

Thursday 28 February 2013 – Afternoon

GCSE MATHEMATICS B

J567/03 Paper 3 (Higher Tier)

Solutions

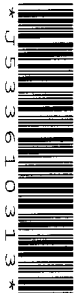
Candidates answer on the Question Paper.

OCR supplied materials:
None

Other materials required:

- Geometrical instruments
- Tracing paper (optional)

Duration: 1 hour 45 minutes



Candidate forename		Candidate surname	
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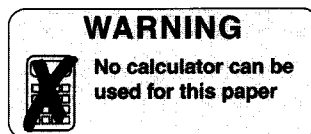
Centre number								Candidate number			
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INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Your answers should be supported with appropriate working. Marks may be given for a correct method even if the answer is incorrect.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

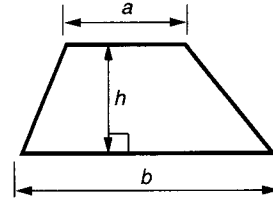
- The number of marks is given in brackets [] at the end of each question or part question.
- Your Quality of Written Communication is assessed in questions marked with an asterisk (*).
- The total number of marks for this paper is **100**.
- This document consists of **20** pages. Any blank pages are indicated.



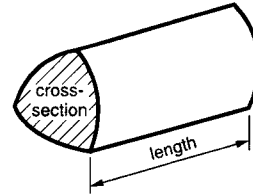
This paper has been pre modified for carrier language

Formulae Sheet: Higher Tier

Area of trapezium = $\frac{1}{2}(a + b)h$



Volume of prism = (area of cross-section) \times length

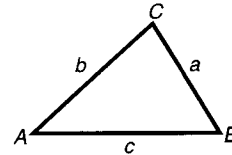


In any triangle *ABC*

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

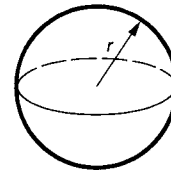
Cosine rule $a^2 = b^2 + c^2 - 2bc \cos A$

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



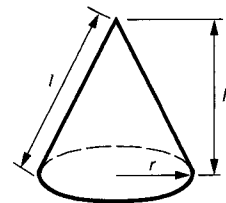
Volume of sphere = $\frac{4}{3} \pi r^3$

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



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

Curved surface area of cone = $\pi r l$



The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$,
where $a \neq 0$, are given by

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

PLEASE DO NOT WRITE ON THIS PAGE

- 1 One day 300 people visit a museum.
The ratio of adults to children is 2 : 3.

$$2 + 3 = 5 \text{ parts}$$

- (a) Work out the number of adults and the number of children.

$$5 \overline{)300} \\ \underline{60}$$

$$1 \text{ part} = 60$$

$$2 \text{ parts} = 60 \times 2 = 120$$

$$3 \text{ parts} = 60 \times 3 = 180$$

(a) Adults 120 Children 180 [2]

- (b) This two-way table summarises some information about the visitors to the museum.

- (i) Complete the table.

	Adults	Children	Total
Male	52	80	132
Female	68	100	168
Total	120	180	300

[1]

- (ii) One of the adults is chosen at random.

Find the probability that the adult is a male.

$$\frac{52}{120} \text{ or } \frac{13}{30}$$

(b)(ii) _____ [2]

- (iii) Find the ratio of male to female visitors.
Write the ratio in its simplest form.

$$132 : 168$$

$$66 : 84$$

$$33 : 42$$

$$11 : 14$$

(iii) 11 : 14 [2]

2 *Fresh Clean* and *Cleanup* are two home cleaning companies.

- (a) *Fresh Clean* charges £3.50 for each room they clean and an extra £15 call out charge. Write down a formula for the total charge, £ F , for cleaning a house with n rooms.

$$F = 3.5n + 15$$

(a) _____ [2]

- (b) *Cleanup* uses this formula to work out the total charge to clean a house.

$$C = 25h + 10$$

C is the total charge in £ for a clean taking h hours.

Pete's house has 8 rooms and will take $1\frac{1}{2}$ hours to clean.

Which of the two cleaning companies, *Fresh Clean* or *Cleanup*, will be cheaper and by how much?

$$\begin{aligned} \text{Cleanup} \quad & 25 \times 1.5 + 10 \\ & 37.5 + 10 = \pounds 47.50 \end{aligned}$$

$$\begin{aligned} \text{Fresh Clean} \quad & 3.5 \times 8 + 15 \\ & = 28 + 15 = \pounds 43 \end{aligned}$$

Fresh Clean cheaper by £4.50

(b) Fresh Clean by £ 4.50 [3]

3 (a) Multiply out.

$$a(3+a) = 3a + a^2$$

(a) 3a + a² [1]

(b) Factorise.

$$4b - 12 = 4(b - 3)$$

(b) 4(b - 3) [1]

(c) Rearrange this formula to make p the subject.

$$T = 4p + 5$$

$$T - 5 = 4p$$

$$\frac{T - 5}{4} = p$$

(c) $p = \frac{T - 5}{4}$ [2]

(d) Solve this inequality.

$$3x - 6 < x + 4$$

$$3x - x < 4 + 6$$

$$2x < 10$$

$$x < \frac{10}{2}$$

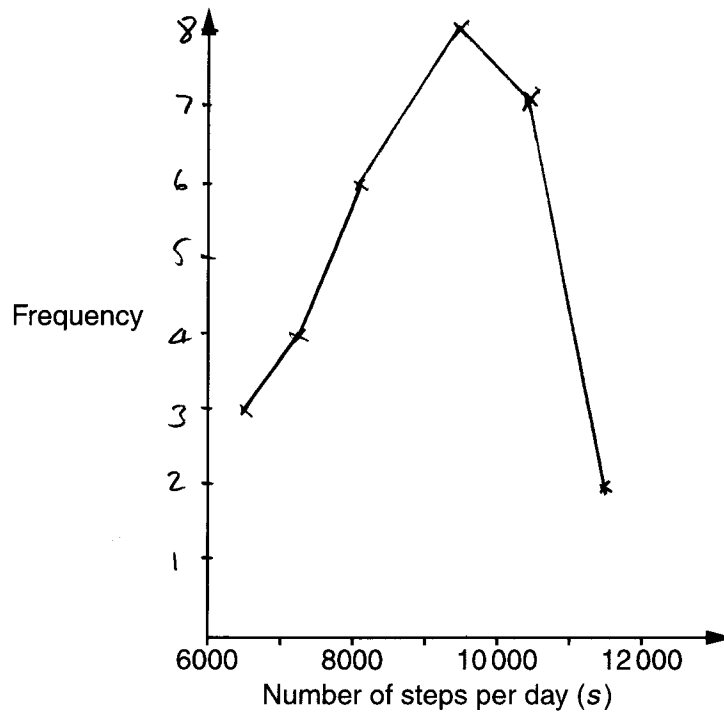
$$x < 5$$

(d) x < 5 [3]

- 4 Sofia uses a pedometer to record the number of steps she takes each day for one month. Her results are summarised in the table below.

Steps per day (s)	Frequency
$6000 \leq s < 7000$	3
$7000 \leq s < 8000$	4
$8000 \leq s < 9000$	6
$9000 \leq s < 10000$	8
$10000 \leq s < 11000$	7
$11000 \leq s < 12000$	2

- (a) Draw a frequency polygon to display this information.



[3]

- (b) Write down the modal class of the number of steps per day.

(b) 9000 ≤ s < 10000 [1]

- (c) Sofia reads that taking at least 10000 steps per day is an important part of a healthy lifestyle.

For what percentage of the month did she meet this target?

$$\frac{9}{30} \times 100 = 30$$

(c) 30 % [2]

- (d) One day Sofia goes for a walk in the hills.
The length of the walk is 7 km, correct to the nearest kilometre.

What is the longest possible length of Sofia's walk?

(d) 7.5 km [1]

- 5 Kate thinks of a number.
She multiplies it by 3 and then adds 3.
- Leo thinks of the same number as Kate.
He subtracts 5 and then multiplies the result by 6.
- Kate and Leo both end up with the same number.
- Find the numbers that they start and end with.

Let number be x

$$3x + 3 = 6(x - 5)$$

$$3x + 3 = 6x - 30$$

$$3 + 30 = 6x - 3x$$

$$33 = 3x$$

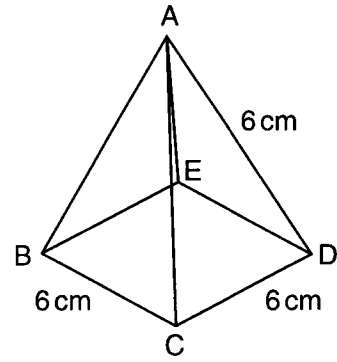
$$\frac{33}{3} = x$$

$$11 = x$$

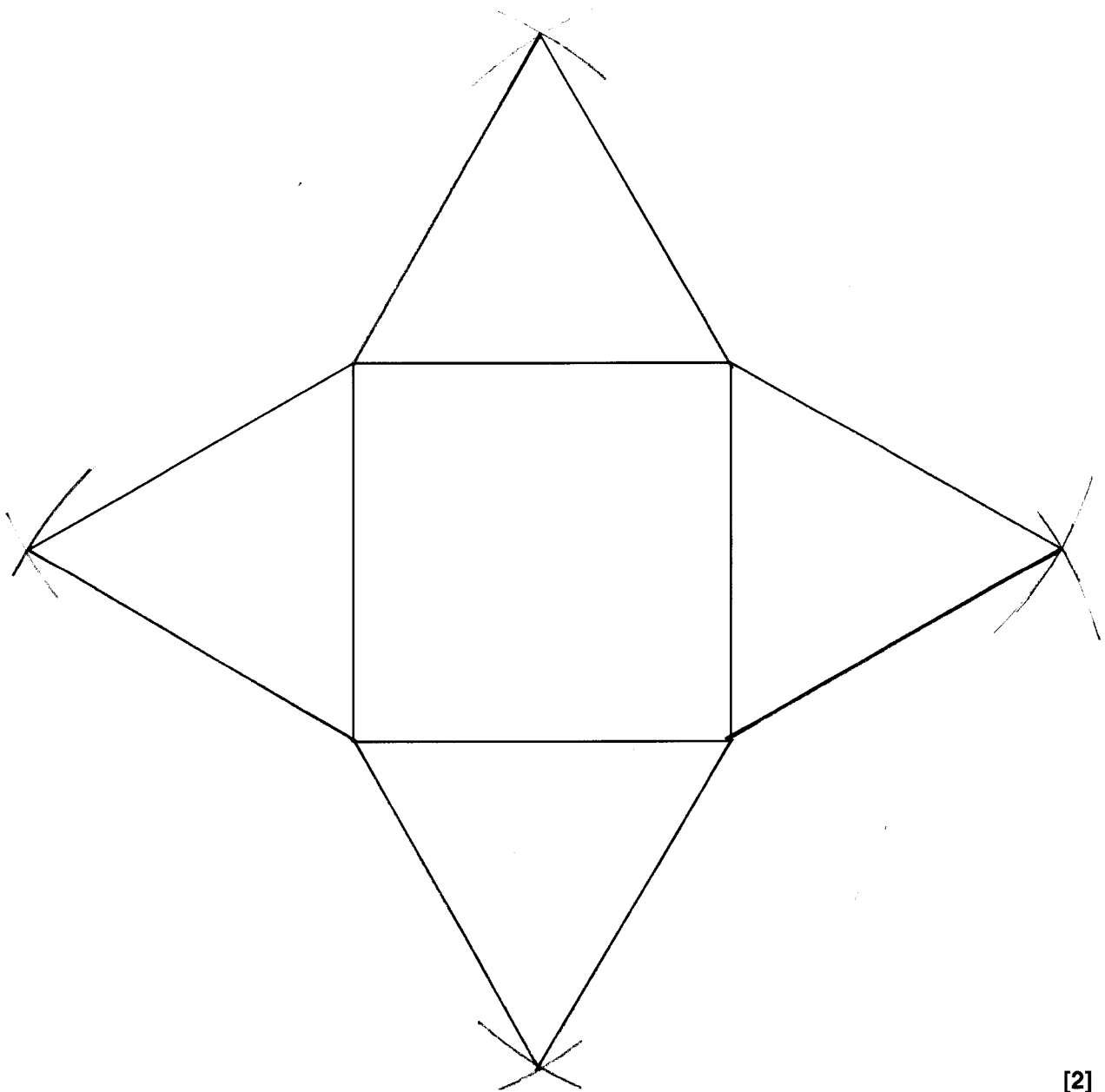
$$3(11) + 3 = 33 + 3 = 36$$

Start 11
End 36 [4]

- 6 ABCDE is a square-based pyramid.
The length of each edge is 6 cm.



- (a) Construct a full-size net of the pyramid.
The base is drawn for you.



[2]

- (b) Use measurements from your diagram to calculate the total surface area of the pyramid.

Height of Δ should be 5.2 cm (5 cm because of photocopying size reduction)

Area of 40s $4 \times \frac{1}{2} \times 6 \times 5.2$
 $= 62.4 \text{ cm}^2$

Base = $6 \times 6 = 36 \text{ cm}^2$

TOTAL SURFACE AREA = 98.4 cm^2

(b) 98.4 cm² [4]
 (Allow 96 – 100.8)

$$\begin{array}{r} 5.2 \\ \times 16 \\ \hline 31.2 \\ \times 2 \\ \hline 62.4 \end{array}$$

- 7 (a) The price of a printer is £64.50 excluding VAT.

Calculate the price of the printer including VAT at 20%.

$$\begin{array}{l} 10\% = \pounds 6.45 \\ 20\% = \pounds 12.90 \end{array}$$

$$\begin{array}{r} \pounds 64.50 \\ \pounds 12.90 + \\ \hline \pounds 77.40 \end{array}$$

(a) £ 77.40 [3]

- (b) The price of a season ticket is increased by 10% in January 2012 and then by another 10% in January 2013.

Calculate the overall percentage increase in the price of the season ticket.

$$\begin{array}{r} 1.1 \\ \times 1.1 \\ \hline 1.21 \end{array}$$

(b) 21 % [3]

- 8 (a) Find the size of the exterior angle of a regular 12-sided polygon.

$$360 \div 12 = 30$$

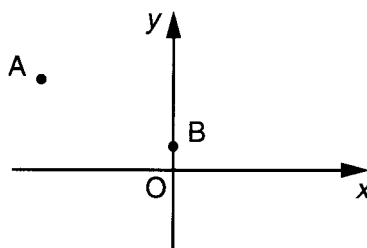
(a) 30 ° [2]

- (b) Hence find the size of the interior angle of a regular 12-sided polygon.

$$180 - 30 = 150$$

(b) 150 ° [1]

- 9 In the sketch below, A is the point (-10, 8) and B is the point (0, 3).



$$\left(\frac{-10+0}{2}, \frac{8+3}{2} \right) = \left(-5, \frac{11}{2} \right)$$

- (a) Find the coordinates of the midpoint of the line AB.

(a) (-5, 5.5) [2]

- (b) Find the equation of the line AB.

$$\text{Gradient } m = \frac{8-3}{-10-0} = \frac{5}{-10} = -\frac{1}{2}$$

$$y = mx + c \quad c \text{ is } y\text{-intercept} = 3$$

$$y = -\frac{1}{2}x + 3$$

(b) $y = -\frac{1}{2}x + 3$ [3]

10 (a) Work out.

$$2\frac{2}{5} \div 2\frac{1}{4}$$

Give your answer as a mixed number in its simplest form.

$$\begin{aligned} & \frac{12}{5} \div \frac{9}{4} \\ = & \frac{12}{5} \times \frac{4}{9} \\ = & \frac{4 \times 4}{5 \times 3} \\ = & \frac{16}{15} \\ = & 1\frac{1}{15} \end{aligned}$$

(a) $1\frac{1}{15}$ [3]

(b) Write down the reciprocal of 5.

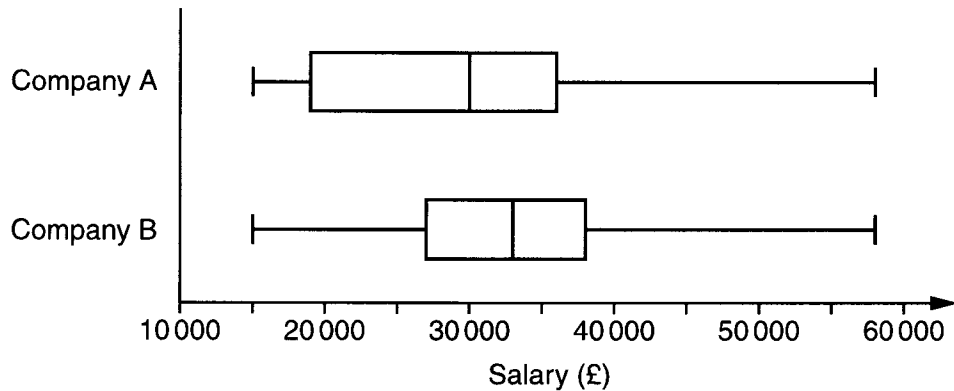
(b) $\frac{1}{5}$ [1]

(c) Write as a single power of 5.

$$5^6 \div 5^{-3} = 5^{6-(-3)} = 5^{6+3} = 5^9$$

(c) 5^9 [1]

11 These box plots represent data for the salaries of the employees working in two companies.



(a) Find the median for company A.

(a) £ 30,000 [1]

(b) Find the interquartile range for company B.

38000 - 27000

(b) £ 11,000 [2]

(c) Make two different comparisons between the salaries in the two companies.

1 On average A had higher salaries than B

2 A salaries were more spread out than those of B

[2]

- 12 State which calculation, in each of the following pairs, has an incorrect answer. Explain how you can tell without giving the correct answer.

(a)

$$\text{A } 300 \times 4000 = 12\,000$$

$$\text{B } 0.003 \times 0.04 = 0.00012$$

Calculation A has an incorrect answer
because not enough zeros, should have 5 zeros [1]

(b)

$$\text{C } 6497 \times 1.08 = 7016.76$$

$$\text{D } 5684 \div 0.96 = 5456.64$$

Calculation D has an incorrect answer
because dividing by number less than 1 should increase original [1]

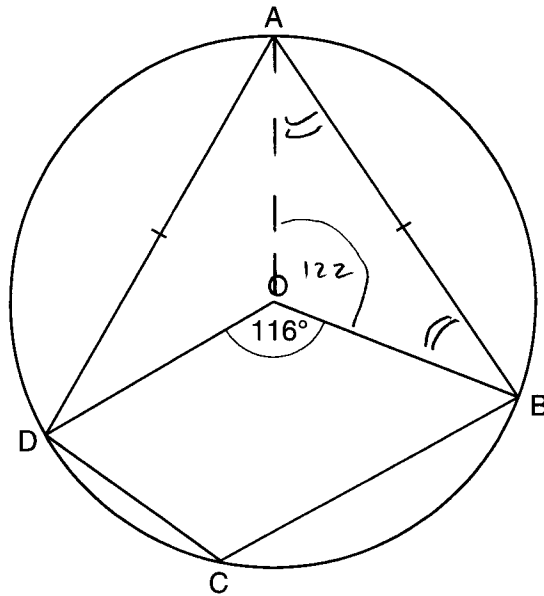
(c)

$$\text{E } 5.8 \times 10^{-3} \times 1.2 \times 10^{-2} = 6.96 \times 10^{-5}$$

$$\text{F } 4.6 \times 10^8 \div 3.7 \times 10^2 = 1.24 \times 10^4$$

Calculation F has an incorrect answer
because power of 10 should be 6 [1]

- 13 In the diagram, A, B, C and D are points on the circle centre O.
 $AB = AD$ and angle $BOD = 116^\circ$.



Not to scale

Calculate

- (a) angle BAD,

(a) 58° ° [1]

- (b) angle BCD,

$$180 - 58 = 122$$

(b) 122° ° [1]

- (c) angle ABO.

$$360 - 116 = 244$$

$$\angle AOB = \frac{244}{2} = 122$$

$$180 - 122 = 58$$

(c) 29° ° [2]

$$\text{Isos } \Delta \quad \frac{58}{2} = 29$$

14 (a) Solve algebraically these simultaneous equations.

$$6x + 2y = 5 \quad (1)$$

$$4x - 5y = 16 \quad (2)$$

$$(1) \times 5 \quad 30x + 10y = 25 \quad (3)$$

$$(2) \times 2 \quad 8x - 10y = 32 \quad (4)$$

$$(3) + (4) \quad 38x = 57$$

$$x = \frac{57}{38} = \frac{3}{2} \quad (\text{cancel by 19})$$

$$\text{Sub in (1)} \quad 6\left(\frac{3}{2}\right) + 2y = 5$$

$$9 + 2y = 5$$

$$2y = 5 - 9$$

$$2y = -4$$

$$y = -\frac{4}{2} = -2$$

$$(a) \quad x = \underline{\underline{\frac{1}{2}}} \\ y = \underline{\underline{-2}} \quad [4]$$

(b) Factorise and solve.

$$6x^2 + 11x - 10 = 0$$

$$6x - 10 \\ -60$$

$$+1 - 60 \\ -1 + 60$$

$$+2 - 30 \\ -2 + 30$$

$$+3 - 20$$

$$-3 + 20$$

$$+4 - 15$$

$$-4 + 15 \checkmark$$

$$6x^2 - 4x + 15x - 10 = 0$$

$$2x(3x - 2) + 5(3x - 2) = 0$$

$$(2x + 5)(3x - 2) = 0$$

$$\text{Either } 2x + 5 = 0$$

$$2x = -5$$

$$x = -\frac{5}{2}$$

$$\text{or } 3x - 2 = 0 \\ 3x = 2 \\ x = \frac{2}{3}$$

$$(b) \quad x = \underline{\underline{-\frac{5}{2}}} \quad \text{and } x = \underline{\underline{\frac{2}{3}}} \quad [3]$$

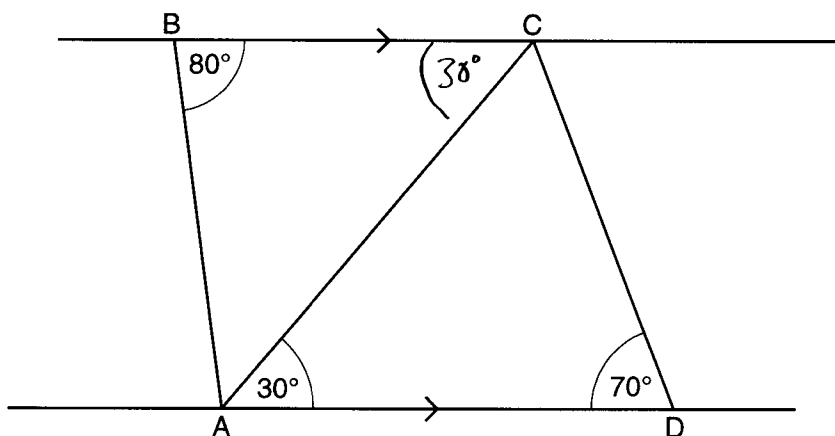
- 15 (a) A photo is 12cm wide by 10cm high.
An enlargement of the photo is 15cm wide.

Calculate the height of the enlargement.

$$\begin{aligned} & 10 \times \frac{15}{12} \\ &= 10 \times \frac{5}{4} \\ &= \frac{50}{4} \\ &= 12\frac{1}{2} \end{aligned}$$

(a) 12.5 cm [3]

- (b) In the diagram, AD is parallel to BC.
Angle ABC = 80°, angle CAD = 30° and angle ADC = 70°.



Not to scale

Show that triangles ABC and DCA are similar.

$$\angle BCA = 30^\circ \text{ (alternate angles)}$$

$$\angle BAC = 180 - (80 + 30) = 180 - 110 = 70^\circ \text{ (angle sum of } \triangle)$$

$$\angle ACD = 180 - (30 + 70) = 180 - 100 = 80^\circ \text{ (angle sum of } \triangle)$$

Both \triangle s have same angles $30^\circ, 70^\circ, 80^\circ$
and are therefore similar.

[3]

16 Vector $\mathbf{p} = \begin{pmatrix} 4 \\ -2 \end{pmatrix}$ and vector $\mathbf{q} = \begin{pmatrix} -3 \\ 5 \end{pmatrix}$.

Calculate.

(a) $\mathbf{p} + \mathbf{q} \quad \begin{pmatrix} 4 + -3 \\ -2 + 5 \end{pmatrix} = \begin{pmatrix} 1 \\ 3 \end{pmatrix}$

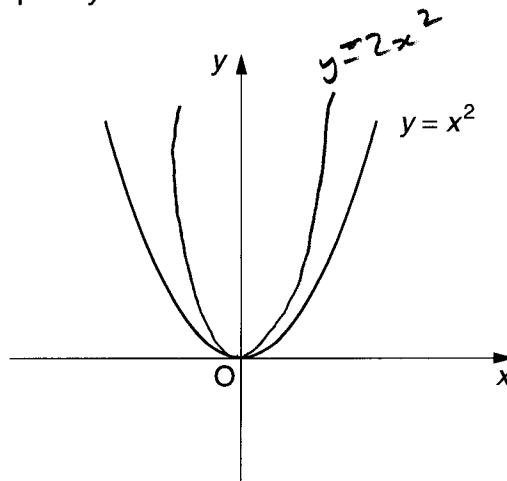
(a) $\begin{pmatrix} 1 \\ 3 \end{pmatrix} \quad [1]$

(b) $3\mathbf{p} - \mathbf{q}$

$$3 \begin{pmatrix} 4 \\ -2 \end{pmatrix} - \begin{pmatrix} -3 \\ 5 \end{pmatrix} = \begin{pmatrix} 12 + 3 \\ -6 - 5 \end{pmatrix} = \begin{pmatrix} 15 \\ -11 \end{pmatrix}$$

(b) $\begin{pmatrix} 15 \\ -11 \end{pmatrix} \quad [2]$

17 This sketch shows the graph of $y = x^2$.



(a) On the same axes, sketch the graph of $y = 2x^2$. [1]

(b) Describe the transformation that maps the graph of $y = x^2$ onto $y = x^2 - 3$.

Translation by $\begin{pmatrix} 0 \\ -3 \end{pmatrix}$

[2]

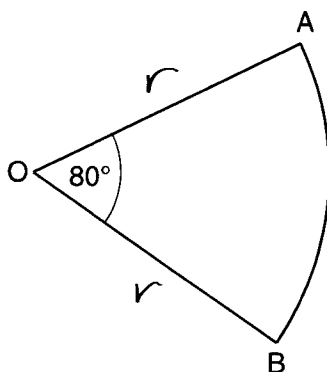
18 Simplify.

$$\frac{6 + \sqrt{2}}{\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}} = \frac{6\sqrt{2} + 2}{2} = 3\sqrt{2} + 1$$

Give your answer in the form $a\sqrt{2} + b$.

$$3\sqrt{2} + 1$$

[3]

19 OAB is a sector of a circle.
Angle AOB = 80° .

Not to scale

$$\text{Arc AB} = \frac{80}{360} \times 2\pi r$$

$$\text{So } 12\pi = \frac{80}{360} \times 2\pi r$$

$$12\pi = \frac{16\pi r}{36}$$

$$12 = \frac{4}{9} r$$

$$12 \times 9 = 4r$$

$$108 = 4r$$

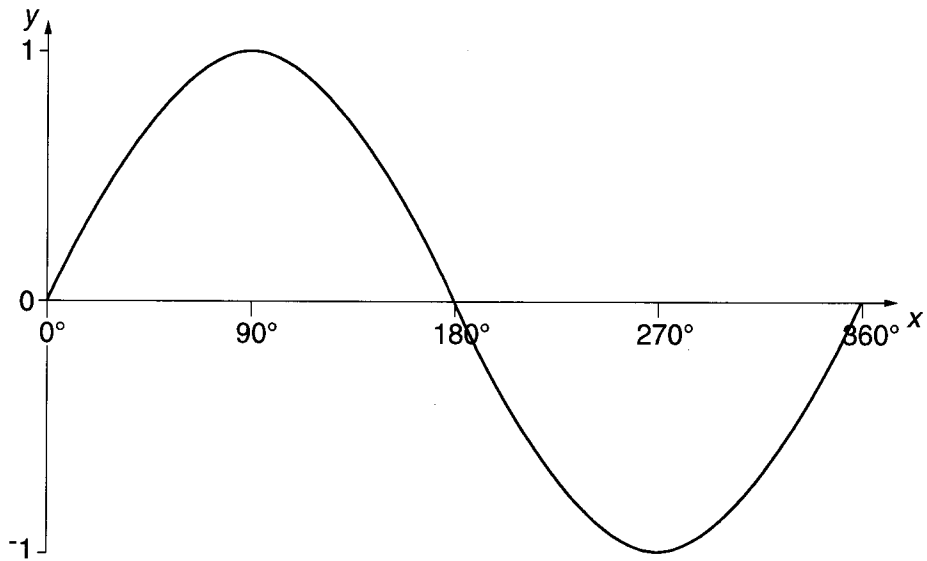
$$\frac{108}{4} = r$$

$$27 = r$$

$$\begin{aligned} \text{Perimeter} &= 12\pi + 2r \\ &= 12\pi + 54 \text{ cm} \end{aligned}$$

$$12\pi + 54 \text{ cm} \quad [4]$$

20 The diagram shows the graph of $y = \sin x$ for $0^\circ \leq x \leq 360^\circ$.



One solution to the equation $\sin x = 0.8$ is $x = 53^\circ$, correct to the nearest degree.

Find the values of x which satisfy $\sin x = -0.8$ in the range $0^\circ \leq x \leq 360^\circ$.

$$180^\circ + 53^\circ = 223^\circ$$

$$360^\circ - 53^\circ = 307^\circ$$

$$x = \underline{223^\circ \text{ and } 307^\circ} \quad [2]$$

TURN OVER FOR QUESTION 21

21* Jamie organises a game to raise money for charity.

Number Generator Game

£1 per go

Pick 2 cards

Win £5
for a number greater than 55

He shuffles these six cards and places them face down on a table.



Players pick a card at random and place it in the *First card* position on the grid below. They then pick a second card at random and place it in the *Second card* position on the grid.

First card	Second card

$6 \times 5 = 30$ possible
patterns

Winners

56
61
62
63
64
65

6 winners

Explain why £5 may not be an appropriate prize for this game.

$$\text{Prob win} = \frac{6}{30} = \frac{1}{5}$$

So expect to pay out £5 1 in every 5 games

As this is the money taken $£1 \times 5$ for 5 games there is no expected profit. Should have lower prize or charge more to play if the game is to show a profit.

[5]

END OF QUESTION PAPER

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