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Name	Register Number	Class
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MACPHERSON SECONDARY SCHOOL

MATHEMATICS

Paper 1

4016/01

October 2012

2 hours

END-OF-YEAR EXAMINATION

SECONDARY THREE EXPRESS

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.

Write your name, register number and class on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

Show all your workings on the same page as the rest of the answer.

Omission of essential working will result in loss of marks.

The total marks for this paper is 80.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

For Examiner's Use	
Total	80

Mathematical Formulae

Compound Interest

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

Mensuration

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

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

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

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

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

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

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

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) Express 3960 as a product of its prime factors, giving your answer in index notation.
- (b) Find the smallest positive integer k for which $3960k$ is a perfect square.

Answers: (a) [2]

(b) $k =$ [1]

-
- 2 Given that $-2 \leq x \leq 3$ and $4 \leq y \leq 8$, find
- (a) the greatest possible value of $y^2 - x^2$,
- (b) the least possible value of $\frac{x}{y}$.

Answers: (a) [2]

(b) [2]

- 3 At 1300 on a particular day, the temperatures in Singapore, Japan and London were 33°C , 12°C and -3°C respectively. If the temperature in Sydney was exactly mid-way between the temperatures in Singapore and London, find the difference in temperatures between Sydney and Japan on that particular day.

Answer: $^{\circ}\text{C}$ [2]

- 4 The diameter of a spherical micro-organism is 457 picometres. Calculate the total surface area of this micro-organism in mm^2 and give your answer in standard form.

Answer: mm^2 [3]

- 5 Simplify the following, leaving your answers in positive index form:

(a) $\frac{x^4 y^{\frac{3}{5}}}{6x} \times \frac{12x^{-3}}{y^{\frac{7}{5}}}$

(b) $\sqrt{\frac{25x^{-2}}{81y^8}}$

Answers: (a) [2]

(b) [3]

-
- 6 Evaluate the following without the use of a calculator:

(a) $\left(\frac{1}{27}\right)^{\frac{1}{3}} \times \left(\frac{1}{3}\right)^0 \div 3^2$

(b) $\sqrt[5]{10^4 \div 10^9}$

Answers: (a) [2]

(b) [2]

7 On the axes in the answer space below, sketch the graphs of:

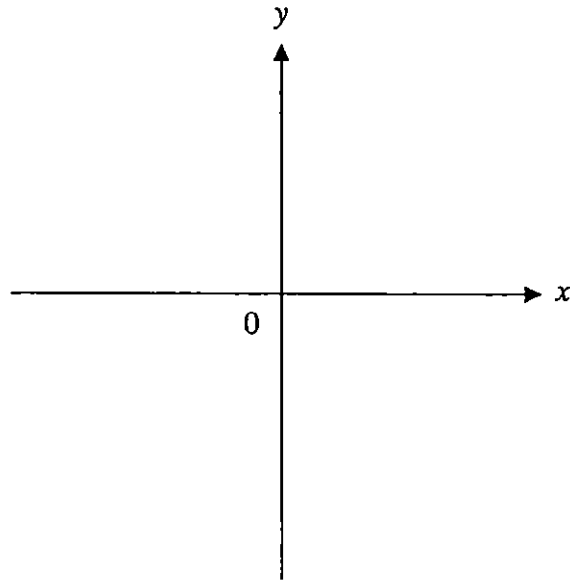
(a) $y = \frac{2}{x}$

(b) $y = 3^x$

Answers:

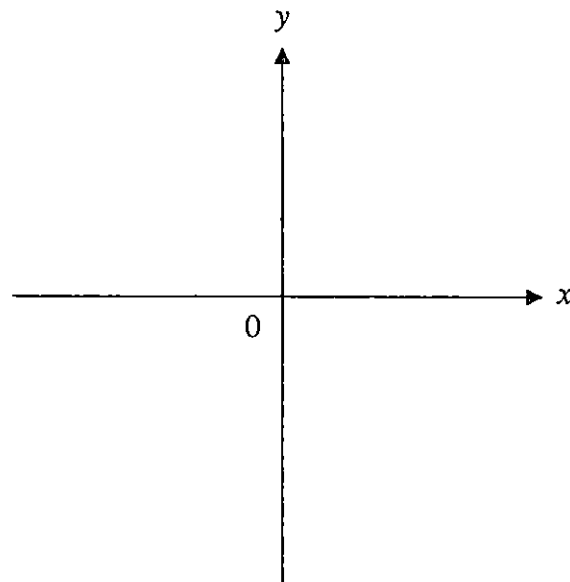
(a)

[1]



(b)

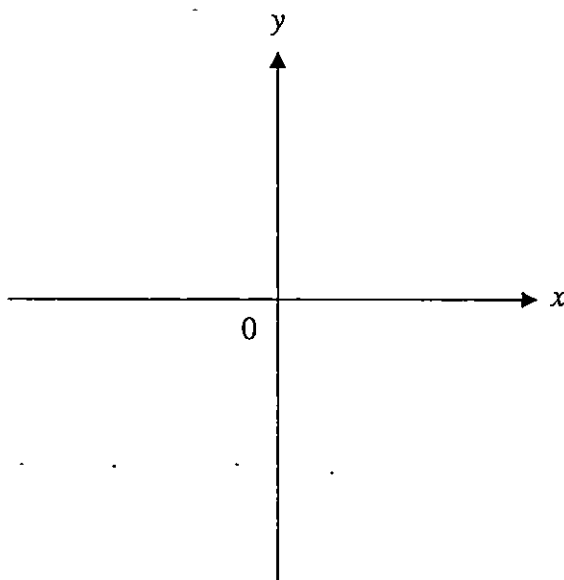
[1]



- 8 Sketch the graph of $y = (x + 1)(x - 2)$, showing clearly the turning point, x - and y -intercepts.

Answer.

[3]



- 9 Solve the equation $2x^2 - 4x - 7 = 0$, giving your answers correct to 3 significant figures.

Answer: [3]

10 Solve the following equations:

(a) $-3x^2 + 11x + 4 = 0$

(b) $\frac{x}{2} - \frac{5}{x+2} = \frac{1}{2}$

Answers: (a) [2]

(b) [3]

11 Make a the subject of the formula $s = ut + \frac{1}{2}at^2$.

Answer: [3]

12 Simplify $\frac{6}{3x-5} - \frac{4}{3x^2-8x+5}$.

Answer: [3]

13 Factorise the following:

(a) $x^2 - 10x + 25$

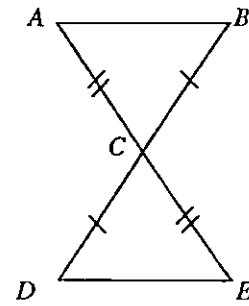
(b) $16x^2 - 81y^2$

Answers: (a) [1]

(b) [1]

[Turn over

- 14 In the figure, lines AE and BD intersect each other at point C .
- (a) Prove that $\triangle ABC$ is congruent to $\triangle EDC$.
- (b) State the angle that is equal to $\angle CDE$.



Answers:

- (a) In $\triangle ABC$ and $\triangle EDC$,

[3]

.....

.....

.....

.....

- (b)

[1]

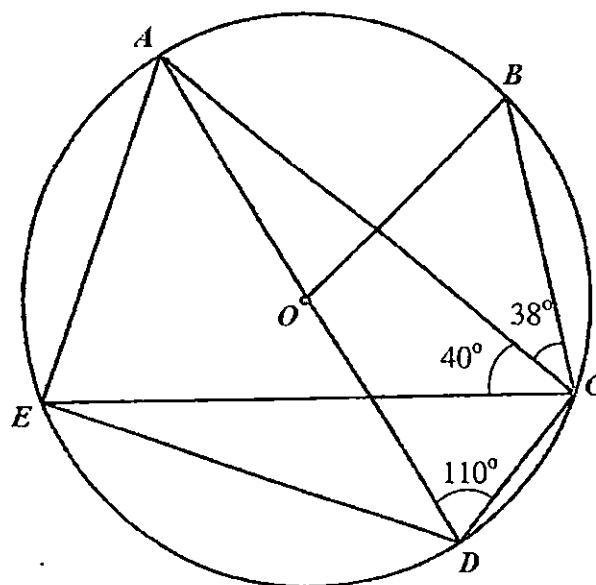
- 15 In the year 2011, Lucas' salary was 10% more than his salary in 2010. In 2012, his salary was 15% more than that in 2011. Calculate the total percentage increase in his salary from 2010 to 2012.

Answer: [2]

[Turn over

- 16 In the diagram, points A, B, C, D and E lie on the circumference of a circle with centre O . It is given that $\angle ACB = 38^\circ$, $\angle ACE = 40^\circ$, $\angle EDC = 110^\circ$ and AD is the diameter of the circle.

- (a) Find
 (i) $\angle ADC$,
 (ii) $\angle CAD$.
 (b) Explain why $\angle AOB = 76^\circ$.
 (c) Find the reflex angle AOB .



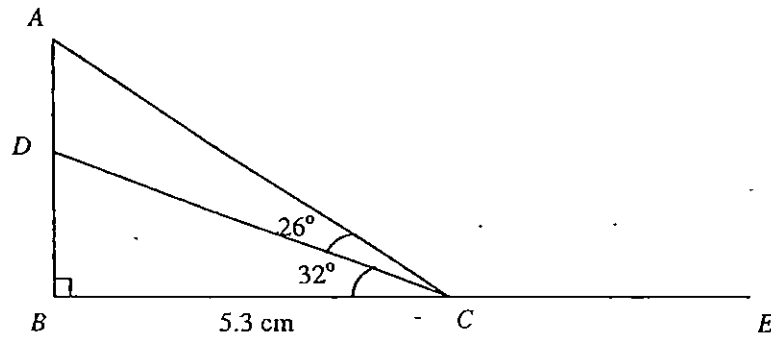
Answers: (ai) $\angle ADC = \dots\dots\dots$ [2]

(aii) $\angle CAD = \dots\dots\dots$ [2]

(b) answer shown above [2]

(c) reflex $\angle AOB = \dots\dots\dots$ [2]

- 17 In the diagram, $BC = 5.3$ cm, $\angle ABC = 90^\circ$, $\angle BCD = 32^\circ$ and $\angle ACD = 26^\circ$.



Find

- (a) the length of BD ,
- (b) the length of AC ,
- (c) the value of $\cos \angle ACE$.

Answers: (a)cm [2]

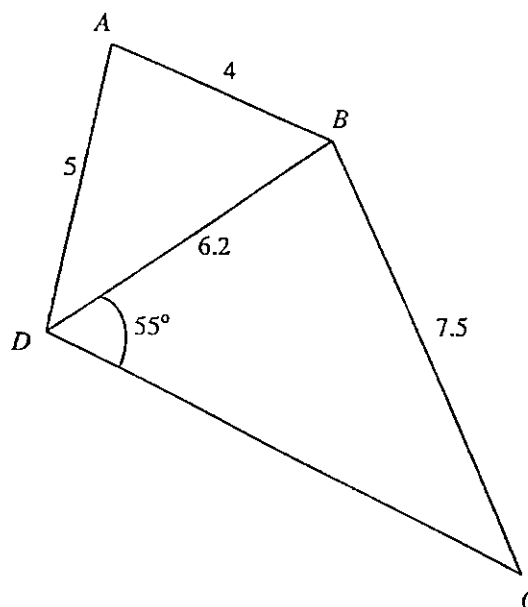
(b)cm [2]

(c) [1]

- 18 In the diagram, $AB = 4$ cm, $BC = 7.5$ cm, $AD = 5$ cm, $BD = 6.2$ cm and $\angle BDC = 55^\circ$.

Calculate

- (a) $\angle ADB$,
 (b) $\angle BCD$,
 (c) the area of $ABCD$.

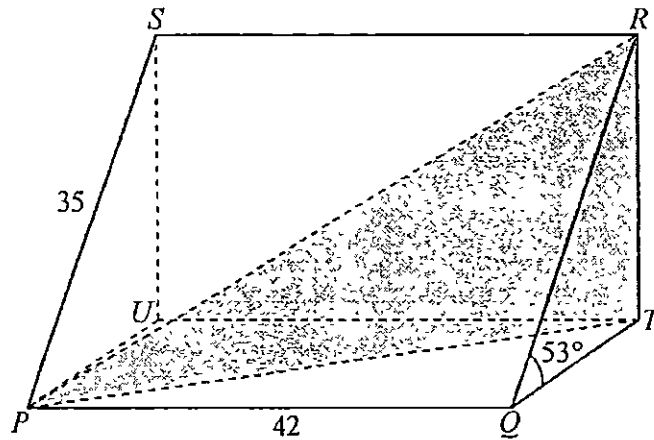


Answers: (a) $\angle ADB = \dots\dots\dots$ [3]

(b) $\angle BCD = \dots\dots\dots$ [2]

(c) $\dots\dots\dots \text{cm}^2$ [3]

- 19 In the diagram, $PQRS$ is a rectangular sloping surface, $PQTU$ is a rectangle on horizontal ground, and RT and SU are vertical lines. It is given that $PQ = SR = UT = 42$ cm, $PS = QR = 35$ cm and $\angle RQT = 53^\circ$. Calculate
- the length of PR ,
 - the length of RT .



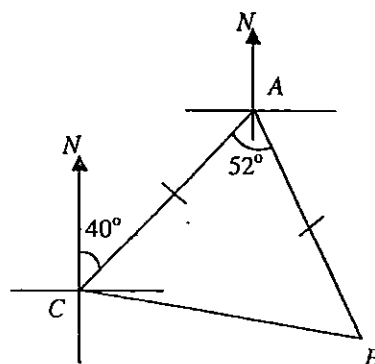
Answers: (a)cm [2]

(b)cm [2]

- 20 In the diagram, the points A , B and C form an isosceles triangle, $\angle BAC = 52^\circ$ and the bearing of A from C is 040° .

Find

- (a) the bearing of B from C ,
(b) the bearing of B from A .



Answers: (a) [2]

(b) [2]

- 21 The equation of line L_1 is $6x - 2y = 7$. Line L_2 passes through the point $(1, -3)$ and has the same gradient as line L_1 . Find the equation of line L_2 .

Answer: [3]

1a $2^3 \times 3^2 \times 5 \times 11$
 1b 110

2a 64
 2b $-\frac{1}{2}$

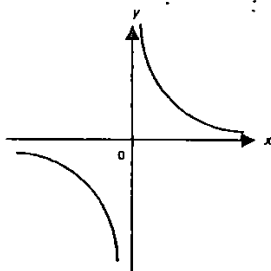
3 3°C

4 $6.56 \times 10^{-13} \text{ mm}^2$

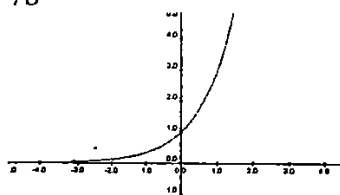
5a $2y^2$
 5b $\frac{5}{9xy^4}$

6a $\frac{1}{3}$
 6b $\frac{1}{10}$

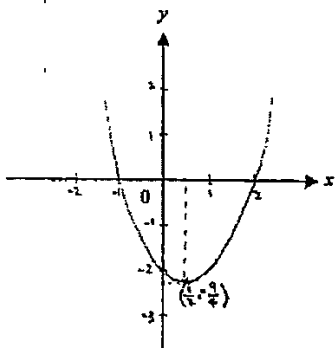
7a



7b



8



9 $x = 3.12$ or $x = -1.12$

10a $x = -\frac{1}{3}$ or $x = 4$

10b $x = -4$ or $x = 3$

11 $a = \frac{2(s-ut)}{t^2}$

12 $\frac{2}{x-1}$

13a $(x-5)^2$

13b $(4x+9y)(4x-9y)$

14a SAS

14b $\angle CBA$

15 26.5%

16ai 70°

16aii 20°

16c 284°

17a 3.31 cm

17b 10.0 cm

17c -0.530

18a 40.1°

18b 42.6°

18c 33.0 cm^2

19a 54.7 cm

19b 28.0 cm

20a 104°

20b 168°

21 $y = 3x - 6$

Name	Register Number	Class
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MACPHERSON SECONDARY SCHOOL

MATHEMATICS

Paper 2

4016/02

October 2012

2 hours 30 minutes

END-OF-YEAR EXAMINATION

SECONDARY THREE EXPRESS

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.

Write your name, register number and class on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

Show all your workings on the same page as the rest of the answer.

Omission of essential working will result in loss of marks.

The total marks for this paper is 100.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

For Examiner's Use	
Total	100

Mathematical Formulae*Compound Interest*

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

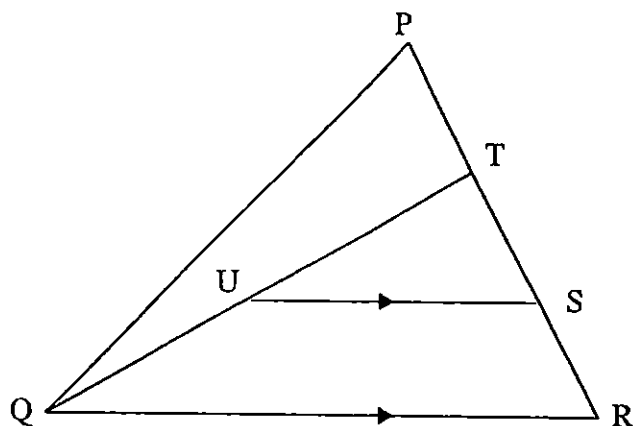
$$\text{Mean} = \frac{\sum fx}{\sum f}$$

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

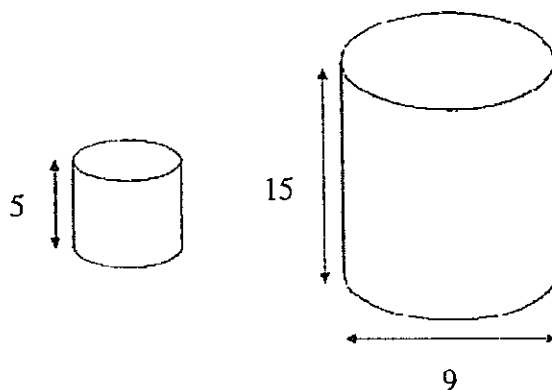
- 1
- (a) Express k as the subject of the formula $r = \frac{k^2 + s^2}{s}$. [2]
- (b) Express $\frac{5}{x-2} - \frac{4}{3x+1}$ as a single fraction in the simplest form. [2]
- (c) Simplify $\frac{x^2 + 4x + 3}{2x^2 + 7x + 5}$. [3]

- 2
- (a) During the Great Singapore Sale, the prices of Triton and Dadar thumb drives were offered at a 20% discount.
- (i) Calculate the price of a Triton thumb drive if its original price was \$42. [1]
- (ii) Calculate the original price of a Dadar thumb drive if it costs \$18 during the sale. [1]
- (b) A Triton thumb drive can be assembled and packaged every x minutes.
- (i) Write down, in terms of x , an expression for the number of Triton thumb drives that can be assembled and packaged in an hour. [1]
- (ii) If it takes two minutes less to assemble and package a Dadar thumb drive, write down, in terms of x , for the number of Dadar thumb drives that can be assembled and packaged in an hour. [1]
- (iii) A total of 11 thumb drives can be assembled and packaged in an hour. Form an equation in x and show that it reduces to $11x^2 - 142x + 120 = 0$. [3]
- (iv) Solve the equation and find the number of Dadar thumb drives that can be assembled and packaged in an hour. [3]

- 3 In the diagram, QUT and $PTSR$ are straight lines and $QR \parallel US$:
- (a) Show that $\triangle QRT$ and $\triangle UST$ are similar. [3]
- (b) Given that $QR = 10$ cm, $RT = 12$ cm, $PT = 4$ cm and $US = 5$ cm, calculate
- (i) the length SR , [2]
- (ii) the ratio of the area of $\triangle UST$: area of $\triangle QRT$, [2]
- (iii) the ratio of the area of $\triangle PQT$: area of $\triangle UST$. [2]



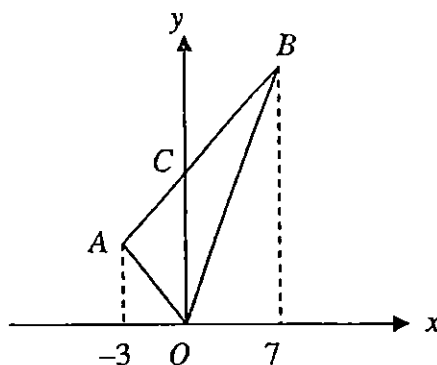
- 4 Howard's Storage sells two types of similar pots for plants. The height of the smaller pot is 5 cm and the height of the bigger pot is 15 cm. The diameter of the bigger pot is 9 cm.



- (a) Find the diameter of the base of the smaller pot. [2]
 (b) Find the ratio of the surface area of the smaller pot to the bigger pot. [2]
 (c) If both pots are completely filled with sand and the smaller pot holds 2.4 kg of sand, find the mass of sand that the bigger pot can hold. [2]

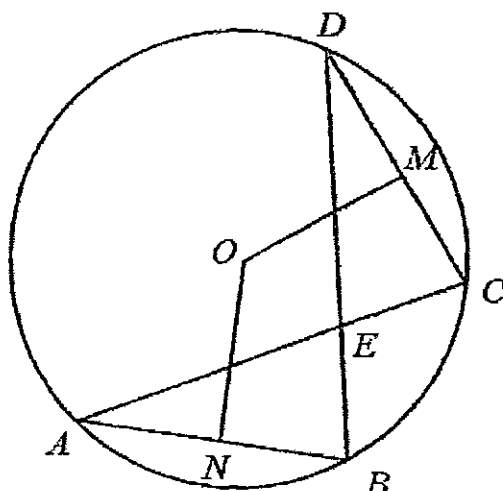
- 5 In the diagram, AB is a straight line. The x -coordinates of A and B are -3 and 7 respectively. Given that O is the origin, $OA = 5$ units, $OB = 25$ units and $OC = 10$ units, find

- (a) the y -coordinates of A and B , [2]
 (b) the coordinates of C , [1]
 (c) the equation of AB , [2]
 (d) the area of triangle AOB . [2]

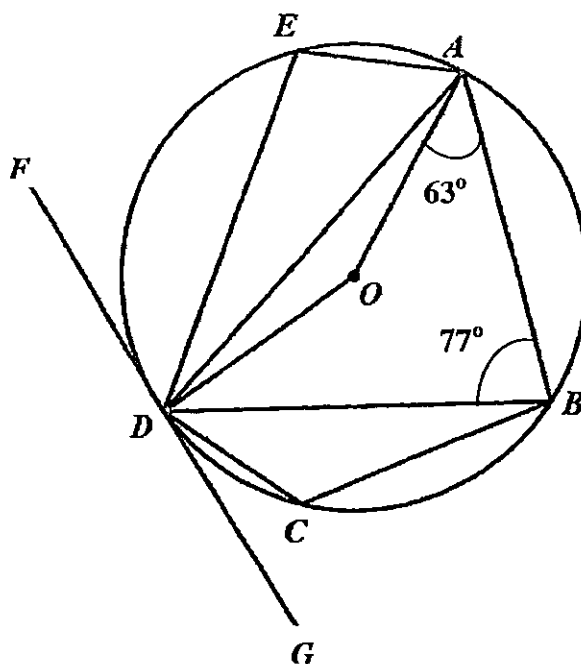


- 6 (a) Given that $2x^2 + 2y^2 = 14$ and $(x + y)^2 = 15$, find the value of
 (i) $3x^2 + 3y^2$, [2]
 (ii) $7xy$. [2]
- (b) Given that $\frac{x+3y}{y-2x} = -\frac{2}{3}$, find the value of $\frac{x}{y}$. [2]

- 7 (a) The points A, B, C and D lie on a circle, centre O . It is given that N and M are midpoints of AB and CD respectively, and that $ON = OM$.



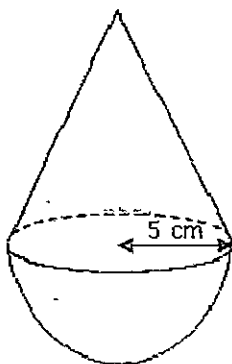
- (i) Show that $\triangle ABE$ and $\triangle DCE$ are congruent. [3]
 (ii) If $AB = 10$ cm and $ON = (r - 1)$ cm, where r is the radius of the circle, find the value of r . [3]
- (b) The points A, B, C, D and E lie on a circle, centre O . FG is a tangent to the circle at D . It is given that $\angle ABD = 77^\circ$ and $\angle BAO = 63^\circ$.



Stating your reasons clearly, find

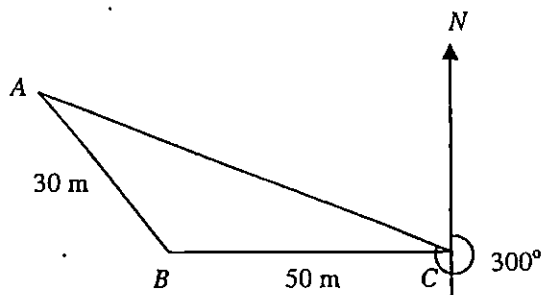
- (i) $\angle AED$, [2]
 (ii) $\angle AOD$, [2]
 (iii) $\angle ODB$, [3]
 (iv) reflex $\angle ADG$. [2]

- 8 A paper weight is formed by joining the plane face of a hemisphere of radius 5 cm to the base of a solid cone of radius 5 cm, as shown in the diagram.



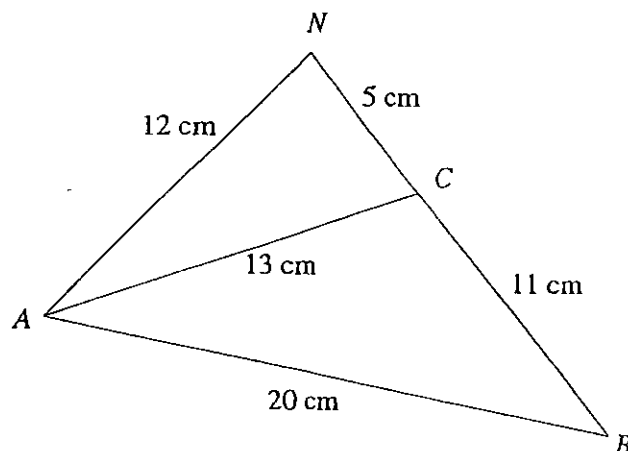
- (a) Find the volume of the hemisphere. [2]
- (b) Given that the volume of the cone is 720 cm^3 , find its height. [2]
- (c) The hemisphere is made of a metal alloy which has a density of 4.3 grams per cubic centimetres. The cone is made of acrylic which has a density of 0.7 grams per cubic centimetres. Find the total mass of the toy. [3]
- (d) The solid cones of a number of such paper weights are formed by melting a solid cylinder of the alloy, of radius 6 cm and length 30 cm. Find the number of cones that can be made from the cylinder. [2]

- 9 In the diagram, A , B and C are three points on level ground. C is due east of B and the bearing of A from C is 300° . The distance between A and B is 30 m and the distance between B and C is 50 m.



- (a) Calculate
 - (i) $\angle BAC$, [3]
 - (ii) the bearing of A from B , [2]
 - (iii) the area of the land enclosed by $\triangle ABC$. [2]
- (b) A tree is located at B . The angle of elevation of the top of the tree from A is 23° .
 - (i) Calculate the height of the tree. [2]
 - (ii) As a man walked from A to C , he saw a bird standing in its nest at the top of the tree. Find the angle of elevation of the bird from the man when he is nearest to the tree. [3]

- 10 In the diagram, ABC is a triangle in which $AC = 13$ cm, $BC = 11$ cm and $AB = 20$ cm. N is a point on BC produced such that $CN = 5$ cm and $AN = 12$ cm.



- (a) Show that $\angle ANC = 90^\circ$. [2]
 (b) Expressing your answers as a fraction, state the values of
 (i) $\tan \angle ABN$, [1]
 (ii) $\sin \angle ACB$. [1]
 (c) Find the value of $\angle BAC$. [3]

- 11 Answer the whole of this question on a sheet of graph paper.

The variables x and y are related by the equation $y = 50 - x^2 - \frac{80}{x}$.

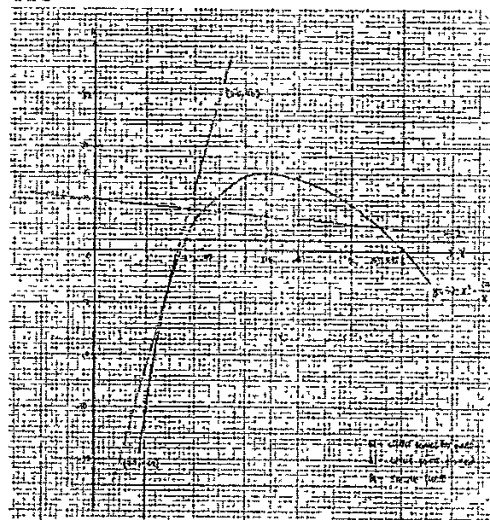
Some corresponding values of x and y , correct to 2 decimal places, are given in the table below.

x	1	1.5	2	3	4	5	6
y	-31.00	-5.58	6.00	14.33	14.00	9.00	p

- (a) Calculate the value of p . [1]
 (b) Using a scale of 2 cm to represent 1 unit on the x -axis and 2 cm to represent 10 units on the y -axis, plot the points given in the table and join them with a smooth curve. [3]
 (c) By drawing a tangent, find the gradient of the curve at $(1.5, -5.58)$. [2]
 (d) Use your graph to find the largest value of y and the value of x for which this occurs. [2]
 (e) Use your graph to find the values of x for which
 (i) $50 - x^2 - \frac{80}{x} = 2$ [2]
 (ii) $50 - x^2 - \frac{80}{x} = -x + 10$ [2]

- 1a $k = \pm\sqrt{rs - s^2}$
 1b $\frac{11x+13}{(x-2)(3x+1)}$
 1c $\frac{x+3}{2x+5}$
 2ai \$33.60
 2aii \$22.50
 2bi $\frac{60}{x}$
 2bii $\frac{60}{x-2}$
 2biv $x = 12$ or $x = 10/11$ (reject), 6
 3a AAA similarity
 3bi 6
 3bii 1 : 4.
 3biii 4 : 3
 4a 3 cm
 4b $\frac{1}{9}$
 4c 64.8 kg
 5a 24
 5b C (0, 10)
 5c $y = 2x + 10$
 5d 50 units²
 6ai 21
 6aii 28
 6b 11
 7ai AAS
 7aii 13 cm
 7bi 103°
 7bii 154°
 7biii 14°
 7biv 257°
 8a 262 cm³
 8b 27.5 cm
 8c 1630 g
 8d 4
 9ai 56.4°
 9aii 356.4°
 9aiii 749 m²

- 9bi 12.7 m
 9bii 27.0°
 10a converse of Pythagoras' theorem
 10bi $\frac{3}{4}$
 10bii $\frac{12}{13}$
 10c 30.5°
 11a 0.67
 11b



- 11c $22.5 \leq m \leq 37.5$
 11d maximum $y = 15$ at $x = 3.4$
 11ei $x = 1.8$ or $x = 5.85$
 11eii $x = 2.17$ or $x = 5.55$