ... [2]

2. In the diagram, ΔABE and ΔACD are similar. $2AB = 3BC$ and $ED = 12$ cm.



(a) Find AD.

$\frac{12}{2} \times 5$ M1
$= 30$ cm A1

Answer (a) .....cm [2]

(b) Given that area of $\Delta ABE = 27$ cm^2, find

(i) area of $BCDE$

$\frac{\Delta ABE}{\Delta ACD} = \left(\frac{3}{5}\right)^2$ M1

$\frac{27}{\Delta ACD} = \frac{9}{25}$

$\Delta ACD = 75$ M1

Area of $BCDE = 75 - 27$
$= 48$ cm^2 ..... A1

Answer (bi) .....cm^2 [3]

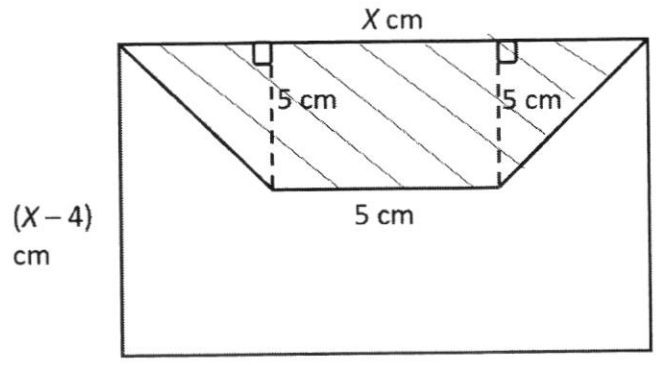
(ii) area of ΔBCE

$\frac{\Delta ABE}{\Delta BCE} = \frac{\frac{1}{2} \times 3 \times h}{\frac{1}{2} \times 2 \times h}$

$\frac{27}{\Delta BCE} = \frac{3}{2}$ M1
$\Delta BCE = 18$ A1

Answer (bii) .....cm^2 [2]

3. A rectangle has length x cm and breadth $(x-4)$ cm. The shaded part shows a trapezium which is cut out of the rectangle.



(a) Form an expression, in terms of x, to show the area of the trapezium.

$\frac{5(5+x)}{2}$ B1

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

(b) When the trapezium is cut out of the rectangle, $\frac{5}{8}$ of the rectangle is left. Form an equation in x and show that it reduces to $3x^2 - 32x - 100 = 0$. [3]

$\frac{5(5+x)}{2} = \frac{3}{8} \times x(x-4)$ M1

$20(5+x) = 3x(x-4)$ M1
$100 + 20x = 3x^2 - 12x$
$3x^2 - 32x - 100 = 0$ A1

(c) Solve the equation $3x^2 - 32x - 100 = 0$.

$x = \frac{-(-32) \pm \sqrt{(-32)^2 - 4(3)(-100)}}{2(3)}$ M1
$x = 13.19322$ or -2.52655
$x = 13.2$ or -2.53 (3sf) A1

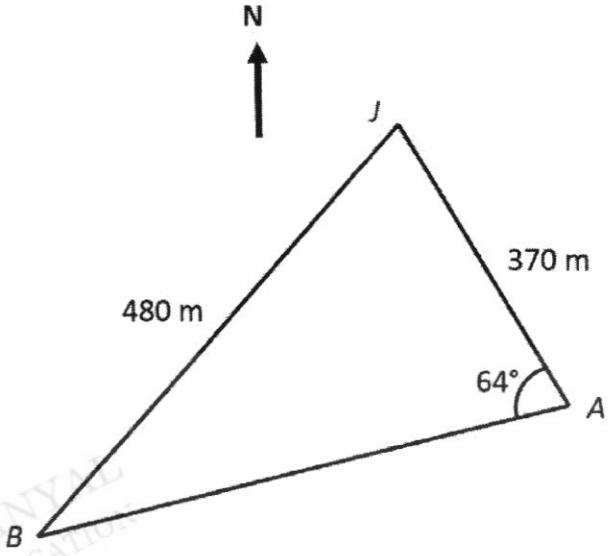
Answer (c) $x =$ ..... or ..... [2]

(d) Hence, find the dimensions of the rectangle.

13.2 cm by 9.19 cm (3sf) B1

Answer (d) ..... [1]

4. A boat started at the jetty (J) and travelled 370 m to A at a bearing of 118^0 from J. It then made its way to B along the path AB.



(a) Find $\angle JBA$

$\frac{\sin \angle JBA}{370} = \frac{\sin 64°}{480}$ M1

$\angle JBA = 43.8538°$

$\angle JBA = 43.9°$ (1dp) A1

Answer (a) .....° [2]

(b) Find the bearing of J from B

$\angle BJA = 180° - 64° - 43.8538°$

$\angle BJA = 72.1462°$ M1

Bearing of J from $B = 180° - (360° - 118° - 72.1462°)$

$= 010.1°$ (1dp) A1

Answer (b) .....° [2]

(c) Another boat started at a point C, 370 m north of J. It travelled an arc with J as the centre to reach A.

(i) Find the distance travelled by this boat.

$\frac{118°}{360°} \times 2\pi(370)$ M1

= 762 m (3sf) A1

Answer (ci) .....m [2]

(c) (ii) Find the area bounded by CJ, AJ and the arc CA.

$\frac{118°}{360°} \times \pi \times 370^2$ M1

$= 141\ 000\ m^2$ A1

Answer (cii) .....m^2 [2]

5. The cash price of a car is \$95 000. There are 2 plans to pay for the car.

Plan A	Plan B
• 5% deposit • Simple interest of 1.78% per annum of the remaining amount • Monthly instalments to be paid over 6 years.	• No deposit • Monthly instalments of \$1140 to be paid over 8 years.

(a) Calculate the monthly instalments under Plan A.

Remaining amount = 0.95 x 95 000
= 90 250 ..... M1

Interest = 90 250 x 0.0178 x 6
= 9638.70 ..... M1

Monthly instalments = (90 250 + 9638.70) ÷ (12 x 6)
= \$1387.34 ..... A1

Answer (a) \$..... [3]

(b) Find the total amount paid under Plan A.

95 000 + 9638.70 ..... M1
= \$104 638.70 ..... A1

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

(c) Find the total amount paid under Plan B.

1140 x 8 x 12 ..... M1
= \$109 440 ..... A1

Answer (c) \$..... [2]

(d) Ian prefers Plan A. What can be one of his reasons?

Lower total amount / other appropriate answers

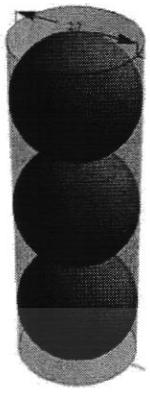
Answer (d) ..... [1]

(e) Tina prefers Plan B. What can be one of her reasons?

No need to pay deposit / lower monthly instalment / other appropriate answers

Answer (e) ..... [1]

6. The International Tennis Federation (ITF) defines the official diameter of a tennis ball as 6.54–6.86 cm. Pressurised tennis balls are usually packed in airtight cans containing three balls. Source of image - https://tasks.illustrativemathematics.org/content-standards/tasks/512



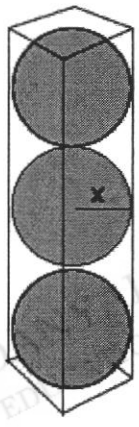
In this question, we take the diameter of a tennis ball to be 6.86 cm.

(a) Find the total surface area of the material used for the cylindrical can.

$(2 \times \pi \times 3.43^2) + (2 \times \pi \times 3.43 \times 3 \times 6.86)$ M1
$= 517$ cm^2 (3sf) A1

Answer (a) .....cm^2 [2]

(b) A manufacturer is thinking of changing the packaging of the can from a cylinder to a cuboid. Find the total surface area of the material used for the cuboid can.
Source of image - https://themathlab.com/geometry/section10/sphere/Tennisballcontainer.htm



$(2 \times 6.86^2) + (4 \times 6.86 \times 3 \times 6.86)$ M1

$= 659$ cm^2 (3sf) A1

Answer (b) .....cm^2 [2]

(c) 24 cans of tennis balls are packed vertically in a carton box in 4 rows by 6 columns.

Does the manufacturer require carton boxes of a different size if the can is changed from a cylinder to a cuboid? Explain. [2]

No. B1
The space needed for the cuboid and cylindrical cans in the carton box is the same / The length, breadth and height needed for the cuboid and cylindrical cans is the same / Other appropriate explanation B1

(d) Besides cost, what else does the manufacturer have to consider if the packaging is changed?

Whether customers can recognize the new packaging /
Ease of stacking or displaying on shelf /
Other appropriate answers B1

Answer (d) ..... [1]

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

The variables x and y are connected by the equation $y = 2x^3 - \frac{1}{3}x - 2$.
Some corresponding values of x and y are given in the following table.

x	- 1.5	- 1	- 0.5	- 0.2	0.5	1	1.5	1.8	2
y	- 8.25	- 3.67	- 2.08	p	- 1.92	- 0.33	4.25	9.06	13.33

(a) Find the value of p, corrected to 2 decimal places. [1]

P = -1.95 .....B1

(b) On the axes provided on Page 13, plot the points given in the table and join them with a smooth curve. [3]

Curve is labelled with equation B1
Points plotted correctly..... B1
Smooth curve B1

(c) Use your graph to find the solution of $2x^3 - \frac{1}{3}x - 2 = 0$. [1]

1.05 ± 0.05 ..... B1

(d) By drawing a tangent, find the gradient of the curve at $x = 1.2$. [2]

Tangent M1
Gradient = 8.31 ± 2 ..... A1

(e) By drawing a suitable straight line, solve $2x^3 + \frac{2}{3}x - 7 = 0$. [3]

Equation of the line $y = -x + 5$..... M1
Draw $y = -x + 5$ correctly on the graph M1
Solution from the graph: x = 1.45 ± 0.05 ..... A1

8. **(a)** Solve the inequalities and represent your solution on the number line.

$$\frac{11x+9}{4} < \frac{3+x}{2} \leq 13+6x$$

$\frac{11x+9}{4} < \frac{3+x}{2}$
$11x+9 < 6+2x$ M1
$9x < -3$
$x < -\frac{1}{3}$ M1

$\frac{3+x}{2} \leq 13+6x$
$3+x \leq 26+12x$ M1
$-23 \leq 11x$
$-2\frac{1}{11} \leq x$ M1

Therefore, $-2\frac{1}{11} \leq x < -\frac{1}{3}$ A1

Answer ..... [5]

[1]

-3 -2 -1 0

Follow thru 1m

(b) The line $2y = 9x - 18$ intersects the x-axis at P and the line $y - 2x = 5$ at Q.

(i) Find the coordinates of P and Q. Find the distance PQ.

When $y = 0$,
$0 = 9x - 18$ M1
$x = 2$
Therefore, $P(2, 0)$ A1

$2y = 9x - 18$ ..... (1)
$y - 2x = 5$
$y = 5 + 2x$ ..... (2)
Sub (2) into (1)
$2(5 + 2x) = 9x - 18$ M1
$10 + 4x = 9x - 18$
$28 = 5x$
$x = 5.6$
$y = 16.2$
Therefore, $Q(5.6, 16.2)$ A1

Answer (b)(i) P (..... , ...) [2]

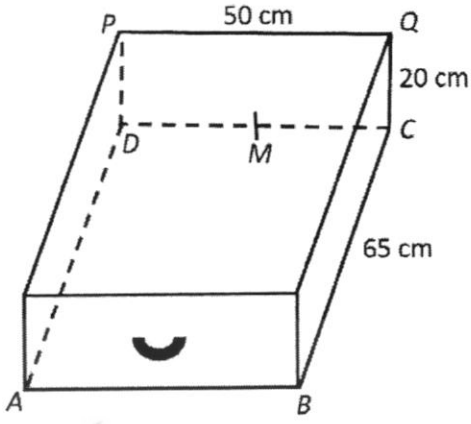
Q (..... , ...) [2]

(ii) Find the distance PQ.
$\sqrt{(2-5.6)^2 + (0-16.2)^2}$ M1

= 16.6 units (3sf) A1

(b)(ii) Distance PQ = ... units [2]

9. **(a)** The diagram shows the interior of a drawer in which $ABCD$ is the horizontal rectangular plane and $PQCD$ is vertical.



(i) Find $\angle DAC$.

$\tan^{-1}\frac{50}{65} = 37.5686$

$= 37.6°$ (1dp) B1

Answer (ai) .....° [1]

(ii) If M is the midpoint of DC, find the length of MB.

$\sqrt{25^2 + 65^2}$ M1

$= 69.6419$

$= 69.6$ cm (3sf) A1

Answer (aii) ..... cm [2]

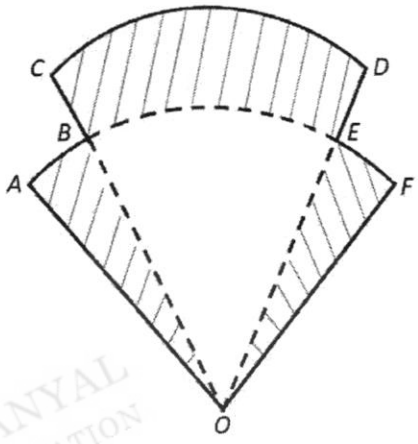
(iii) Find the angle of depression of B from the midpoint of PQ.

$\tan^{-1}\frac{20}{69.6419}$ M1

$= 16.0°$ (1dp) A1

Answer (aiii) .....° [2]

(b) The diagram shows a logo made up of 3 sectors. *OCD* has radius 8 cm and is subtended by an angle of 0.96 radian. *OAB* and *OEF* are identical sectors of radius 5 cm and each subtended by an angle of 0.44 radian.
The shaded regions are painted gold in colour.



(i) Find the perimeter of the logo.

$(2 \times 5 \times 0.44) + (8 \times 0.96) + 2(5 + 3)$ M1

$= 28.08$ cm A1

Answer (bi) .....cm [2]

(ii) Find the percentage of the logo NOT painted in gold.

Total area

$= \left(2 \times \frac{1}{2} \times 5^2 \times 0.44\right) + \left(\frac{1}{2} \times 8^2 \times 0.96\right)$

$= 41.72$ M1

Area not painted in gold

$= \frac{1}{2} \times 5^2 \times 0.96$

$= 12$ M1

Percentage of the logo NOT painted in gold

$= \frac{12}{41.72} \times 100\%$

$= 28.8\%$ (3sf) A1

Answer (bii) .....% [3]

End of Paper

Solution for Q7