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**BEATTY SECONDARY SCHOOL
END-OF-YEAR EXAMINATION 2023
SECONDARY THREE EXPRESS**

CANDIDATE
NAME

CLASS

REGISTER
NUMBER

MATHEMATICS

Paper 1

Setter:

4052/01

5 October 2023

1 hour 45 minutes

Candidates answer on the Question Paper
Additional Materials: NIL

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.
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 70.

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

This document consists of **18** printed pages and **0** blank page.

[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

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

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

1 On a map, a length of 5 cm represents an actual distance of 6 km.

(a) Express the scale of the map in the form 1 : r .

Answer 1 : [1]

(b) A park has an actual area of 3.6 km^2 . Find the area, in cm^2 , of the park on the map.

Answer cm^2 [2]

2 (a) Factorise $x^4 - y^2$.

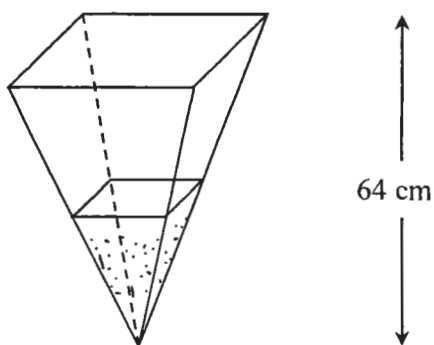
Answer [1]

(b) Factorise fully $10ab + 1 - 2a - 5b$.

Answer [2]

5

- 3 The diagram shows a container in the shape of an inverted square pyramid of height 64 cm. The volume of water in the container is $\frac{1}{7}$ the volume of the pyramid.



Calculate the height of the pyramid that is not in contact with water.

Answer cm [3]

- 4 (a) Express as a single fraction in its simplest form $\frac{2}{3a-1} - \frac{3a}{(3a-1)^2}$.

Answer [2]

- (b) Simplify $\frac{45xy^2}{12} \div \frac{x^3}{4y}$.

Answer [2]

7

5 $y = \frac{11x^2 + 4}{x^2 + a}$

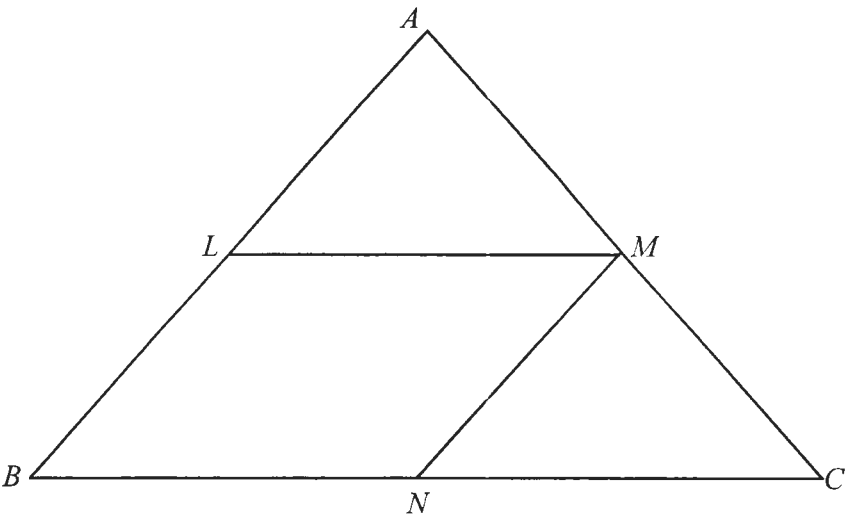
- (a) Find the value of a when $x = -2$ and $y = 20$.

Answer $a = \dots\dots\dots$ [2]

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

Answer $x = \dots\dots\dots$ [3]

6



The diagram shows a triangle ABC . $LMNB$ is a parallelogram and L and M are the midpoints of AB and AC respectively.

Show that triangle ALM and triangle MNC are congruent.

Answer

.....

.....

.....

.....

..... [2]

7

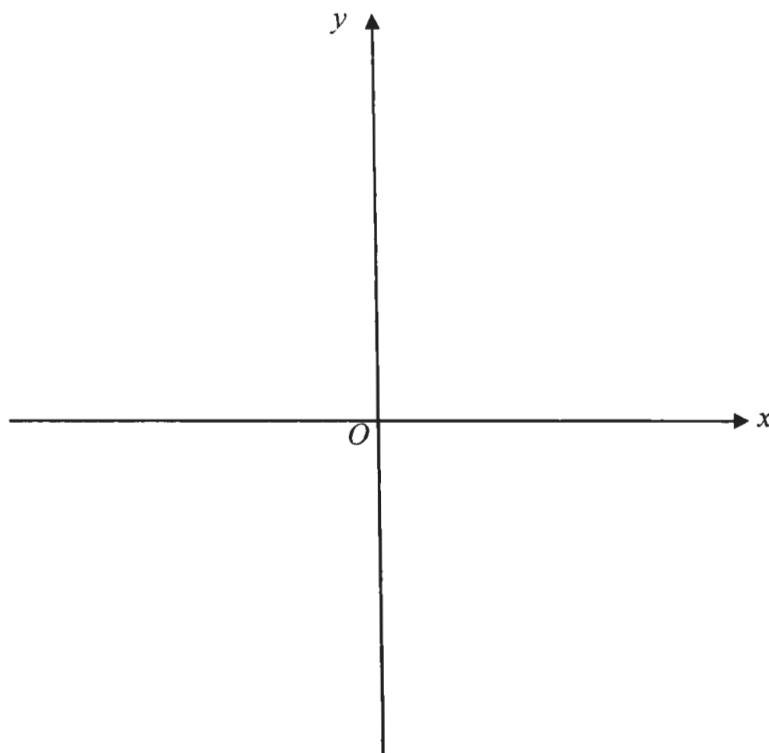
Show that $(3n - 2)^2 + 11$ is a multiple of 3 for all integer values of n . [2]

Answer

- 8 (a) Sketch the graph of $y = 16 - (x + 3)^2$ on the axes below.
Indicate clearly the coordinates of the points where the graph crosses the axes and the turning point on the curve.

Answer

[3]



- (b) Write down the equation of the line of symmetry of the graph $y = 16 - (x + 3)^2$.

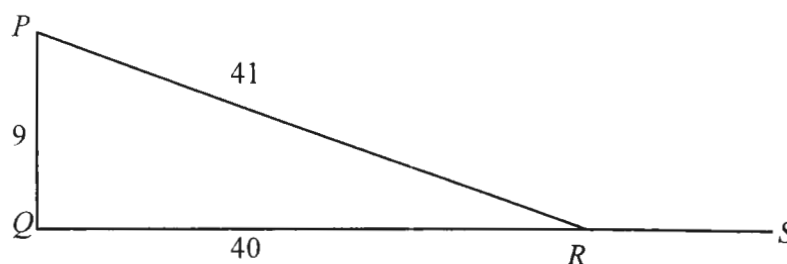
Answer [1]

[Turn Over

- 9 (a) The sine of an angle is 0.8711.
Give two possible values for the angle.

Answer or [2]

- (b) In triangle PQR , $PQ = 9$ cm, $QR = 40$ cm and $PR = 41$ cm.



- (i) Show that angle PQR is right-angled.
Answer

[2]

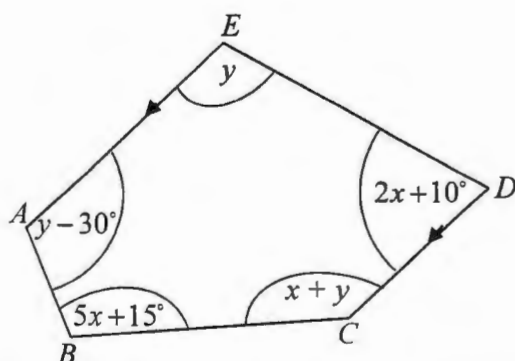
- (ii) Write down the values of
(a) $\sin \angle PRQ$,

Answer [1]

- (b) $\cos \angle PRS$.

Answer [1]

- 10 $ABCDE$ is a pentagon where AE is parallel to CD .
The angles are shown on the diagram.



- (a) Write down two simultaneous equations, in terms of x and y , to represent this information.

Answer

..... [3]

- (b) Solve the simultaneous equations.

Answer $x = \dots\dots\dots, y = \dots\dots\dots$ [3]

12

- 11 (a) Express 270 as a product of its prime factors.

Answer [1]

- (b) The number $270k$ is a perfect cube.
Find the smallest positive integer value of k .

Answer $k =$ [1]

- (c) x is a number between 400 and 500.
The highest common factor of x and 270 is 45.
Find the value of x .

Answer $x =$ [1]

13

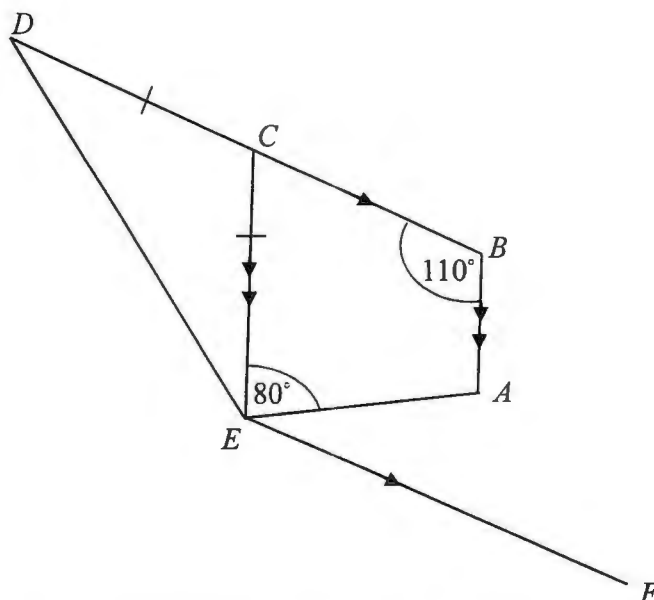
- 12 (a) Simplify $\left(\frac{81x^8}{y^{12}}\right)^{-\frac{1}{4}}$. Leave your answer in positive indices.

Answer [2]

- (b) Given that $9^{k+1} \div 3 = 3^k$, find k .

Answer $k =$ [2]

13



In the diagram, EF is parallel to DCB , CE is parallel to BA and $CD = CE$.

$\angle CEA = 80^\circ$ and $\angle ABC = 110^\circ$.

Calculate

(a) $\angle CED$,

Answer [1]

(b) $\angle AEF$,

Answer [1]

(c) reflex $\angle BAE$.

Answer [2]

15

14 d is inversely proportional to the square of t .

- (a) When $t = 3$, $d = 15$.
Find d when $t = 9$.

Answer $d = \dots\dots\dots$ [2]

- (b) A change in t produces a change in d .
Find the percentage change in d when the value of t is doubled.

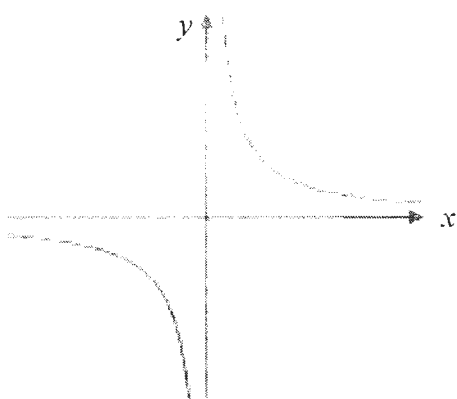
Answer $\dots\dots\dots\%$ [3]

15

$y = x^2 - 2$	$y = \frac{2}{x}$	$y = 2 - x^2$	$y = 2^x$	$y = \frac{2}{x^2}$	$y = -\frac{2}{x}$
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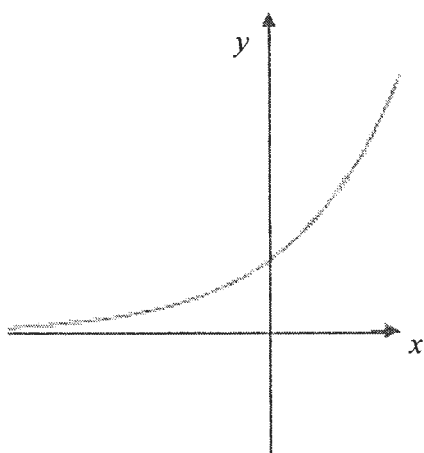
Write down a possible equation for each of the graphs below.

(a)



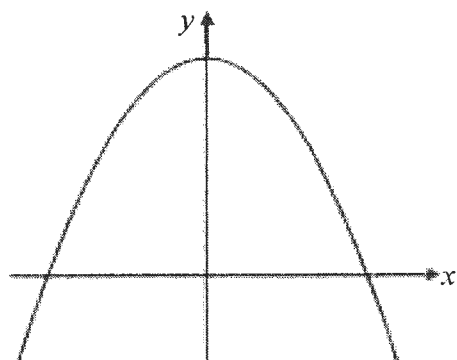
Answer [1]

(b)



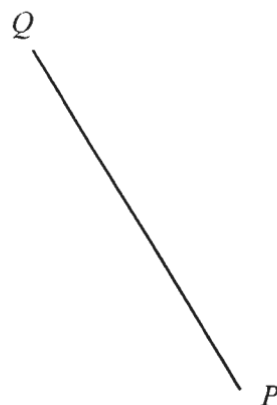
Answer [1]

(c)



Answer [1]

- 16 (a) Construct the triangle PQR where $QR = 10$ cm and angle $PQR = 120^\circ$. PQ has already been drawn. [2]



- (b) Construct
- (i) the perpendicular bisector of PQ , [1]
 - (ii) the bisector of angle RPQ . [1]
- (c) Mark clearly the point X which is inside the triangle, equidistant from P and Q and equidistant from PQ and PR . Measure and write down the length of XQ .
- Answer $XQ = \dots\dots\dots$ cm [1]
- (d) Point Y lies inside triangle PQR and it is nearer to Q than P and it is nearer to PR than PQ . Shade the region where Y lies. [1]

17 The Sun is 93 million miles from the Earth.

- (a) Given that 1 mile = 1.6093 km, find the distance of the Sun from Earth in metres. Leave your answer in standard form.

Answer m [2]

- (b) The speed of light is 3.0×10^8 m/s.
Find the time, in minutes and seconds, for light to travel to Earth.

Answer minutes seconds [2]

19

- 18 (a)** A bank offers a saving account with a simple interest of 3.2% per year. Lee deposited a sum of money in this account. At the end of 4 years, he received \$20 304.
Calculate the sum of money that Lee deposited in the bank.

Answer \$ [2]

- (b)** Without doing any calculation, explain why Lee will get a better return if he invests in a saving plan that pays a compound interest of 3.2% per year.

Answer

.....

 [1]



**BEATTY SECONDARY SCHOOL
END-OF-YEAR EXAMINATION 2023
SECONDARY THREE EXPRESS**

CANDIDATE
NAME

CLASS

REGISTER
NUMBER

MARK SCHEME

MATHEMATICS

Paper 1

Setter: Mrs Samsol

4052/01

5 October 2023

1 hour 45 minutes

Candidates answer on the Question Paper
Additional Materials: NIL

READ THESE INSTRUCTIONS FIRST

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[Turn Over

3

Mathematical Formulae*Compound Interest*

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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 On a map, a length of 5 cm represents an actual distance of 6 km.

(a) Express the scale of the map in the form 1 : r .

5 cm : 6 km
 1 cm : 1.2 km
 1 : 120 000 B1

Answer 1 : [1]

(b) A park has an actual area of 3.6 km². Find the area, in cm², of the park on the map.

1 cm : 1.2 km
 1 cm² : 1.44 km² M1 [area scale]
 $3.6 \text{ km}^2 : \frac{3.6}{1.44} = 2.5 \text{ cm}^2$ A1

Answer cm² [2]

- 2 (a) Factorise $x^4 - y^2$.

$$= (x^2 + y)(x^2 - y) \text{ B1}$$

Answer [1]

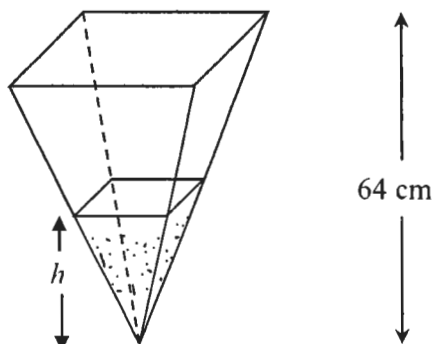
(b) Factorise fully $10ab + 1 - 2a - 5b$.

$10ab + 1 - 2a - 5b$ or $10ab - 5b - 2a + 1$
 $= 10ab - 2a - 5b + 1$ $= 5b(2a - 1) - (2a - 1)$
 $= 2a(5b - 1) - (5b - 1)$ M1 [factorisation with common factor]
 $= (5b - 1)(2a - 1)$ or $(1 - 5b)(1 - 2a)$ A1

Answer [2]

5

- 3 The diagram shows a container in the shape of an inverted square pyramid of height 64 cm. The volume of water in the container is $\frac{1}{7}$ the volume of the pyramid.



Calculate the height of the pyramid that is not in contact with water.

Let h be the height of the water in the pyramid.

$$\left(\frac{h}{64}\right)^3 = \frac{1}{7} \dots\dots\dots \text{M1}$$

$$h = \sqrt[3]{\frac{1}{7}} \times 64$$

$$h = 33.456 \dots\dots\dots \text{A1}$$

Height of pyramid not in contact with water

$$= 64 - 33.456$$

$$= 30.544$$

$$= 30.5 \text{ cm} \dots\dots\dots \text{A1} \checkmark \text{ [accept } 64 - h]$$

Answer cm [3]

6

- 4 (a) Express as a single fraction in its simplest form $\frac{2}{3a-1} - \frac{3a}{(3a-1)^2}$.

$$\begin{aligned} & \frac{2}{3a-1} - \frac{3a}{(3a-1)^2} \\ &= \frac{2(3a-1) - 3a}{(3a-1)^2} \dots\dots\dots \text{M1 [combine into a single fraction]} \\ &= \frac{6a - 2 - 3a}{(3a-1)^2} \\ &= \frac{3a - 2}{(3a-1)^2} \dots\dots\dots \text{A1} \end{aligned}$$

Answer [2]

- (b) Simplify $\frac{45xy^2}{12} \div \frac{x^3}{4y}$.

$$\begin{aligned} & \frac{45xy^2}{12} \div \frac{x^3}{4y} \\ &= \frac{45xy^2}{12} \times \frac{4y}{x^3} \dots\dots\dots \text{M1} \left[\times \frac{4y}{x^3} \right] \\ &= \frac{15y^3}{x^2} \dots\dots\dots \text{A1} \end{aligned}$$

Answer [2]

7

5 $y = \frac{11x^2 + 4}{x^2 + a}$

- (a) Find the value of a when $x = -2$ and $y = 20$.

$$\begin{aligned}
 20 &= \frac{11(-2)^2 + 4}{(-2)^2 + a} \\
 20 &= \frac{48}{4 + a} \quad \text{..... M1 [substitution and evaluation]} \\
 4 + a &= 2.4 \\
 a &= -\frac{8}{5} \quad \text{or } -1.6 \quad \text{..... A1}
 \end{aligned}$$

Answer $a = \dots\dots\dots$ [2]

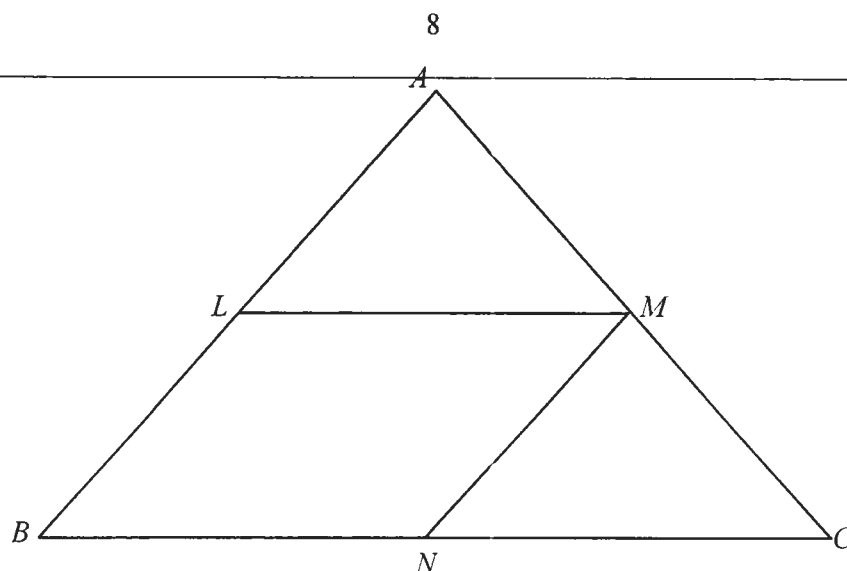
- (b) Rearrange the formula to make x the subject.

$$\begin{aligned}
 y &= \frac{11x^2 + 4}{x^2 + a} \\
 y(x^2 + a) &= 11x^2 + 4 \quad \text{.....M1 [multiplication with } x^2 + a \text{]} \\
 x^2y + ay &= 11x^2 + 4 \\
 x^2y - 11x^2 &= 4 - ay \\
 x^2(y - 11) &= 4 - ay \quad \text{..... M1 [factorisation]} \\
 x &= \pm \sqrt{\frac{4 - ay}{y - 11}} \quad \text{or} \quad x = \pm \sqrt{\frac{ay - 4}{11 - y}} \quad \text{..... A1}
 \end{aligned}$$

Answer $x = \dots\dots\dots$ [3]

[Turn Over

6



The diagram shows a triangle ABC . $LMNB$ is a parallelogram and L and M are the midpoints of AB and AC respectively.

Show that triangle ALM and triangle MNC are congruent.

Answer

$\angle ALM = \angle MNC$ (corresponding angles, $LM \parallel BC$)
 $\angle LMA = \angle NCM$ (corresponding angles, $LM \parallel BC$)
 $AM = MC$ (M is midpoint of AC)
 triangle ALM and triangle MNC are congruent. (AAS test)

Optional

B1 for any 2 correct reasons.
 B2 for all 3 correct reasons and conclusion.
 Accept other congruence tests

$AM = MC$ (M is point of AC)
 $AL = LB$ (L is midpoint of AB)
 $= MN$ (opposite sides of parallelogram)
 show that $\triangle ALM$ is similar to $\triangle ABC$ first
 $LM = BN$ (opposite sides of parallelogram)
 $= NC$ ($BC = 2LM$) – SSS Test

$AL = LB$ (L is midpoint of AB)
 $= MN$ (opposite sides of parallelogram)
 $\angle LAM = \angle NMC$ (corresponding angles, $AB \parallel MN$)
 $AM = MC$ (M is midpoint of AC)
 $\therefore \triangle ALM \cong \triangle MNC$ (SAS Test)

[2]

7

Show that $(3n-2)^2 + 11$ is a multiple of 3 for all integer values of n .

[2]

Answer

$$(3n-2)^2 + 11$$

$$= 9n^2 - 12n + 4 + 11 \dots\dots\dots \text{M1 [expansion]}$$

$$= 9n^2 - 12n + 15$$

$$= 3(3n^2 - 4n + 5)$$

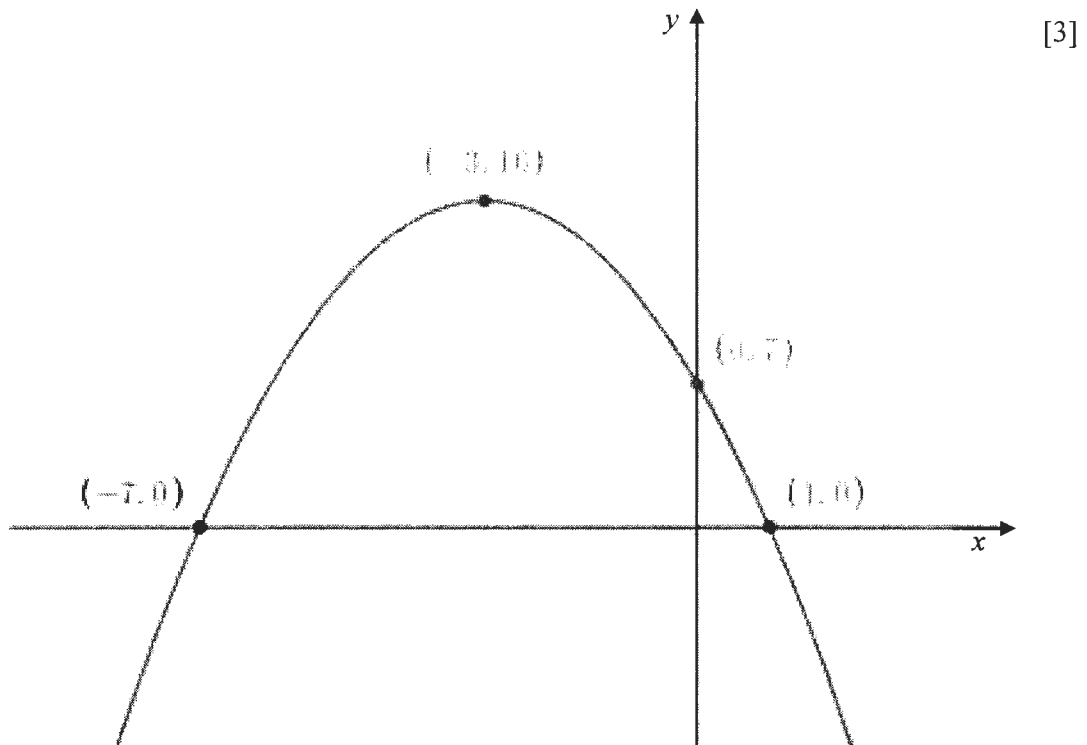
Since 3 is a factor of $(3n-2)^2 + 11$, hence

$(3n-2)^2 + 11$ is a multiple of 3 for all values of n .

A1 with conclusion

- 8 (a) Sketch the graph of $y = 16 - (x + 3)^2$ on the axes below.
Indicate clearly the coordinates of the points where the graph crosses the axes and the turning point on the curve.

Answer



G1 – shape of graph passing through $(-3, 16)$
G1 – correct intercepts and graph must be symmetrical
G1 – label points on the y and x-axes and the turning point

- (b) Write down the equation of the line of symmetry of the graph $y = 16 - (x + 3)^2$.

$x = -3$ B1

Answer [1]

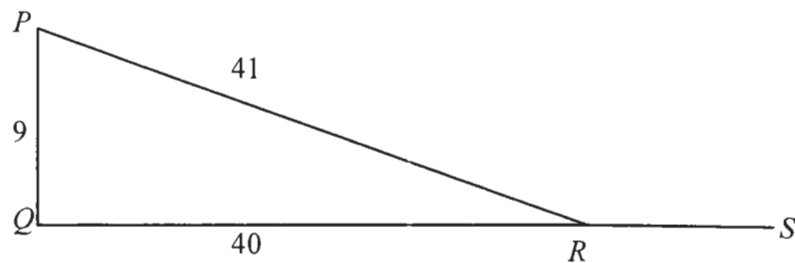
10

- 9 (a) The sine of an angle is 0.8711.
Give two possible values for the angle.

60.6° , 119.4° ----- B2 [or 1.06 rad, 2.08 rad]

Answer or [2]

- (b) In triangle PQR , $PQ = 9$ cm, $QR = 40$ cm and $PR = 41$ cm.



- (i) Show that angle PQR is right-angled.

[2]

Answer

$PR^2 = 41^2 = 1681$ $PQ^2 + QR^2 = 9^2 + 40^2 = 1681$ $\therefore PR^2 = PQ^2 + QR^2.$ By the converse of Pythagoras' Theorem, triangle PQR is a right-angled triangle and $\angle PQR = 90^\circ$	} M1 [calculation of sides] } A1 –[with conclusion]
--	---

- (ii) Write down the values of

- (a) $\sin \angle PRQ$,

$\frac{9}{41}$ B1

Answer [1]

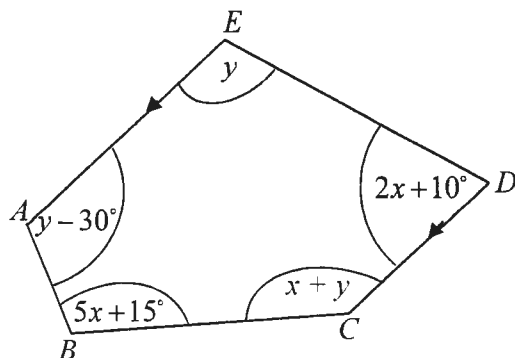
- (b) $\cos \angle PRS$.

$-\frac{40}{41}$ B1

Answer [1]

11

- 10 $ABCDE$ is a pentagon where AE is parallel to CD .
The angles are shown on the diagram.



- (a) Write down two simultaneous equations, in terms of x and y , to represent this information.

sum of interior angles of pentagon = 540
 $5x + 15 + x + y + 2x + 10 + y + y - 30 = 540$ M1
 $8x + 3y = 545$(1).....A1
 or
 $y - 30 + 5x + 15 + x + y = 540 - 180$M1
 $6x + 2y = 375$(2).....A1
 and
 $2x + 10 + y = 180$
 $2x + y = 170$(3)

Either
equation
1&3 or 2&3

Answer

..... [3]

- (b) Solve the simultaneous equations.

$8x + 3y = 545$ (1)
 $2x + y = 170$ (2)
 $(2) \times 3$
 $6x + 3y = 510$ (3) M1✓ [substitution or elimination]
 $(1) - (3) \quad 2x = 35$
 $x = 17.5$ A1
 $y = 135$ A1

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

12

- 11 (a) Express 270 as a product of its prime factors.

$$270 = 2 \times 3^3 \times 5 \quad \text{..... B1}$$

Answer [1]

- (b) The number $270k$ is a perfect cube.
Find the smallest positive integer value of k .

$$k = 2^2 \times 5^2 = 100 \quad \text{..... B1}$$

Answer $k =$ [1]

- (c) x is a number between 400 and 500.
The highest common factor of x and 270 is 45.
Find the value of x .

$270 = 2 \times 3^3 \times 5$ $\text{HCF } 45 = 3^2 \times 5$ $x = 3^2 \times 5 \times 11 = 495 \quad \text{..... B1}$
--

Answer $x =$ [1]

13

- 12 (a) Simplify $\left(\frac{81x^8}{y^{12}}\right)^{-\frac{1}{4}}$. Leave your answer in positive indices.

$$\begin{aligned} & \left(\frac{81x^8}{y^{12}}\right)^{-\frac{1}{4}} \\ &= \left(\frac{y^{12}}{81x^8}\right)^{\frac{1}{4}} \quad \text{or} \quad \left(\frac{\frac{1}{3}x^{-2}}{y^{-3}}\right) \dots \text{M1 [positive index or simplify]} \\ &= \frac{y^3}{3x^2} \quad \dots \text{A1} \end{aligned}$$

Answer [2]

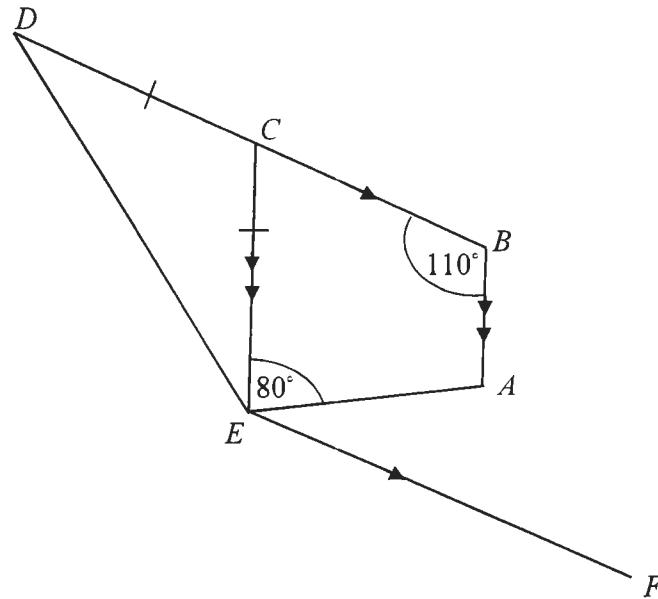
- (b) Given that $9^{k+1} \div 3 = 3^k$, find k .

$$\begin{aligned} & 9^{k+1} \div 3 = 3^k \\ & 3^{2k+2} \div 3 = 3^k \quad \dots \text{M1} [9^{k+1} = 3^{2(k+1)}] \\ & 3^{2k+1} = 3^k \\ & 2k+1 = k \\ & k = -1 \quad \dots \text{A1} \end{aligned}$$

Answer $k =$ [2]

[Turn Over

13



In the diagram, EF is parallel to DCB , CE is parallel to BA and $CD = CE$.
 $\angle CEA = 80^\circ$ and $\angle ABC = 110^\circ$.

Calculate

(a) $\angle CED$,

$$\angle BCE = 180^\circ - 110^\circ = 70^\circ$$

$$\angle CED = 70^\circ \div 2 = 35^\circ \dots\dots\dots \text{B1}$$

Answer [1]

(b) $\angle AEF$,

$$\angle AEF = 180^\circ - 70^\circ - 80^\circ$$

$$= 30^\circ \dots\dots\dots \text{B1}$$

Answer [1]

(c) reflex $\angle BAE$.

$$\text{reflex } \angle BAE = 110^\circ + 70^\circ + 80^\circ \dots\dots\dots \text{M1}$$

$$= 260^\circ \dots\dots\dots \text{B1}$$

Answer [2]

15

14 d is inversely proportional to the square of t .

- (a) When $t = 3$, $d = 15$.
Find d when $t = 9$.

$$\begin{aligned}
 d &= \frac{k}{t^2} \\
 15 &= \frac{k}{3^2} \dots\dots\dots \text{M1} \\
 k &= 135 \\
 d &= \frac{135}{9^2} \\
 d &= \frac{5}{3} \text{ or } 1\frac{2}{3} \dots\dots\dots \text{A1}
 \end{aligned}$$

Answer $d = \dots\dots\dots$ [2]

- (b) A change in t produces a change in d .
Find the percentage change in d when the value of t is doubled.

$$\begin{aligned}
 d_1 &= \frac{k}{t^2} \\
 d_2 &= \frac{k}{(2t)^2} \dots\dots\dots \text{M1} \\
 &= \frac{k}{4t^2} \\
 \text{percentage change} &= \frac{\frac{k}{4t^2} - \frac{k}{t^2}}{\frac{k}{t^2}} \times 100\% \dots\dots\dots \text{M1} \left[\frac{\text{final} - \text{original}}{\text{original}} \right] \\
 &= \left(\frac{1}{4} - 1 \right) \times 100\% \\
 &= -75\% \dots\dots\dots \text{A1}
 \end{aligned}$$

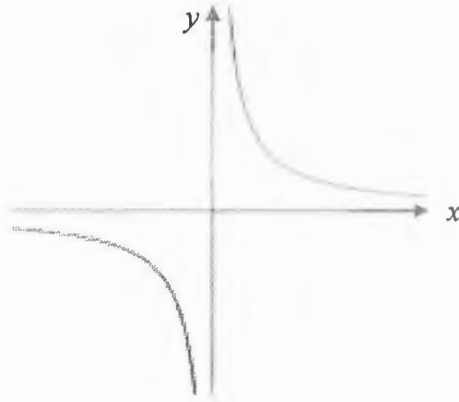
Answer $\dots\dots\dots\%$ [3]

15

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

Write down a possible equation for each of the graphs below.

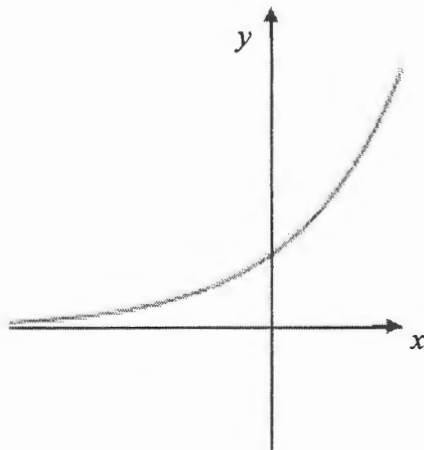
(a)



$$y = \frac{2}{x} \dots \text{B1}$$

Answer [1]

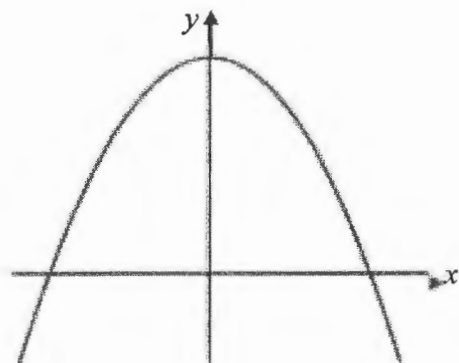
(b)



$$y = 2^x \dots \text{B1}$$

Answer [1]

(c)



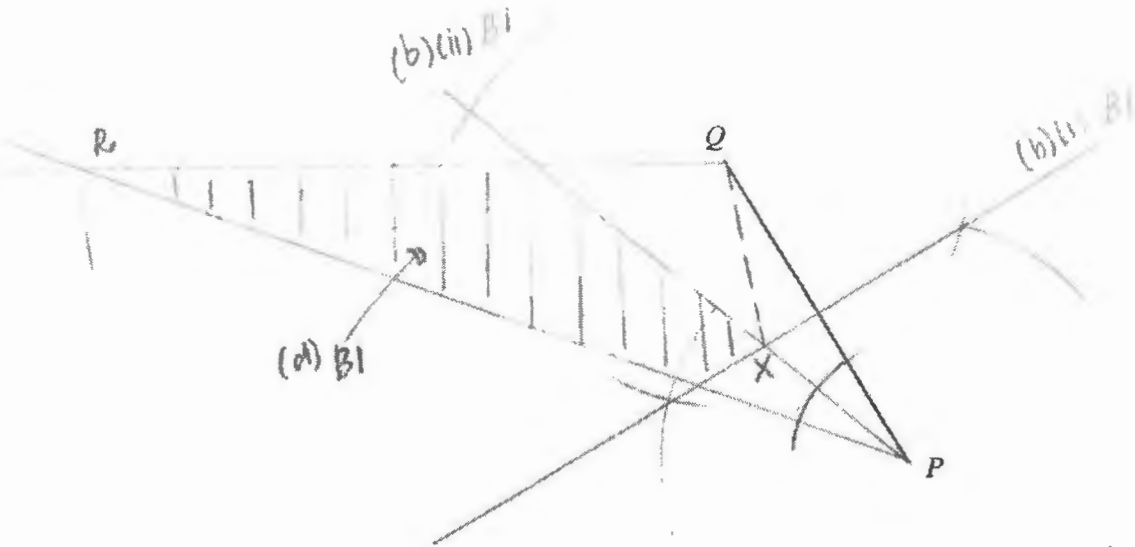
$$y = 2 - x^2 \dots \text{B1}$$

Answer [1]

17

- 16 (a) Construct the triangle PQR where $QR = 10$ cm and angle $PQR = 120^\circ$. PQ has already been drawn. [2]

angle $PQR = 120^\circ$ B1
 $QR = 10$ cm (with arc at point R) B1



- (b) Construct
 (i) the perpendicular bisector of PQ , [1]
 (ii) the bisector of angle RPQ . [1]
- (c) Mark clearly the point X which is inside the triangle, equidistant from P and Q and equidistant from PQ and PR . Measure and write down the length of XQ .
 Answer 2.8 to 3.0. cm ... B1 [1]
- (d) Point Y lies inside triangle PQR and it is nearer to Q than P and it is nearer to PR than PQ . Shade the region where Y lies. [refer to diagram B1] [1]

[Turn Over

17 The Sun is 93 million miles from the Earth.

- (a) Given that 1 mile = 1.6093 km, find the distance of the Sun from Earth in metres. Leave your answer in standard form.

$$\begin{aligned} 93 \text{ million miles} &= 93 \times 10^6 \times 1.6093 \times 1000 \text{ m} \dots\dots \text{M1} [\times 1.6093 \times 1000] \\ &= 1.496649 \times 10^{11} \text{ m} \dots\dots\dots \text{A1} \end{aligned}$$

Answer m [2]

- (b) The speed of light is 3.0×10^8 m/s.
Find the time, in minutes and seconds, for light to travel to Earth.

$$\begin{aligned} \text{time taken} &= \frac{1.496649 \times 10^{11}}{3.0 \times 10^8} \dots\dots\dots \text{M1} \\ &= 498.883 \text{ seconds} \\ &= 8 \text{ minutes } 19 \text{ seconds} \dots\dots\dots \text{A1} \end{aligned}$$

Answer..... minutes seconds [2]

19

- 18 (a) A bank offers a saving account with a simple interest of 3.2% per year. Lee deposited a sum of money in this account. At the end of 4 years, he received \$20 304. Calculate the sum of money that Lee deposited in the bank.

$$\begin{aligned} \text{total interest rate} &= 3.2 \times 4 = 12.8\% \quad \dots\dots \text{M1} \\ \text{sum of money} &= \frac{20304}{112.8} \times 100 \\ &= \$18\,000 \quad \dots\dots\dots \text{A1} \end{aligned}$$

or

$$\begin{aligned} 20304 - P &= \frac{P \times 3.2 \times 4}{100} \dots\dots \text{M1 [substitution]} \\ 20304 - P &= 0.128P \\ 1.128P &= 20304 \\ P &= 18000 \quad \dots\dots\dots \text{A1} \end{aligned}$$

Answer \$ [2]

- (b) Without doing any calculation, explain why Lee will get a better return if he invests in a saving plan that pays a compound interest of 3.2% per year.

Answer

He will get a better return because the principal each year is increasing. B1
0
 or the principal and interest is reinvested in each of the following year

 [1]



**BEATTY SECONDARY SCHOOL
END-OF-YEAR EXAMINATION 2023
SECONDARY THREE EXPRESS**

CANDIDATE
NAME

CLASS

REGISTER
NUMBER

MATHEMATICS

Paper 2

4052/02

6 October 2023

1 hour 45 minutes

[Click or tap here to enter text.](#)

Candidates answer on the Question Paper

Additional Materials: Nil

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number in the spaces at the top of this page.

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.

Given non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.

The use of an approved scientific calculator is expected, where appropriate.

You are reminded of the need for clear presentation in your answers.

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 70.

For Examiner's Use

This document consists of **16** printed pages and **0** blank 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

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

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

3

- 1 (a) (i) Solve the inequalities $8 + 3x < 10 + \frac{7}{2}x \leq 11.5 - 3x$.

Answer [3]

- (ii) Hence write down the largest integer that satisfies

$$8 + 3x < 10 + \frac{7}{2}x \leq 11.5 - 3x.$$

Answer [1]

- (b) (i) Factorise $9x^2 - 12xy + 4y^2$.

Answer [1]

- (ii) Hence for $9x^2 - 12xy + 4y^2 = 0$, find the value of $\frac{9x}{10y}$.

Answer [2]

[Turn over

- (c) Alan invested \$3800 in a bank. The interest was compounded quarterly at $r\%$ per annum. At the end of 3 years, he had a total of \$4143.50 in his account. Find the interest rate per annum.

Answer% [3]

- (d) When $x = -3$ or $x = 2$, the expression $\frac{1}{(x+p)(x+1)} - \frac{1}{2x^2 + qx - 3}$ is undefined.

Given p and q are positive integers, find the possible value of p and the possible value of q .

Answer $p = \dots$ or

$q = \dots$ [3]

- 2 A pond is filled up with 60 m^3 of water. Two pumps, A and B , are used to drain the water in the pond. Pump A can drain water at a rate of $x \text{ m}^3$ per minute, while pump B can drain 0.3 m^3 more water per minute.

- (a) (i) Write down the time taken in terms of x , in minutes, for pump A to drain out all the water from the pond completely.

Answer minutes [1]

- (ii) Write down the time taken, in minutes, for pump B to drain out all the water from the pond completely.

Answer minutes [1]

- (b) Given that Pump A takes 3 minutes and 20 seconds more than pump B , form an equation in x and show that it reduces to $10x^2 + 3x - 54 = 0$.

Answer

[3]

[Turn over

6

- (c) Solve the equation $10x^2 + 3x - 54 = 0$.

Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [2]

- (d) Hence write down the time taken in minutes for pump B to drain out all the water from the pond completely.

Answer $\dots\dots\dots$ minutes [1]

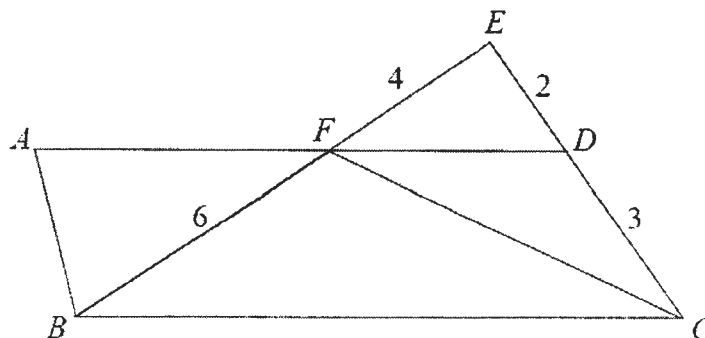
- (e) If both pumps are turned on together, will the pumps be able to drain out all the water completely within 12 minutes? Explain your answer with appropriate working.

Answer

[2]

7

- 3 (a) In the diagram, AD and BC are straight lines where $CD = 3$ cm, $DE = 2$ cm, $EF = 4$ cm and $FB = 6$ cm.



- (i) Show that triangle EBC is similar to triangle EFD .

Answer

[2]

- (ii) Explain why AD is parallel to BC .

Answer

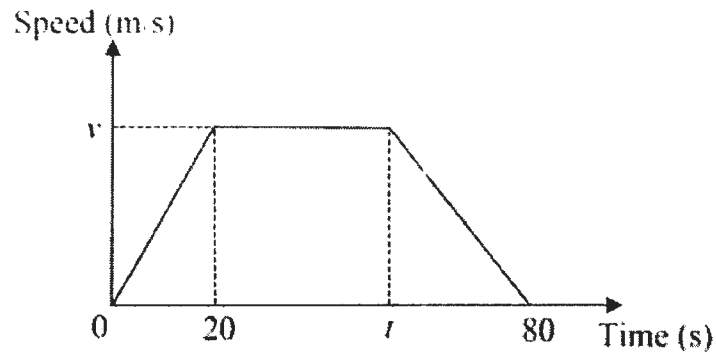
[2]

- (iii) Given that triangle EFD is 20 cm^2 , calculate the area of quadrilateral $BCDF$.

Answer cm^2 [2]

[Turn over

- (b) The following diagram shows the speed-time graph of a car during a journey. The car accelerated from rest at 1.25 m/s^2 to a speed of $v \text{ m/s}$ in 20 seconds. It travelled at this speed until t seconds before it came to a stop at $t = 80$ seconds. The total distance travelled for the whole journey was 1.45 km. The distance travelled by the car during a certain time interval is equal to the area bounded by the graph and the time-axis in that time interval.



- (i) Find the maximum speed of the journey.

Answer m/s [1]

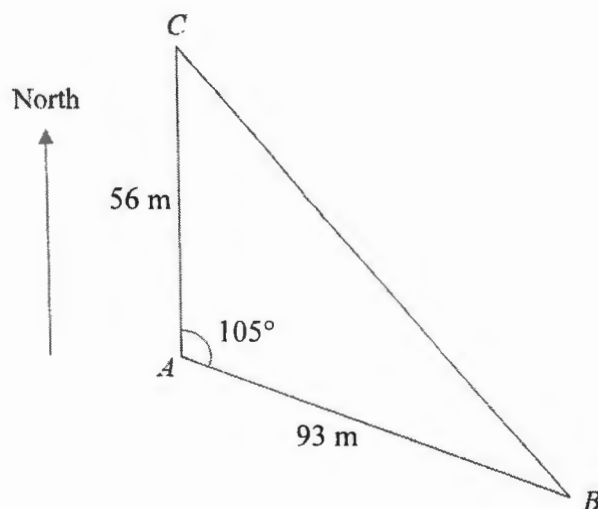
- (ii) Calculate the average speed, in km/h, of the car for the whole journey.

Answer km/h [2]

- (iii) Find the value of t .

Answer $t =$ [2]

4 (a)



ABC is a triangular plot of land.

It is given that $AB = 93$ m, $AC = 56$ m and $\angle BAC = 105^\circ$. A is due south of C .

(i) Find BC .

Answer m [2]

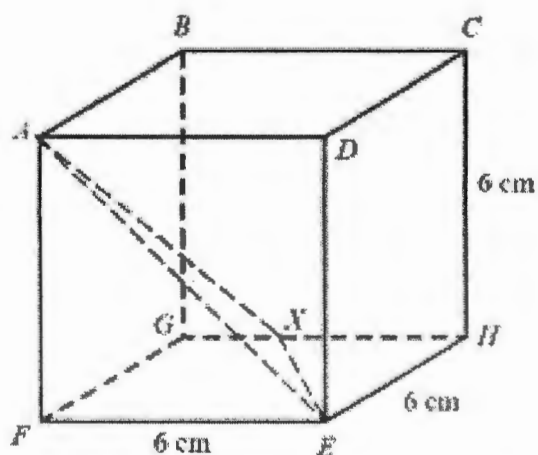
(ii) Find the bearing of C from B .

Answer $^\circ$ [2]

- (iii) A tree of height 25 m is planted at A . A man walks from B to C . Calculate the largest angle of elevation of the top of the tree from the man.

Answer° [3]

(b)



$ABCDEFGH$ is a cube of side 6 cm. The point X lies on the side GH such that $GX : XH = 1 : 3$.

(i) Find the length of EX .

Answer cm [2]

(ii) Find $\angle AXE$.

Answer cm [4]

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

x	-4	-3.5	-3	-2.5	-1	0	1	1.5	2
y	-8	a	0	1.55	1	0	2	5.06	10

- (a) Find the value of a .

Answer $a = \dots\dots\dots$ [1]

- (b) On the graph paper provided on the next page, draw the graph of $y = \frac{3}{2}x^2 + \frac{1}{2}x^3$ using a scale of 2 cm to represent 1 unit on the x -axis and 1 cm to represent 1 unit on the y -axis. [3]

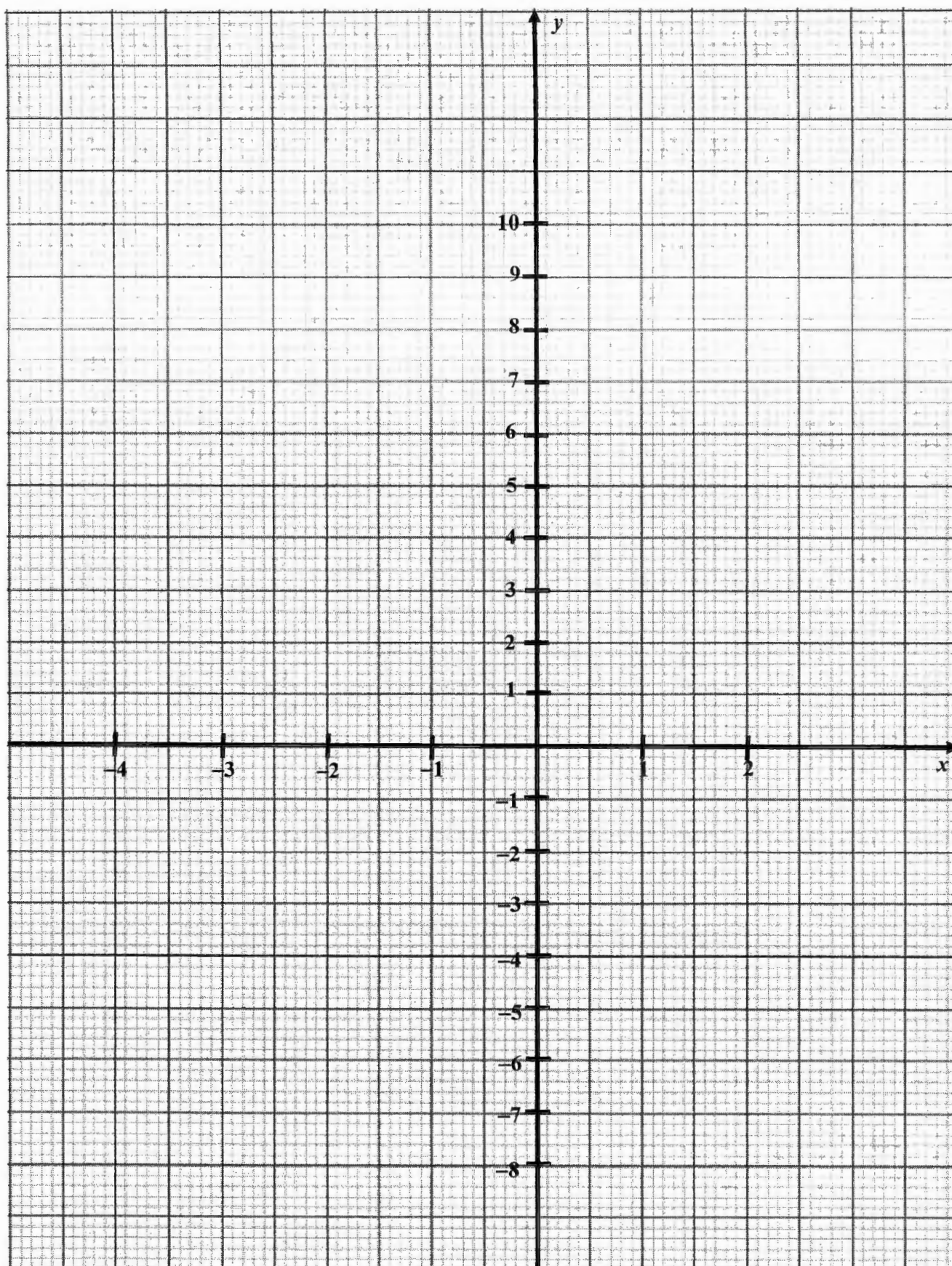
- (c) Use your graph to write down the range of values of x for which $y > 1$.

Answer $\dots\dots\dots$
 $\dots\dots\dots$ [2]

- (d) (i) On the same axis, draw the line with gradient -2 that passes through the point $(2, 1)$. [1]

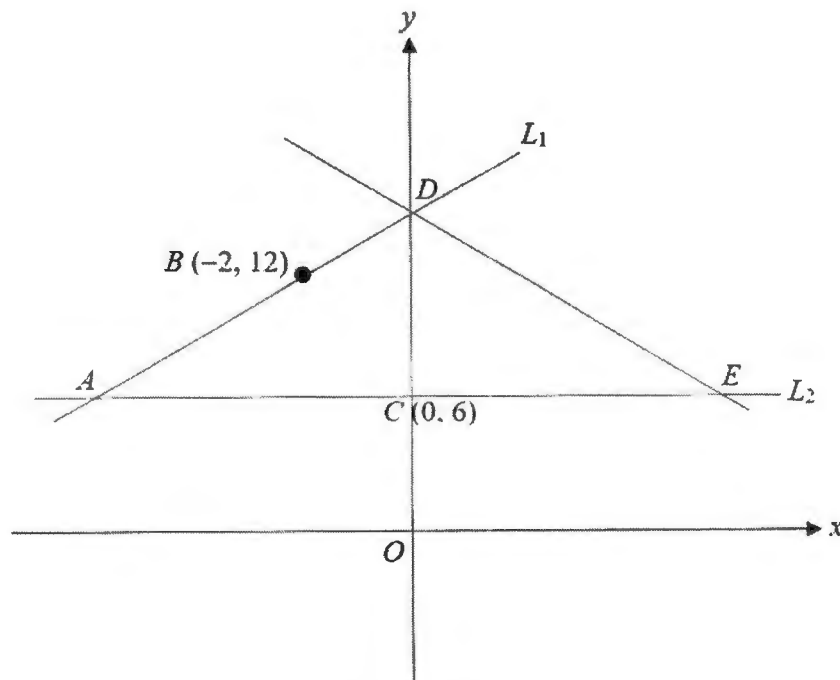
- (ii) Write down the x -coordinate of the point of intersection of the line from d(i) and the graph of $y = \frac{3}{2}x^2 + \frac{1}{2}x^3$.

Answer $x = \dots\dots\dots$ [1]



[Turn over

6



The diagram shows a line, L_1 , drawn through point B with coordinates $(-2, 12)$ and another line, L_2 , drawn through point C with coordinates $(0, 6)$. L_1 cuts the y -axis at D and L_2 is parallel to the x -axis. L_1 and L_2 intersect at A .

- (i) Write down the equation of the line AC .

Answer [1]

- (ii) The gradient of L_1 is 2. Find the equation of L_1 .

Answer [1]

- (iii) Find the coordinates of point A .

Answer [1]

- (iv) Find the area of triangle AOD , where O is the origin.

Answer [2]

- (v) It is given that angle $ADC = \text{angle } EDC$. Write down the equation of the line DE .

Answer [2]

- (vi) Jane draws another line $2y + x = 3$ on the same axes and claims that it passes through the point B .

Do you agree with her? Justify your answer with calculations.

Answer

[2]

- 7 Ibuprofen, which is a non-steroidal anti-inflammatory drug (NSAID), is used for the treatment of fever, including post-immunisation fever, and relief of mild to moderate pain such as a sore throat, toothache, earache, minor body or muscle ache and sprains.



Parents of young children may administer ibuprofen to them when they have high fever as it can bring down the temperature more efficiently. However, it should be administered only when the temperature is more than 38.5°C .

The dosage for a typical bottle of ibuprofen is 100 mg/5 ml (i.e. 100 mg of ibuprofen in 5 ml of solution).

- (i) If a 3.75 ml dose of solution is given to a child, find the amount of ibuprofen in the dose in g ($1\text{ mg} = 10^{-3}\text{ g}$).

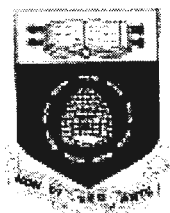
Answer g [2]

A regular dose for a child is 4 to 10 mg/kg/dose and can be administered every 6 to 8 hours. The maximum dosage per day is 40 mg/kg/day.

- (ii) A 11.5-kg child was given a 6 ml of the solution every 6 hours. Determine, with appropriate working, whether the child was given an overdose for the day.

Answer

[4]



**BEATTY SECONDARY SCHOOL
END-OF-YEAR EXAMINATION 2023
SECONDARY THREE EXPRESS**

CANDIDATE
NAME

MARK SCHEME

CLASS

REGISTER
NUMBER

MATHEMATICS

Paper 2

Setter:

4052/02

6 October 2023

1 hour 45 minutes

Candidates answer on the Question Paper

Additional Materials: Nil

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number in the spaces at the top of this page.

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.

Given non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.

The use of an approved scientific calculator is expected, where appropriate.

You are reminded of the need for clear presentation in your answers.

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 70.

For Examiner's Use

This document consists of **16** printed pages and **0** blank pages.

Mathematical Formulae*Compound Interest*

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

Mensuration

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

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

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

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

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

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

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

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

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

Statistics

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

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

3

- 1 (a) (i) Solve the inequalities $8+3x < 10 + \frac{7}{2}x \leq 11.5 - 3x$.

$$\begin{array}{ll}
 8+3x < 10 + \frac{7}{2}x & \text{and} \quad 10 + \frac{7}{2}x \leq 11.5 - 3x \\
 -\frac{1}{2}x < 2 & \frac{13}{2}x \leq 1.5 \\
 x > -4 & [B1] \quad x \leq \frac{3}{13} \quad [B1 \text{ o.e.}] \\
 \therefore -4 < x \leq \frac{3}{13} & [A1]
 \end{array}$$

Answer [3]

- (ii) Hence write down the largest integer that satisfies

$$8+3x < 10 + \frac{7}{2}x \leq 11.5 - 3x.$$

Answer 0 [B1] [1]

- (b) (i) Factorise $9x^2 - 12xy + 4y^2$.

Answer $(3x-2y)^2$ [B1] [1]

- (ii) Hence for $9x^2 - 12xy + 4y^2 = 0$, find the value of $\frac{9x}{10y}$.

$$\begin{array}{ll}
 (3x-2y)^2 = 0 & \\
 3x-2y = 0 & \\
 3x = 2y & \\
 \frac{x}{y} = \frac{2}{3} & [M1] \text{ ecf} \\
 \frac{9x}{10y} = \frac{2}{3} \times \frac{9}{10} = \frac{3}{5} & [A1]
 \end{array}$$

Answer [2]

- (c) Alan invested \$3800 in a bank. The interest was compounded quarterly at $r\%$ per annum. At the end of 3 years, he had a total of \$4143.50 in his account. Find the interest rate per annum.

$$4143.5 = 3800 \left(1 + \frac{r}{400} \right)^{12} \quad [\text{M1}]$$

$$1 + \frac{r}{400} = \left(\frac{4143.5}{3800} \right)^{\frac{1}{12}} \quad [\text{M1}]$$

$$r = \left[\left(\frac{4143.5}{3800} \right)^{\frac{1}{12}} - 1 \right] \times 400 = 2.90\% \text{ (3sf)} \quad [\text{A1}]$$

Answer% [3]

- (d) When $x = -3$ or $x = 2$, the expression $\frac{1}{(x+p)(x+1)} - \frac{1}{2x^2 + qx - 3}$ is undefined.

Given p and q are positive integers, find the possible value of p and the possible value of q .

$$\frac{1}{(x+p)(x+1)} - \frac{1}{2x^2 + qx - 3} \text{ is undefined when } (x+p)(x+1) = 0 \text{ or } 2x^2 + qx - 3 = 0$$

When $x = -3$,

$$(-3+p)(-3+1) = 0 \quad \text{or} \quad 2(-3)^2 + q(-3) - 3 = 0 \quad [\text{M1}]$$

$$p = 3 \quad q = 5$$

When $x = 2$,

$$(2+p)(2+1) = 0 \quad \text{or} \quad 2(2)^2 + q(2) - 3 = 0 \quad [\text{M1}]$$

$$p = -2 \quad q = -2\frac{1}{2}$$

Since p and q are positive integers, $p = 3$ and $q = 5$. [A1]

Answer $p =$ or

$q =$ [3]

- 2 A pond is filled up with 60 m^3 of water. Two pumps, A and B , are used to drain the water in the pond. Pump A can drain water at a rate of $x \text{ m}^3$ per minute, while pump B can drain 0.3 m^3 more water per minute.

- (a) (i) Write down the time taken in terms of x , in minutes, for pump A to drain out all the water from the pond completely.

$$\text{Answer } \dots\dots\dots \frac{60}{x} \text{ [B1]} \text{ minutes [1]}$$

- (ii) Write down the time taken, in minutes, for pump B to drain out all the water from the pond completely.

$$\frac{600}{10x+3} \text{ [B1] (Accept } \frac{60}{x+0.3} \text{)}$$

$$\text{Answer } \dots\dots\dots \text{ minutes [1]}$$

- (b) Given that Pump A takes 3 minutes and 20 seconds more than pump B , form an equation in x and show that it reduces to $10x^2 + 3x - 54 = 0$.

Answer

$$\frac{60}{x} - \frac{60}{x+0.3} = 3\frac{1}{3} \quad \text{[M1] ecf}$$

$$60(x+0.3) - 60x = \frac{10}{3}x(x+0.3)$$

$$18 = \frac{10}{3}(x^2 + 0.3x)$$

$$x^2 + 0.3x = \frac{27}{5} \quad \text{[M1 for removing brackets]}$$

$$5x^2 + \frac{3}{2}x = 27$$

$$10x^2 + 3x - 54 = 0 \text{ (shown)} \quad \text{[A1]}$$

[3]

[Turn over

6

- (c) Solve the equation $10x^2 + 3x - 54 = 0$.

$$x = \frac{-3 \pm \sqrt{(3)^2 - 4(10)(-54)}}{2(10)} \quad [\text{M1}]$$

$$= 2.17863 \text{ or } -2.47863$$

$$= 2.18 \text{ or } -2.48 \text{ (3sf)} \quad [\text{A1}]$$

Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [2]

- (d) Hence write down the time taken in minutes for pump B to drain out all the water from the pond completely.

$$\text{Time taken for pump B} = \frac{60}{2.17863 + 0.3}$$

$$= 24.2 \text{ minutes (3sf)} \quad [\text{B1}]$$

Answer $\dots\dots\dots$ minutes [1]

- (e) If both pumps are turned on together, will the pumps be able to drain out all the water completely within 12 minutes? Explain your answer with appropriate working.

Answer

$$\text{Rate of pump A + pump B} = 2.17863 + (2.17863 + 0.3)$$

$$= 4.65726 \text{ m}^3/\text{min}$$

$$\text{Time taken for both pumps to drain the pond} = \frac{60}{4.65726}$$

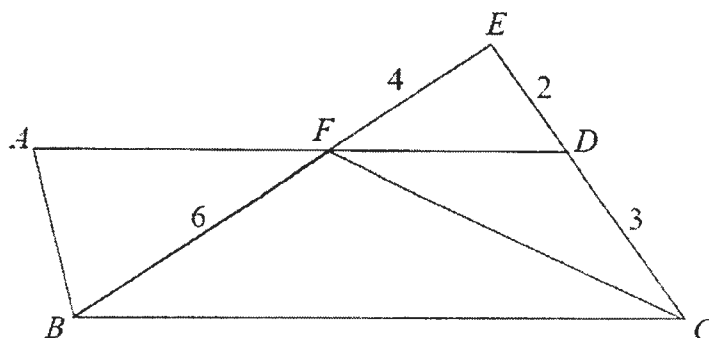
$$= 12.9 \text{ min} > 12 \text{ min} \quad [\text{M1}] \text{ ecf}$$

The two pumps will not be able to drain out all the water completely within 12 minutes. [A1] or condition based on working

[2]

7

- 3 (a) In the diagram, AD and BC are straight lines where $CD = 3$ cm, $DE = 2$ cm, $EF = 4$ cm and $FB = 6$ cm.



- (i) Show that triangle EBC is similar to triangle EFD .

Answer

$$\frac{EB}{EF} = \frac{10}{4} = \frac{5}{2}$$

$$\angle BEC = \angle FED \text{ (common angle)}$$

$$\frac{EC}{ED} = \frac{5}{2}$$

Triangle EBC is similar to triangle EFD (SAS)

2 statements [B1]

3 statements with
conclusion [B1]

SAS optional

[2]

- (ii) Explain why AD is parallel to BC .

Answer

Since triangle EBC is similar to triangle EFD ,

$$\angle EDF = \angle ECB \text{ (or } \angle EFD = \angle EBC \text{)} \quad [\text{M1}]$$

They are corresponding angles to lines AD and BC , hence AD and BC are parallel. (Emphasize to lines AD and BC)

[2]

- (iii) Given that triangle EFD is 20 cm^2 , calculate the area of quadrilateral $BCDF$.

$$\frac{\text{Area of } \triangle EBC}{\text{Area of } \triangle EFD} = \left(\frac{5}{2}\right)^2 \quad [\text{M1}]$$

$$\text{Area of } \triangle EBC = \left(\frac{5}{2}\right)^2 \times 20 = 125 \text{ cm}^2$$

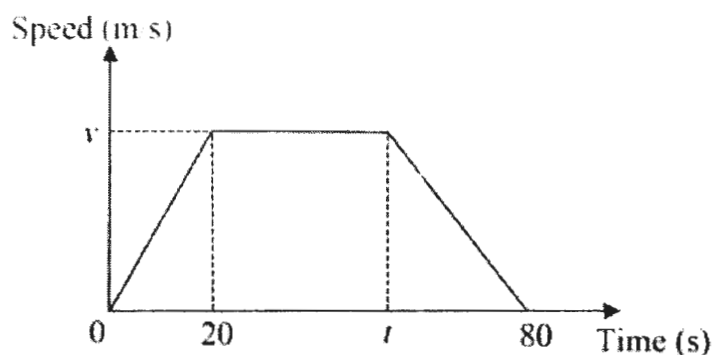
$$\text{Area of quadrilateral } BCDF = 125 - 20$$

$$= 105 \text{ cm}^2 \quad [\text{A1}]$$

Answer cm^2 [2]

[Turn over

- (b) The following diagram shows the speed-time graph of a car during a journey. The car accelerated from rest at 1.25 m/s^2 to a speed of $v \text{ m/s}$ in 20 seconds. It travelled at this speed until t seconds before it came to a stop at $t = 80$ seconds. The total distance travelled for the whole journey was 1.45 km. The distance travelled by the car during a certain time interval is equal to the area bounded by the graph and the time-axis in that time interval.



- (i) Find the maximum speed of the journey.

$$\frac{v}{20} = 1.25$$

$$v = 25 \text{ m/s} \quad [\text{B1}]$$

Answer m/s [1]

- (ii) Calculate the average speed, in km/h, of the car for the whole journey.

$$\text{Average speed} = \frac{1450}{80} \quad [\text{M1}]$$

$$= 18.125 \text{ m/s}$$

$$= 65.25 \text{ km/h (or } \frac{261}{4} \text{)} \quad [\text{A1}]$$

Answer km/h [2]

- (iii) Find the value of t .

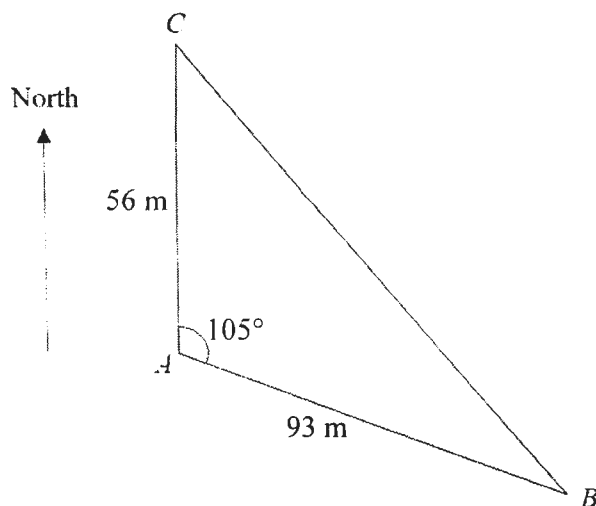
$$\frac{1}{2} \times [80 + (t - 20)] \times 25 = 1450 \quad [\text{M1}] \text{ ecf}$$

$$60 + t = 116$$

$$t = 56 \quad [\text{A1}]$$

Answer $t =$ [2]

4 (a)



ABC is a triangular plot of land.

It is given that $AB = 93$ m, $AC = 56$ m and $\angle BAC = 105^\circ$. A is due south of C .

(i) Find BC .

$$BC^2 = 56^2 + 93^2 - 2(56)(93)\cos 105^\circ \quad [\text{M1}]$$

$$BC = 120.336$$

$$= 120 \text{ m}$$

[A1]

Answer m [2]

(ii) Find the bearing of C from B .

$$\frac{\sin \angle ACB}{93} = \frac{\sin 105^\circ}{120.336} \quad [\text{B1 or equivalent}] \text{ ecf}$$

$$\angle ACB = 48.288^\circ$$

$$\text{Bearing of } C \text{ from } B = 360^\circ - 48.288^\circ$$

$$= 311.7^\circ$$

[A1]

Answer° [2]

[Turn over

- (iii) A tree of height 25 m is planted at A . A man walks from B to C . Calculate the largest angle of elevation of the top of the tree from the man.

Let the point where the largest angle of elevation is be X .

$$\sin 48.288^\circ = \frac{AX}{56} \quad [\text{B1 or equivalent}] \text{ ecf}$$

$$AX = 41.8039$$

Let the angle of elevation be θ .

$$\tan \theta = \frac{25}{41.8039} \quad [\text{B1 or equivalent}] \text{ ecf}$$

$$\theta = 30.9^\circ \quad [\text{A1}]$$

Alternate solution

Let the point where the largest angle of elevation is be X .

$$\frac{1}{2}(56)(93)\sin 105^\circ = \frac{1}{2}(120.336)(AX) \quad [\text{B1 or equivalent}] \text{ ecf}$$

$$AX = 41.8041$$

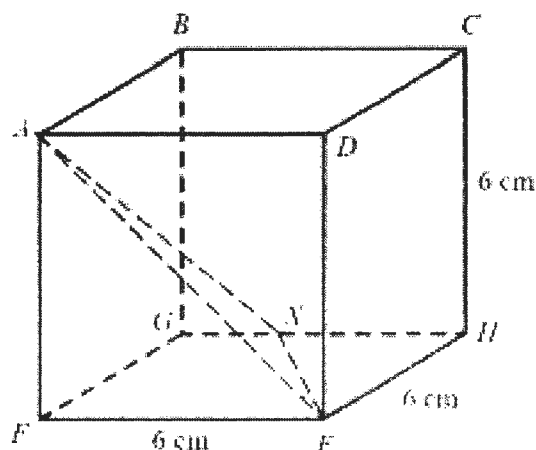
Let the angle of elevation be θ .

$$\tan \theta = \frac{25}{41.8041} \quad [\text{B1 or equivalent}] \text{ ecf}$$

$$\theta = 30.9^\circ \quad [\text{A1}]$$

Answer° [3]

(b)



$ABCDEFGH$ is a cube of side 6 cm. The point X lies on the side GH such that $GX : XH = 1 : 3$.

(i) Find the length of EX .

$$HX = \frac{6}{4} \times 3 = 4.5 \text{ cm} \quad [\text{M1}]$$

$$EX = \sqrt{6^2 + 4.5^2} = 7.5 \text{ cm} \quad [\text{A1}]$$

Answer cm [2]

(ii) Find $\angle AXE$.

$$AE = \sqrt{6^2 + 6^2} = \sqrt{72} \text{ or } 8.48528 \quad [\text{M1}]$$

$$FX = \sqrt{6^2 + 1.5^2} = \sqrt{38.25} \text{ or } 6.18466$$

$$\begin{aligned} AX &= \sqrt{6^2 + (\sqrt{38.25})^2} \\ &= \sqrt{74.25} \text{ or } 8.6168 \quad [\text{M1}] \end{aligned}$$

$$(\sqrt{72})^2 = (\sqrt{74.25})^2 + 7.5^2 - 2(\sqrt{74.25})(7.5) \cos \angle AXE \quad [\text{M1}]$$

$$\angle AXE = 63.1^\circ \text{ (1dp)} \quad [\text{A1}]$$

Answer cm [4]

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

x	-4	-3.5	-3	-2.5	-1	0	1	1.5	2
y	-8	a	0	1.55	1	0	2	5.06	10

- (a) Find the value of a .

Answer $a = -3.06$ [B1] [1]

- (b) On the graph paper provided on the next page, draw the graph of $y = \frac{3}{2}x^2 + \frac{1}{2}x^3$ using a scale of 2 cm to represent 1 unit on the x -axis and 1 cm to represent 1 unit on the y -axis. [3]

- (c) Use your graph to write down the range of values of x for which $y > 1$.

-2.75 < x < -1 [B1]
Accept -2.8 to -2.7; -1.05 to -0.95

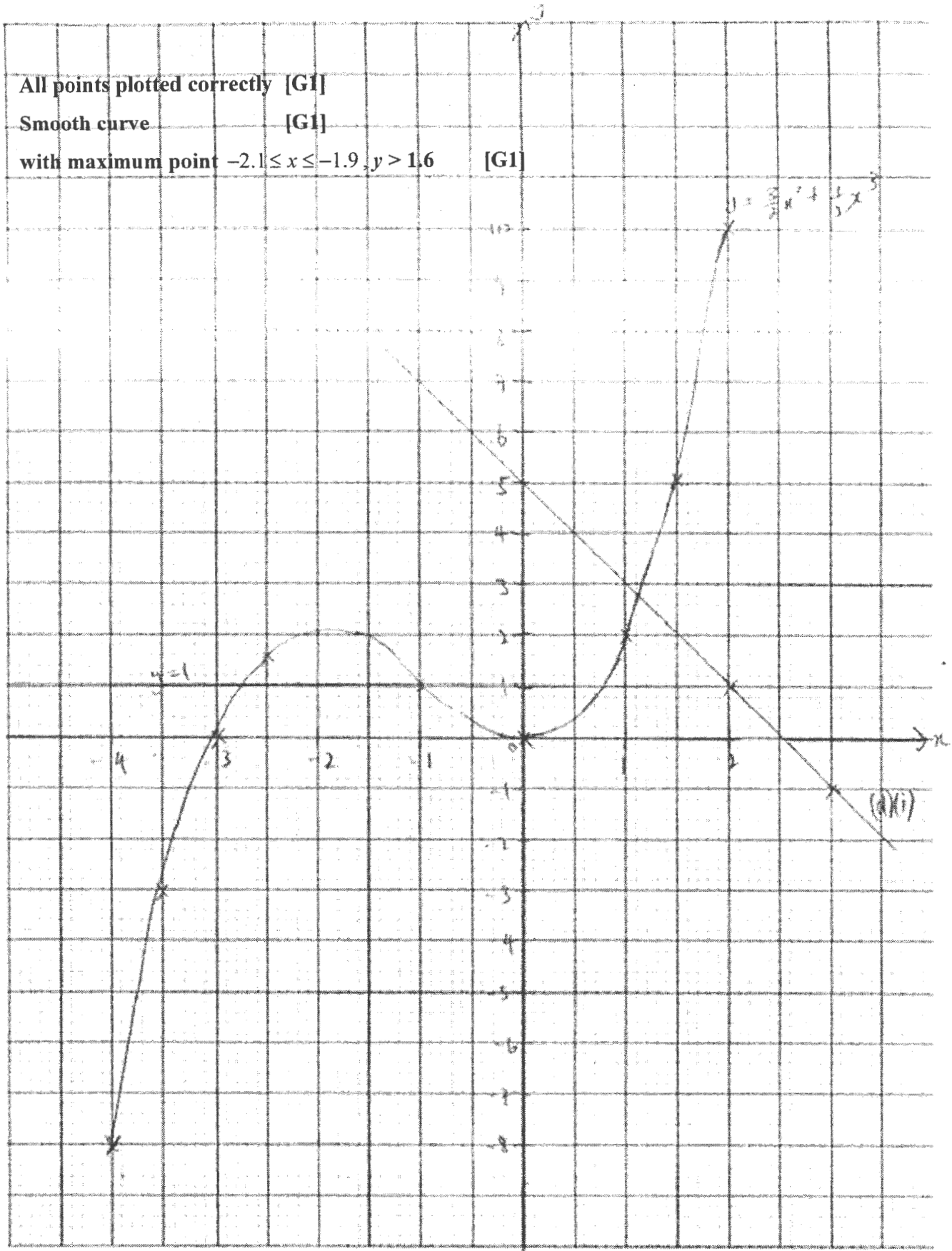
$x > 0.8$ [B1]
Accept 0.75 to 0.85 (accepted some 0.65 and 0.7, depending on accuracy of graph drawn) Answer [2]

- (d) (i) On the same axis, draw the line with gradient -2 that passes through the point (2, 1). [1]

- (ii) Write down the x -coordinate of the point of intersection of the line from d(i) and the graph of $y = \frac{3}{2}x^2 + \frac{1}{2}x^3$.

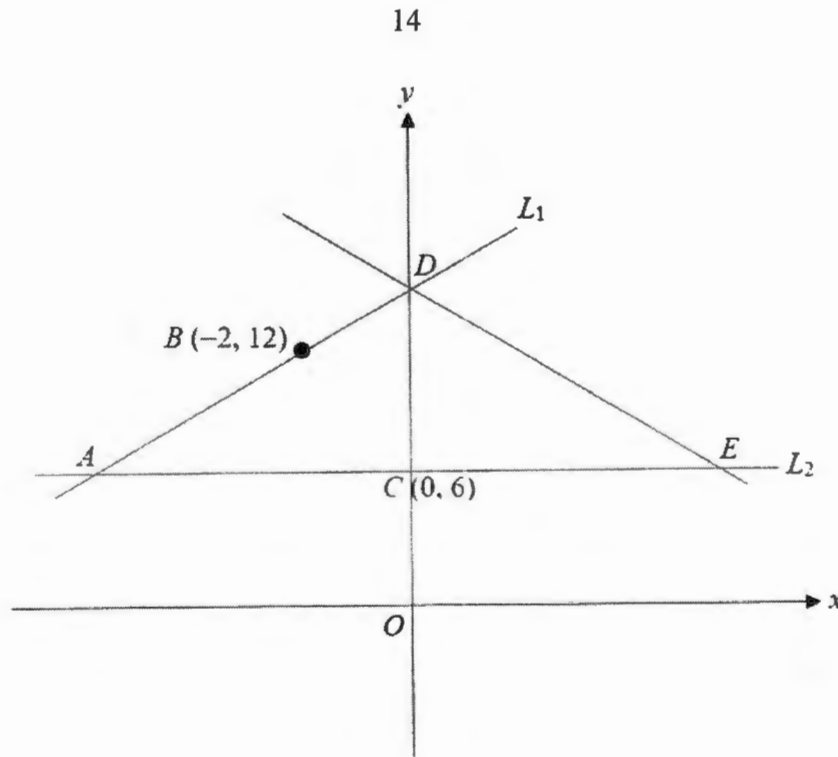
$x = 1.1$ [B1]
Accept 1.05 to 1.15 (accepted some 1.2, depending on accuracy of graph drawn)

Answer $x =$ [1]



[Turn over

6



The diagram shows a line, L_1 , drawn through point B with coordinates $(-2, 12)$ and another line, L_2 , drawn through point C with coordinates $(0, 6)$. L_1 cuts the y -axis at D and L_2 is parallel to the x -axis. L_1 and L_2 intersect at A .

- (i) Write down the equation of the line AC .

Answer $y = 6$ [B1] [1]

- (ii) The gradient of L_1 is 2. Find the equation of L_1 .

$$\begin{aligned} y &= 2x + c, B(-2, 12) \\ 12 &= 2(-2) + c \\ c &= 16 \quad \therefore y = 2x + 16 \quad \text{[B1]} \end{aligned}$$

Answer [1]

- (iii) Find the coordinates of point A .

$$\begin{aligned} &\text{Substitute } y = 6 \text{ into} \\ 6 &= 2x + 16 \\ x &= -5 \end{aligned}$$

Answer $(-5, 6)$ [B1] [1]

- (iv) Find the area of triangle AOD , where O is the origin.

$$\begin{aligned}\text{Area of triangle } AOD &= \frac{1}{2}(16)(5) \quad [\text{M1}] \text{ ecf} \\ &= 40 \text{ units}^2 \quad [\text{A1}]\end{aligned}$$

Answer [2]

- (v) It is given that angle $ADC = \text{angle } EDC$. Write down the equation of the line DE .

$$\begin{aligned}m_{DE} &= -2 \quad [\text{B1}] \\ \therefore y &= -2x + 16 \quad [\text{B1}] \text{ ecf from (ii)}\end{aligned}$$

Answer [2]

- (vi) Jane draws another line $2y + x = 3$ on the same axes and claims that it passes through the point B .

Do you agree with her? Justify your answer with calculations.

Answer

$$\begin{aligned}&\text{Substitute the point } B(-2, 12) \text{ into the line } 2y + x = 3, \\&\text{LHS} = 2(12) + (-2) \\&\quad = 22 \neq \text{RHS} \\&\text{Since point } B \text{ does not satisfy the equation } 2y + x = 3, \\&\text{it does not lie on the line } 2y + x = 3. \text{ Jane is not correct.} \\&\text{(Must show comparison of their values with } (-2, 12))\end{aligned}$$

[2]

[Turn over

- 7 Ibuprofen, which is a non-steroidal anti-inflammatory drug (NSAID), is used for the treatment of fever, including post-immunisation fever, and relief of mild to moderate pain such as a sore throat, toothache, earache, minor body or muscle ache and sprains.

Parents of young children may administer ibuprofen to them when they have high fever as it can bring down the temperature more efficiently. However, it should be administered only when the temperature is more than 38.5°C .



The dosage for a typical bottle of ibuprofen is 100 mg/5 ml (i.e. 100 mg of ibuprofen in 5 ml of solution).

- (i) If a 3.75 ml dose of solution is given to a child, find the amount of ibuprofen in the dose in g ($1\text{ mg} = 10^{-3}\text{ g}$).

5 ml ----- 0.1 g	[M1 for 0.1 g]
3.75 ml ----- $\frac{0.1}{5} \times 3.75 = 0.075\text{ g}$	[A1]

Answer g [2]

A regular dose for a child is 4 to 10 mg/kg/dose and can be administered every 6 to 8 hours. The maximum dosage per day is 40 mg/kg/day.

- (ii) A 11.5-kg child was given a 6 ml of the solution every 6 hours. Determine, with appropriate working, whether the child was given an overdose for the day.

Answer

Maximum daily dosage based on 11.5 kg child

1 kg ----- 40 mg

11.5 kg ----- 40×11.5

$= 460\text{ mg of ibuprofen}$ [M1 or equivalent]

Dosage administered to child in a day

In one 6-hour, dosage is

5 ml ----- 100 mg

6 ml ----- $\frac{100}{5} \times 6$

$= 120\text{ mg of ibuprofen}$ [M1 or equivalent]

In a day, dosage = $120\text{ mg} \times 4$

$= 480\text{ mg of ibuprofen}$ [M1 or equivalent]

Since $480\text{ mg} > 460\text{ mg}$, the child was given an overdose.

[A1 for reason with conclusion]

Alternate solution:

In one 6-hour, dosage is

5 ml ----- 100 mg

6 ml ----- $\frac{100}{5} \times 6$

= 120 mg of ibuprofen [M1 or equivalent]

For a 11.5 kg child:

11.5 kg ----- 120 mg

1 kg ----- $\frac{120}{11.5}$

= 10.4 mg/kg/dose [M1 or equivalent]

Since 10.4 mg/kg/dose > 10 mg/kg/dose [M1 for comparison]

hence the child was given an overdose. [A1]

