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

CANDIDATE NAME			
CLASS		REGISTER NUMBER	

MATHEMATICS

4052/01

Paper 1
Setter:

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]

---

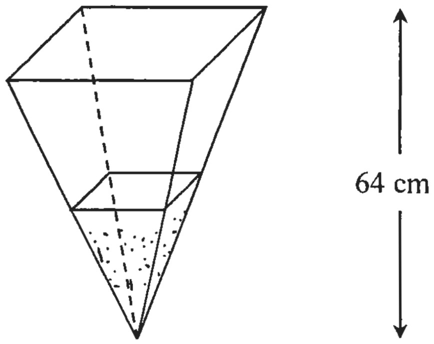
2 **(a)** Factorise $x^4 - y^2$.

Answer .... [1]

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

Answer .... [2]

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]

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

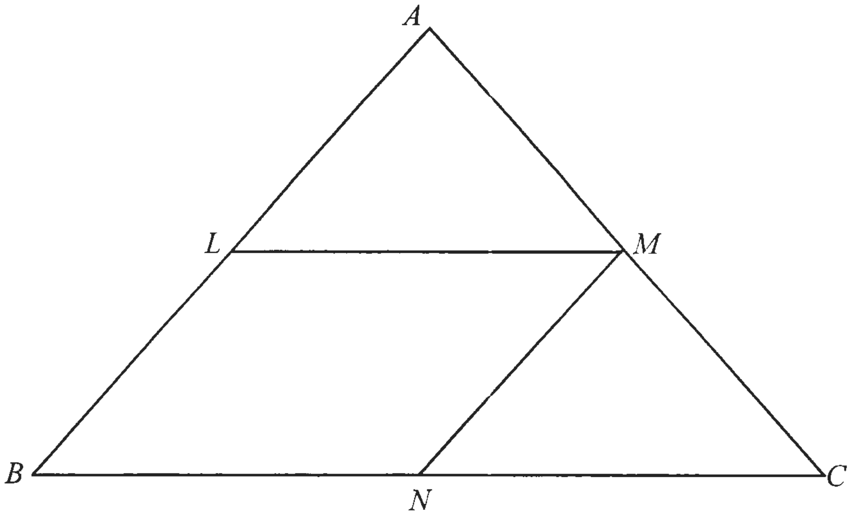
(a) Find the value of a when $x = -2$ and $y = 20$.

Answer $a =$ .... [2]

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

Answer $x =$ .... [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]

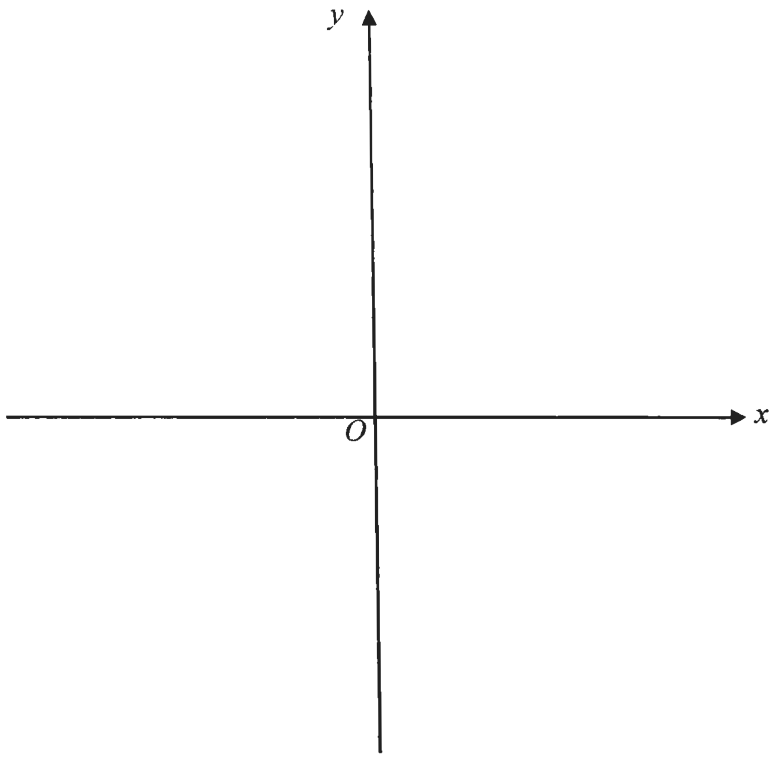
---

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]



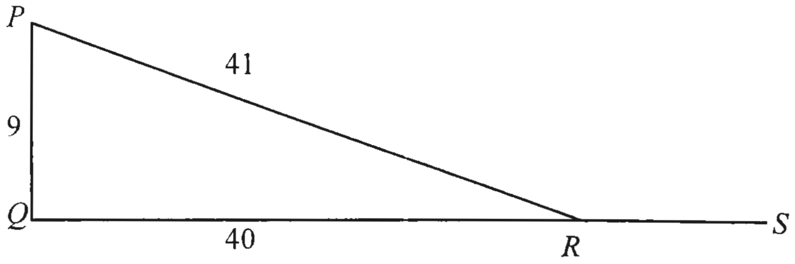
(b) Write down the equation of the line of symmetry of the graph $y = 16 - (x+3)^2$.

Answer .... [1]

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. [2]
Answer

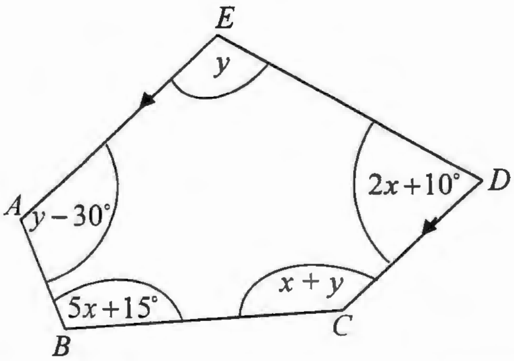
(ii) Write down the values of
(a) $\sin\angle PRQ$,

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

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]

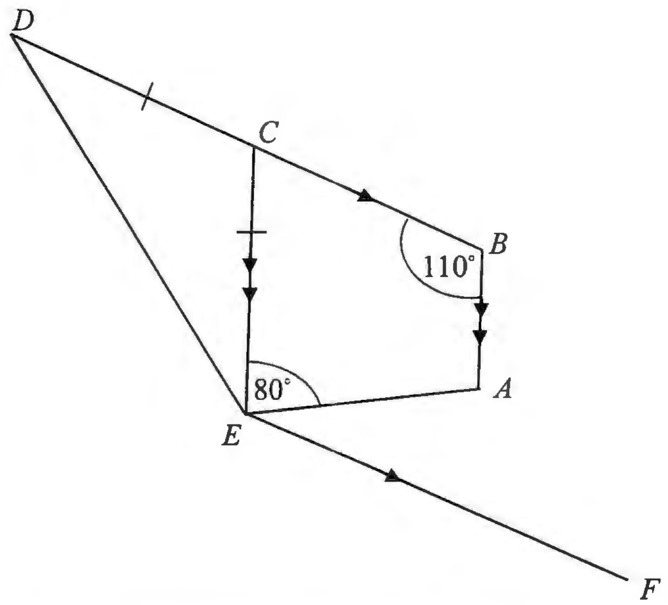
12 **(a)** Simplify $\left(\frac{81x^8}{y^{12}}\right)^{-\frac{1}{4}}$. Leave your answer in positive indices.

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]

14 d is inversely proportional to the square of t.

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

Answer $d =$ .... [2]

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

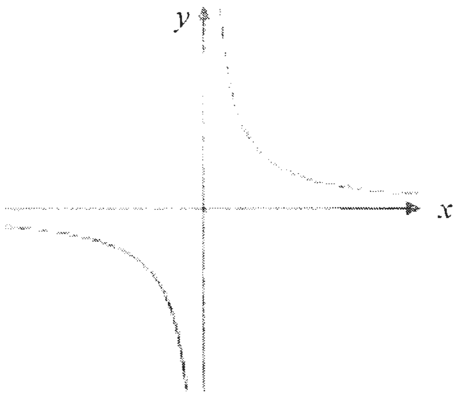
Answer ....% [3]

15

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

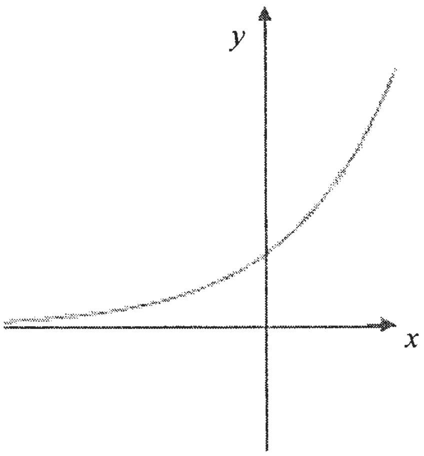
Write down a possible equation for each of the graphs below.

(a)



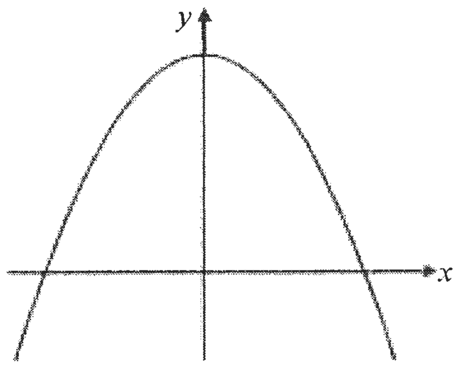
Answer .... [1]

(b)



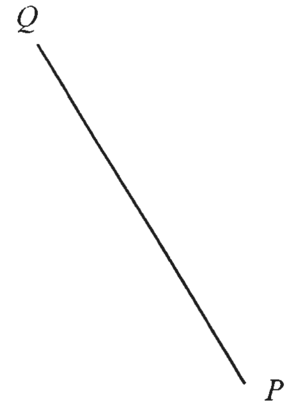
Answer .... [1]

(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 $XQ =$ .... 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]

[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 from.

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]

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]

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MARK SCHEME

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Setter: Mrs Samsol

1 hour 45 minutes

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[Turn Over

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 km^2. Find the area, in cm^2, of the park on the map.

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

Answer .... cm^2 [2]

---

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

$= (x^2 + y)(x^2 - y)$ 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 $(1\text{-}5b)(1\text{-}2a)$............. A1

Answer .... [2]

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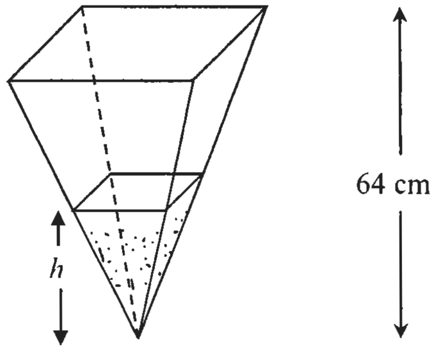
3 The diagram shows a container in the shape of an inverted square pyramid of height 64 cm. The volume of water in the container is $\frac{1}{7}$ the volume of the pyramid.



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

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

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

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

$h = 33.456$ A1

Height of pyramid not in contact with water

$= 64 - 33.456$

$= 30.544$

$= 30.5$ cm .... A1√ [accept $64 - h$]

Answer .... cm [3]

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

$$\frac{2}{3a-1}-\frac{3a}{(3a-1)^2}$$

$$=\frac{2(3a-1)-3a}{(3a-1)^2} \quad \text{............... M1 [combine into a single fraction]}$$

$$=\frac{6a-2-3a}{(3a-1)^2}$$

$$=\frac{3a-2}{(3a-1)^2} \quad \text{...................... A1}$$

Answer .... [2]

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

$$\frac{45xy^2}{12}\div\frac{x^3}{4y}$$

$$=\frac{45xy^2}{12}\times\frac{4y}{x^3} \quad \text{............... M1} \left[\times\frac{4y}{x^3}\right]$$

$$=\frac{15y^3}{x^2} \quad \text{...................... A1}$$

Answer .... [2]

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

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

$$20 = \frac{11(-2)^2 + 4}{(-2)^2 + a}$$

$20 = \dfrac{48}{4 + a}$ .... M1 [substitution and evaluation]

$4 + a = 2.4$

$a = -\dfrac{8}{5}$ or -1.6 .... A1

Answer $a =$ .... [2]

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

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

$y(x^2 + a) = 11x^2 + 4$ ....M1 [multiplication with $x^2 + a$]

$x^2y + ay = 11x^2 + 4$

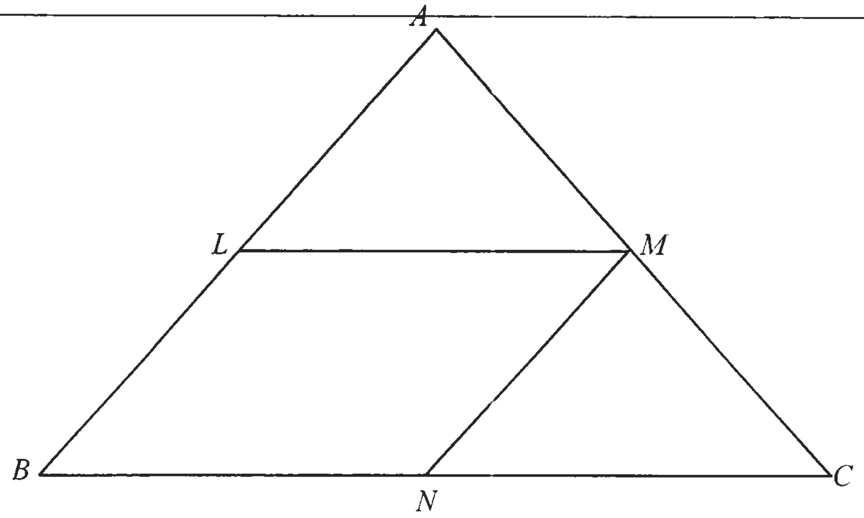
$x^2y - 11x^2 = 4 - ay$

$x^2(y - 11) = 4 - ay$ .... M1 [factorisation]

$x = \pm\sqrt{\dfrac{4 - ay}{y - 11}}$ or $x = \pm\sqrt{\dfrac{ay - 4}{11 - y}}$ A1

Answer $x =$ .... [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

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

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 ΔALM is similar to ΔABC first
$LM = BN$(opposite sides of parallelogram)
$= NC(BC = 2LM)$ – SSS Test

$AL = LB$(L is midpoint of AB)
$= MN$(opposite sides of paralleogram)
$\angle LAM = \angle NMC$(corresponding angles, AB //
$AM = MC$(M is midpoint of AC)
$\therefore \Delta ALM \equiv \Delta MNC$ (SAS Test)

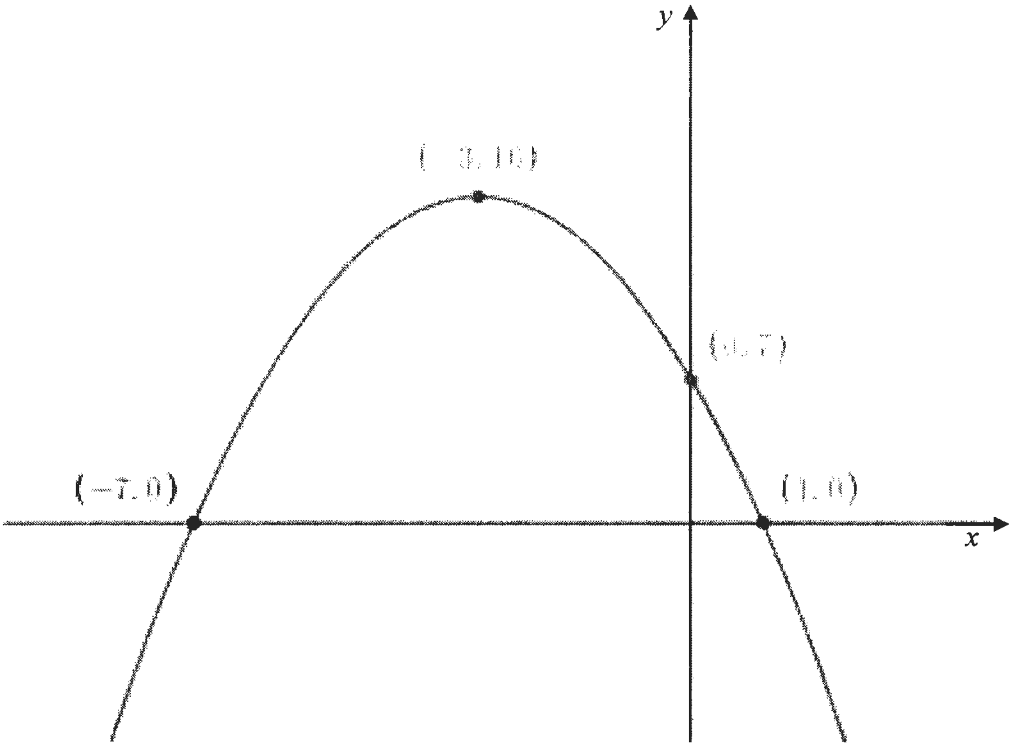
[2]

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

Answer

$(3n-2)^2 + 11$
$= 9n^2 - 12n + 4 + 11$ .... 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



[3]

G1 – shape of graph passing through (-3, 16)
G1 – correct intercepts and 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

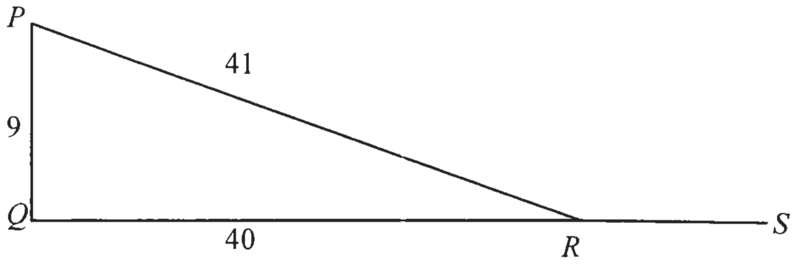
Answer .... [1]

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

$PR^2 = 41^2 = 1681$
$PQ^2 + QR^2 = 9^2 + 40^2 = 1681$
M1 [calculation of sides]

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

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

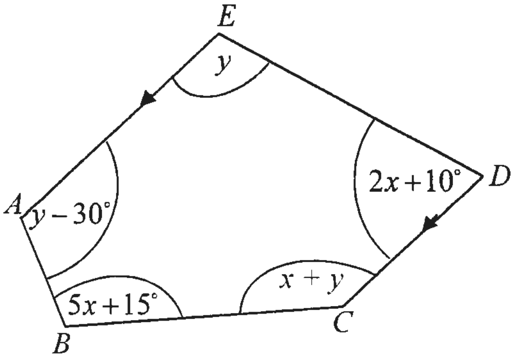
$\frac{9}{41}$ B1

Answer .... [1]

(b) $\cos\angle PRS$.

$-\frac{40}{41}$ ..... B1 *Answer* .... [1]

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]

$(1)-(3)$ $2x=35$

$x=17.5$ A1

$y=135$ A1

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

[Turn Over

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

$270 = 2 \times 3^3 \times 5$ B1

Answer .... [1]

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

$k = 2^2 \times 5^2 = 100$ 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.

$270 = 2 \times 3^3 \times 5$

HCF $45 = 3^2 \times 5$

$x = 3^2 \times 5 \times 11 = 495$ B1

Answer $x =$ .... [1]

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

$$\left(\frac{81x^8}{y^{12}}\right)^{-\frac{1}{4}}$$

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

$$=\frac{y^3}{3x^2} \qquad \text{........ A1}$$

Answer .... [2]

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

$9^{k+1} \div 3 = 3^k$

$3^{2k+2} \div 3 = 3^k$ .... M1[$9^{k+1}=3^{2(k+1)}$]

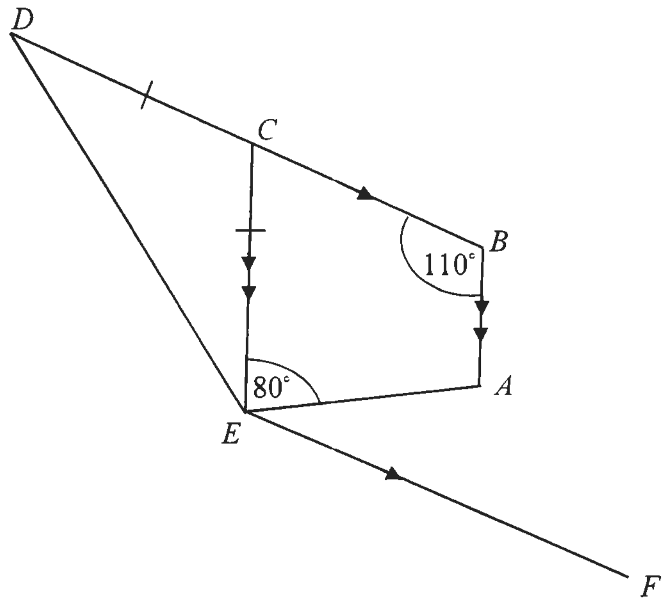
$3^{2k+1} = 3^k$

$2k+1 = k$

$k = -1$ A1

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) $\angle CED$,

$\angle BCE = 180^\circ - 110^\circ = 70^\circ$
$\angle CED = 70^\circ \div 2 = 35^\circ$ B1

Answer .... [1]

(b) $\angle AEF$,

$\angle AEF = 180^\circ - 70^\circ - 80^\circ$
$= 30^\circ$ B1

Answer .... [1]

(c) reflex $\angle BAE$.

reflex $\angle BAE = 110^\circ + 70^\circ + 80^\circ$........M1
$= 260^\circ$ B1

Answer .... [2]

14 d is inversely proportional to the square of t.

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

$d = \frac{k}{t^2}$

$15 = \frac{k}{3^2}$ M1

$k = 135$

$d = \frac{135}{9^2}$

$d = \frac{5}{3}$ or $1\frac{2}{3}$ A1

Answer $d =$ .... [2]

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

$d_1 = \frac{k}{t^2}$

$d_2 = \frac{k}{(2t)^2}$ M1

$= \frac{k}{4t^2}$

percentage change $= \dfrac{\frac{k}{4t^2} - \frac{k}{t^2}}{\frac{k}{t^2}} \times 100\%$ .... M1 $\left[\dfrac{\text{final- original}}{\text{original}}\right]$

$= \left(\frac{1}{4} - 1\right) \times 100\%$

$= -75\%$ A1

Answer ....% [3]

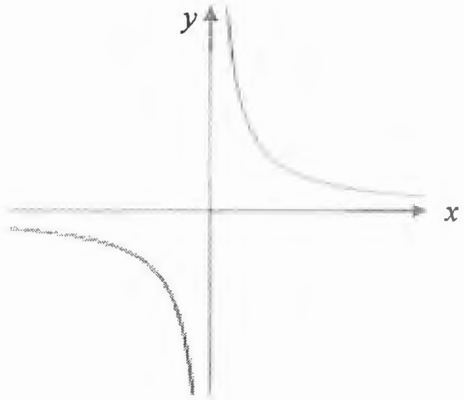
[Turn Over

15

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

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

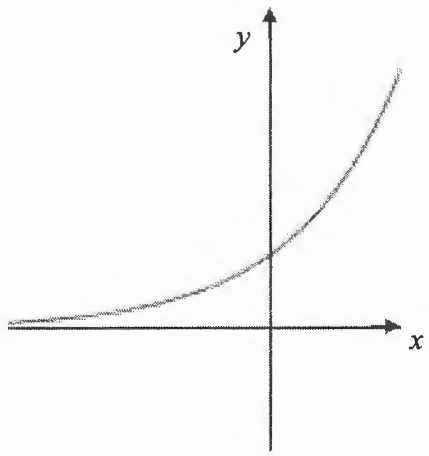
(a)



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

Answer .... [1]

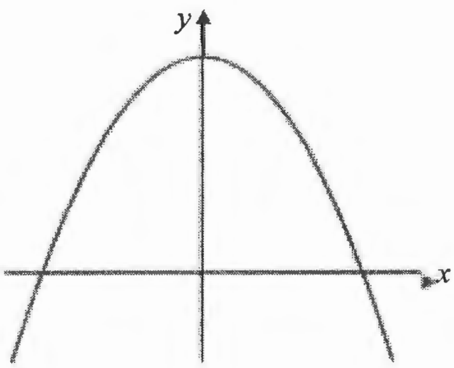
(b)



$y = 2^x$ B1

Answer .... [1]

(c)

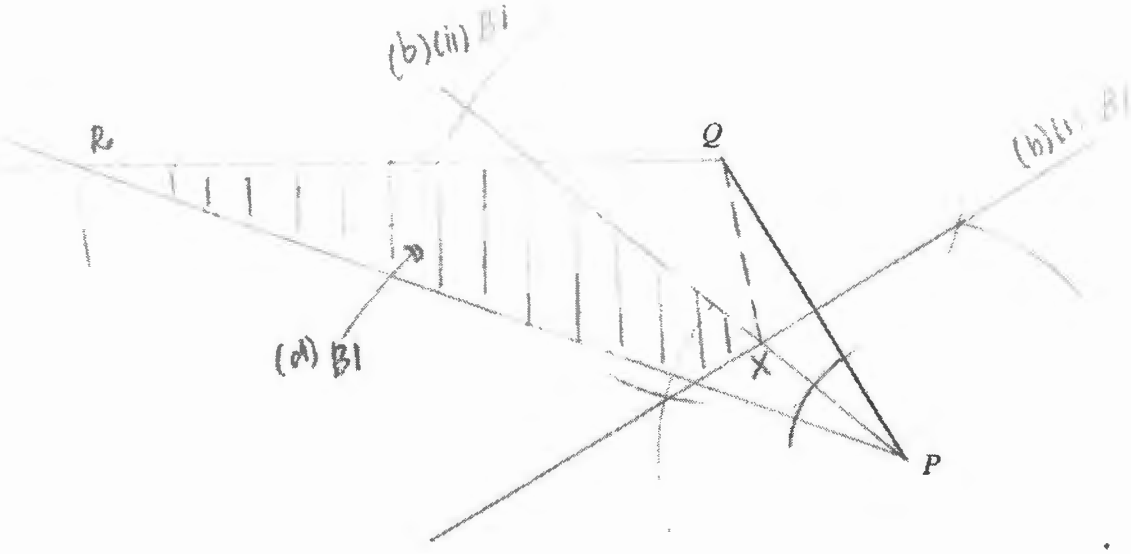


$y = 2 - x^2$ B1

Answer .... [1]

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]

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 from.

93 million miles = $93 \times 10^6 \times 1.6093 \times 1000$ m .....M1 [x 1.6093x 1000]

= 1.496649×10^{11} m A1

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.

time taken $= \dfrac{1.496649 \times 10^{11}}{3.0 \times 10^8}$ M1

= 498.883 seconds

= 8 minutes 19 seconds A1

Answer............ minutes .... seconds [2]

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.

total interest rate $= 3.2 \times 4 = 12.8\%$ M1

sum of money $= \dfrac{20304}{112.8} \times 100$

$= \$18\ 000$ A1

or

$20304 - P = \dfrac{P \times 3.2 \times 4}{100}$ .....M1 [substitution]

$20304 - P = 0.128P$

$1.128P = 20304$

$P = 18000$ A1

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
....o
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 **4052/02**

Paper 2 **6 October 2023**

Click or tap here to enter text. **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.

[Turn over

Mathematical Formulae

Compound Interest

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

Mensuration

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

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

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

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

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

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

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

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 **(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]

(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 $p=$ .... 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 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

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

Answer $x =$ .... or .... [2]

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

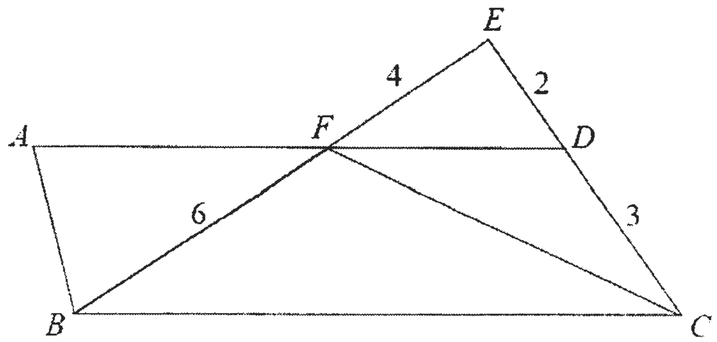
Answer .... minutes [1]

(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]

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.

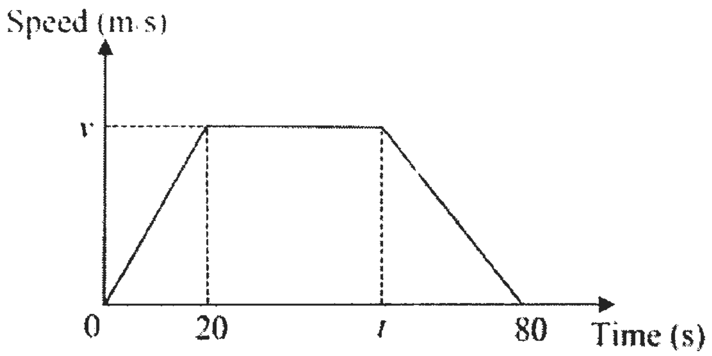
Answer

[2]

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

Answer ……………………… cm^2 [2]

(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 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]

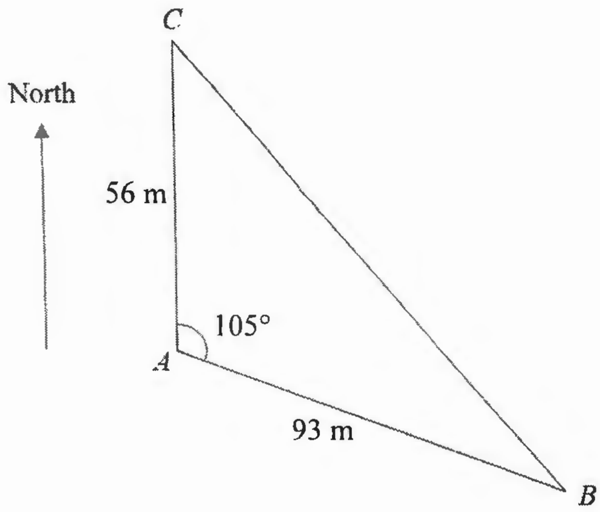
(ii) Calculate the average speed, in km/h, of the car for the whole journey.

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 $\angle BAC = 105°$. *A* is due south of *C*.

(i) Find *BC*.

Answer ……………………… m [2]

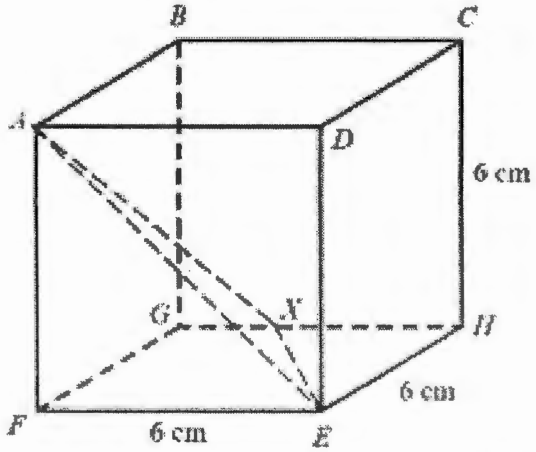
(ii) Find the bearing of *C* from *B*.

Answer ………………………° [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 $a =$ .... [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 $y > 1$.

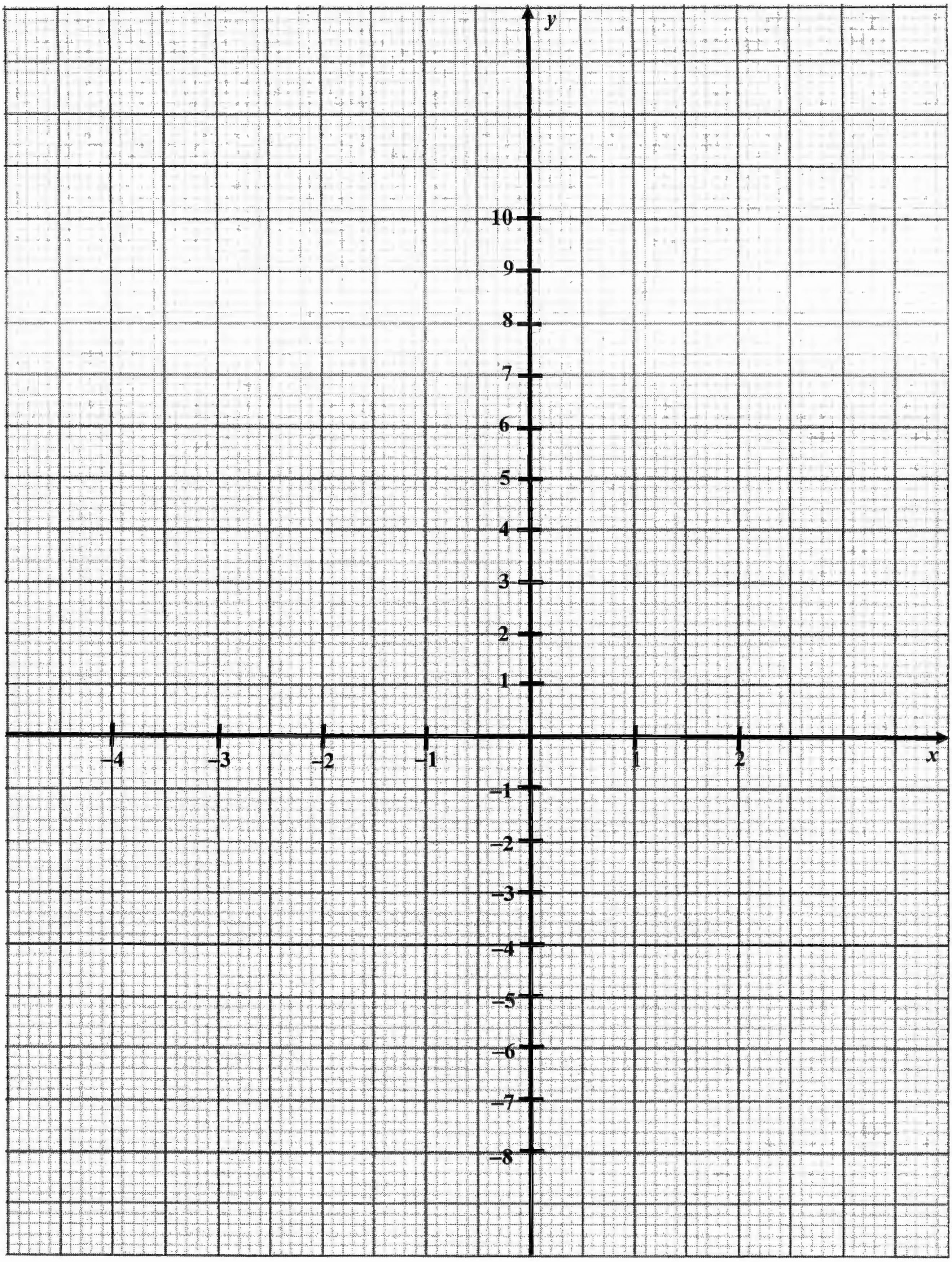
Answer ....

.... [2]

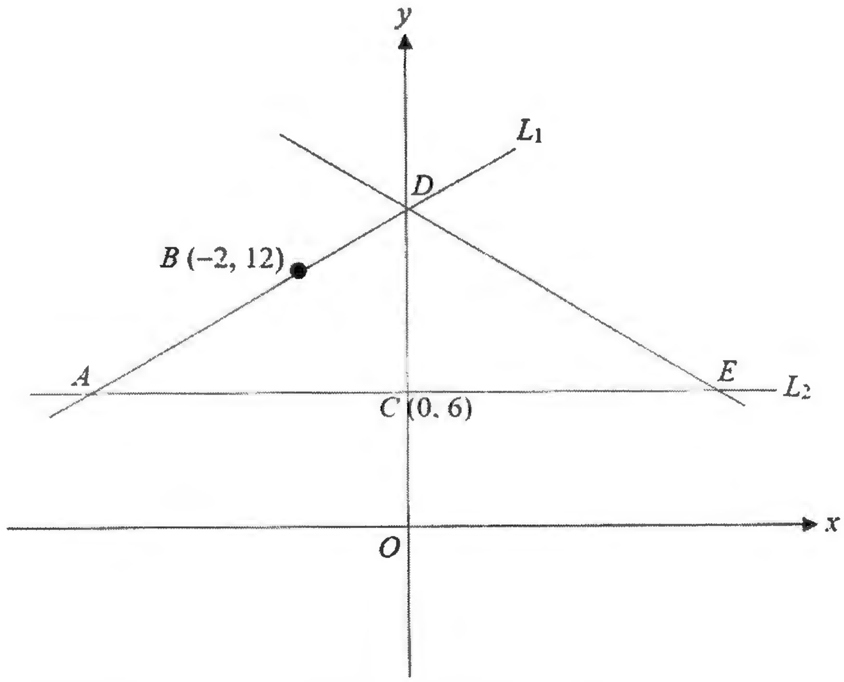
(d) **(i)** On the same axis, draw the line with gradient −2 that passes through the point (2, 1). [1]

(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 $x =$ .... [1]


y
10
9
8
7
6
5
4
3
2
1
−4
−3
−2
−1
1
2
x
−1
−2
−3
−4
−5
−6
−7
−8

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 = 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 mg = 10^{-3} 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 **4052/02**

Paper 2 **6 October 2023**

Setter: **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

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

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

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

$8+3x<10+\frac{7}{2}x$	and	$10+\frac{7}{2}x\leq 11.5-3x$	
$-\frac{1}{2}x<2$		$\frac{13}{2}x\leq 1.5$	
$x>-4$	[B1]	$x\leq\frac{3}{13}$	[B1 o.e.]

$\therefore\ -4<x\leq\frac{3}{13}$ [A1]

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 $\frac{9x}{10y}$.

$(3x-2y)^2=0$

$3x-2y=0$

$3x=2y$

$\frac{x}{y}=\frac{2}{3}$ [M1] ecf

$\frac{9x}{10y}=\frac{2}{3}\times\frac{9}{10}=\frac{3}{5}$ [A1]

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.

$$4143.5 = 3800\left(1+\frac{\frac{r}{4}}{100}\right)^{12} \qquad \text{[M1]}$$

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

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

Answer ....% [3]

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

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

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

When $x=-3$,

$(-3+p)(-3+1)=0$ or $2(-3)^2+q(-3)-3=0$ [M1]

$p=3$ $\qquad$ $q=5$

When $x=2$,

$(2+p)(2+1)=0$ or $2(2)^2+q(2)-3=0$ [M1]

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

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 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.

$\frac{60}{x}$ [B1]

Answer .... minutes [1]

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

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

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

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

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

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

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

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

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

[3]

[Turn over

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

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

$= 2.17863$ or -2.47863

$= 2.18$ or -2.48 (3sf) [A1]

Answer $x =$ .... or .... [2]

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

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

$= 24.2$ minutes (3sf) [B1]

Answer .... 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

Rate of pump A + pump B = 2.17863 + (2.17863 + 0.3)

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

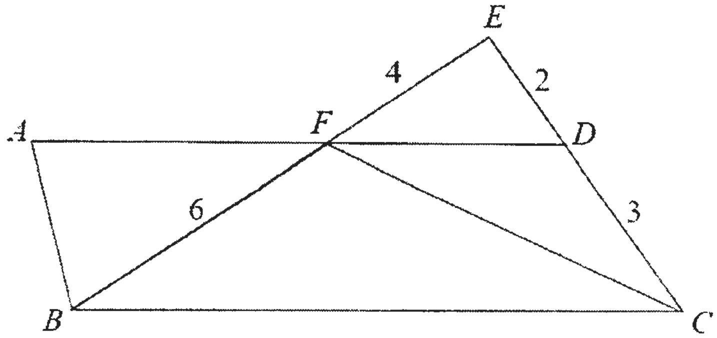
Time taken for both pumps to drain the pond $= \dfrac{60}{4.65726}$

$= 12.9$ min > 12 min [M1] 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]

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

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

$\angle BEC = \angle FED$ (common angle)

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

Triangle EBC is similar to triangle EF (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,

$\angle EDF = \angle ECB$ (or $\angle EFD = \angle EBC$) [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 $BCDF$.

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

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

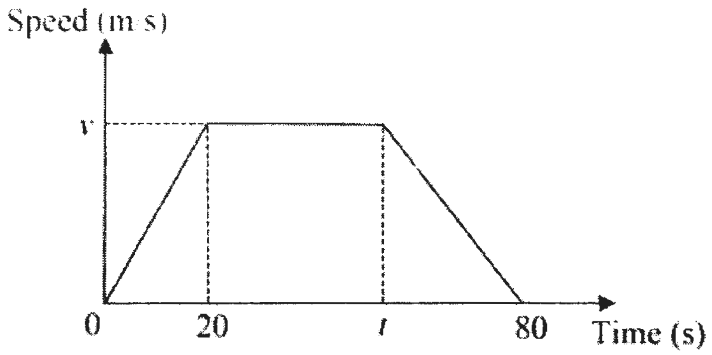
Area of quadrilateral $BCDF = 125 - 20$

$= 105$ cm^2 [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 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.

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

$v = 25$ m/s [B1]

Answer .... m/s [1]

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

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

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

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

Answer .... km/h [2]

(iii) Find the value of t.

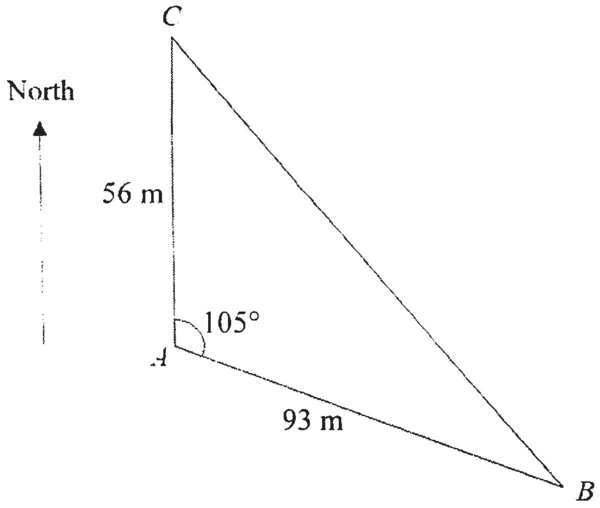
$$\frac{1}{2} \times \left[80 + (t - 20)\right] \times 25 = 1450 \quad \text{[M1] ecf}$$

$$60 + t = 116$$

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

Answer $t =$ .... [2]

4 **(a)**



ABC is a triangular plot of land.

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

(i) Find BC.

$BC^2 = 56^2 + 93^2 - 2(56)(93)\cos 105°$ [M1]

$BC = 120.336$

$= 120$ m [A1]

Answer .... m [2]

(ii) Find the bearing of C from B.

$\dfrac{\sin \angle ACB}{93} = \dfrac{\sin 105°}{120.336}$ [B1 or equivalent] ecf

$\angle ACB = 48.288°$

Bearing of C from B = 360° - 48.288°

= 311.7° [A1]

Answer ....° [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.

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

$\sin 48.288° = \dfrac{AX}{56}$ [B1 or equivalent] ecf

$AX = 41.8039$

Let the angle of elevation be θ.

$\tan\theta = \dfrac{25}{41.8039}$ [B1 or equivalent] ecf

$\theta = 30.9°$ [A1]

Alternate solution

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

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

$AX = 41.8041$

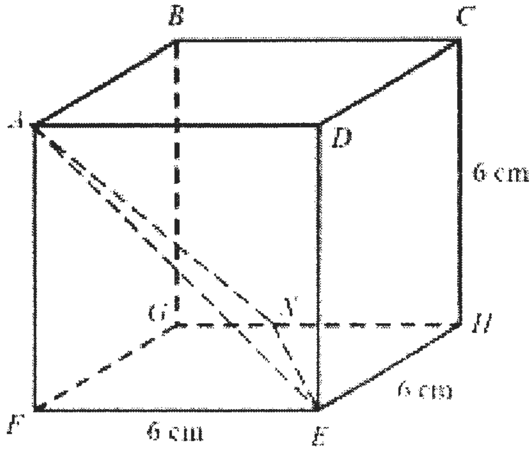
Let the angle of elevation be θ.

$\tan\theta = \dfrac{25}{41.8041}$ [B1 or equivalent] ecf

$\theta = 30.9°$ [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*.

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

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

Answer .... cm [2]

(ii) Find $\angle AXE$.

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

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

$AX = \sqrt{6^2 + \left(\sqrt{38.25}\right)^2}$

$= \sqrt{74.25}$ or 8.6168 [M1]

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

$\angle AXE = 63.1°$ (1dp) [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]

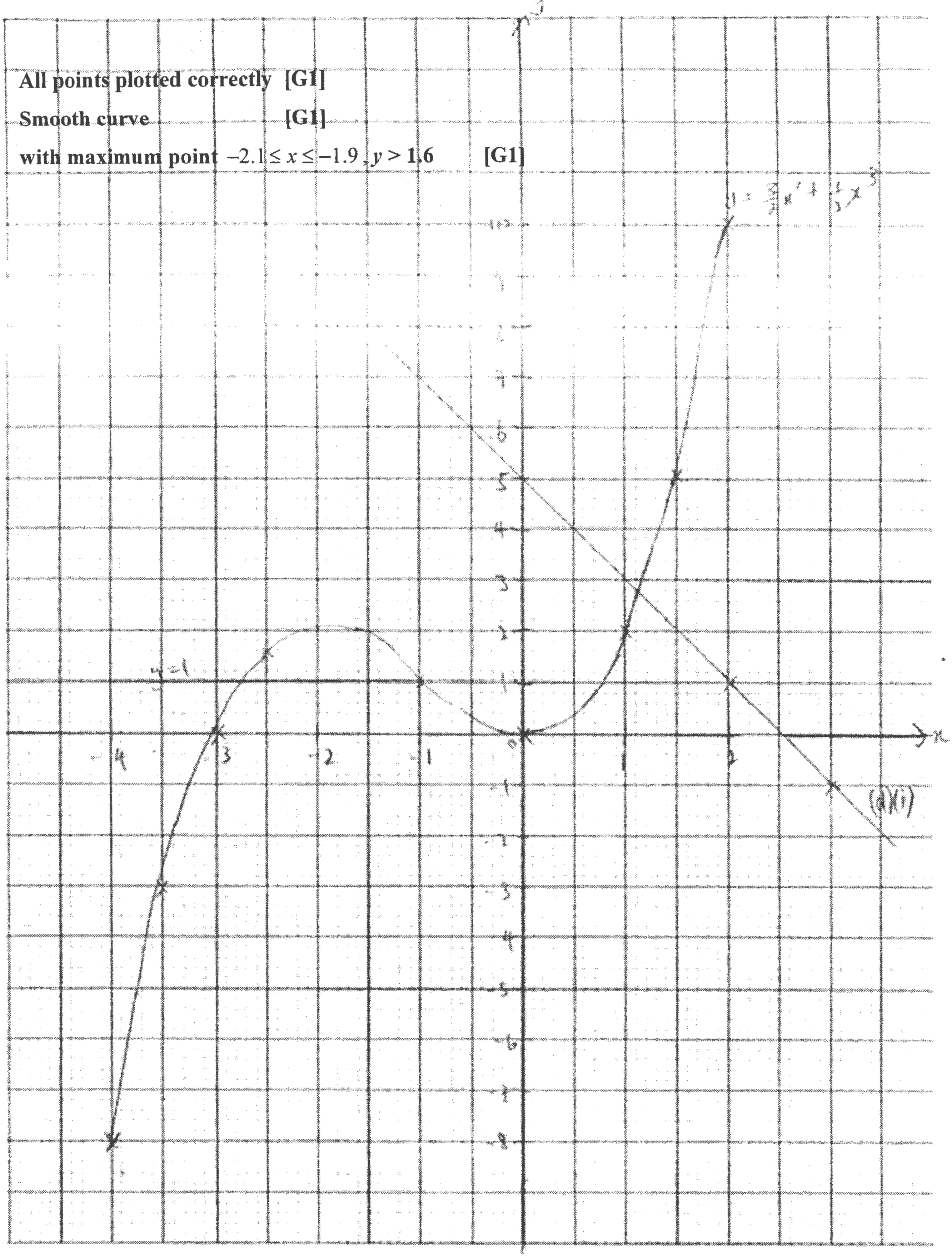
(d) **(i)** On the same axis, draw the line with gradient −2 that passes through the point (2, 1).

[1]

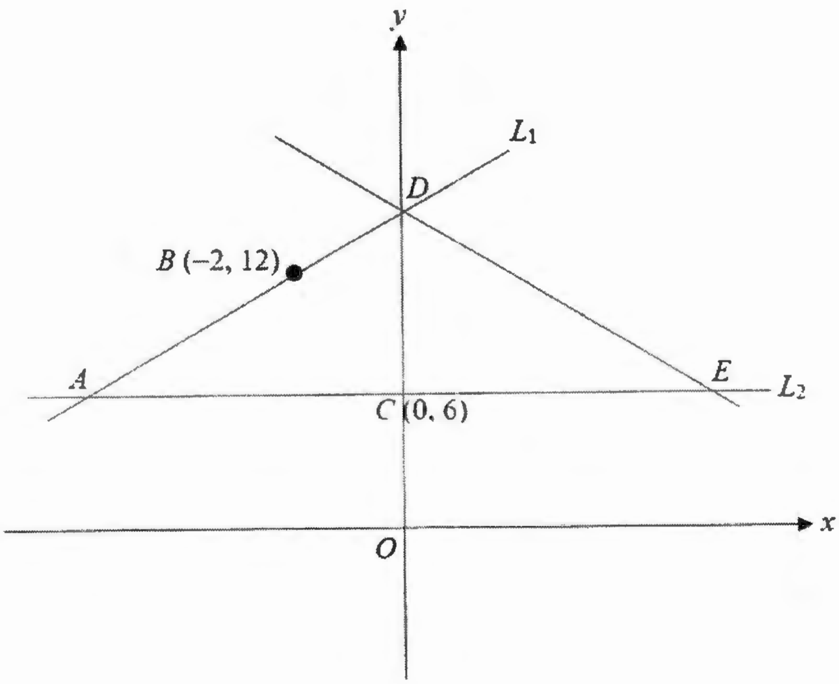
(ii) Write down the x-coordinate of the point of intersection of the line from **d(i)** and the graph of $y = \frac{3}{2}x^2 + \frac{1}{2}x^3$.

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

Answer $x =$ .... [1]


All points plotted correctly [G1]
Smooth curve [G1]
with maximum point $-2.1 \le x \le -1.9$, $y > 1.6$ [G1]
y=1
(a)(i)

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.

$y = 2x + c$, $B(-2, 12)$

$12 = 2(-2) + c$

$c = 16$ $\quad \therefore \; y = 2x + 16$ $\quad$ [B1]

Answer .... [1]

(iii) Find the coordinates of point A.

Substitute $y = 6$ into

$6 = 2x + 16$

$x = -5$

Answer .... (−5, 6) [B1] .... [1]

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

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

Answer .... [2]

(v) It is given that angle ADC = angle EDC. Write down the equation of the line DE.

$m_{DE} = -2$ [B1]

$\therefore\ y = -2x + 16$ [B1] ecf from **(ii)**

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

Substitute the point $B(-2, 12)$ into the line $2y + x = 3$,

LHS = $2(12) + (-2)$

$= 22 \neq$ RHS

Since point B does not satisfy the equation $2y + x = 3$, [M1]

it does not lie on the line $2y + x = 3$. Jane is not correct. [A1]

(Must show comparison of their values with (–2, 12))

[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 mg = 10^{-3} g).

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

<u>Maximum daily dosage based on 11.5 kg child</u>

1 kg ----- 40 mg

11.5 kg ----- 40 × 11.5

= 460 mg of ibuprofen [M1 or equivalent]

<u>Dosage administered to child in a day</u>

In one 6-hour, dosage is

5 ml ----- 100 mg

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

= 120 mg of ibuprofen [M1 or equivalent]

In a day, dosage = 120 mg × 4

= 480 mg of ibuprofen [M1 or equivalent]

Since 480 mg > 460 mg, the child was given an overdose.

[A1 for reason with conclusion]

[4]

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]