

N5

Practice Paper A

MATHEMATICS
National Qualifications - National 5
Paper 1 (non-calculator)
Covering all Units

Time allowed - 1 hour

Fill in these boxes and read carefully what is printed below

Full name of centre

Town

Forename(s)

Surname

Date of birth

Day Month Year

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Candidate number

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Seat number

Total marks - 40

1. You may NOT use a calculator.
2. Use **blue** or **black** ink. Pencil may be used for graphs and diagrams only.
3. Write your working and answers in the spaces provided. Additional space for answers is provided at the end of the booklet. If you use this space, write clearly the number of the question you are attempting.
4. Square ruled paper is provided.
5. Full credit will be given only where the solution contains appropriate working.
6. State the units for your answer where appropriate.
7. Before leaving the examination room you must give up this booklet to the invigilator. If you do not, you may lose all the marks for this paper.

FORMULAE LIST

The roots of $ax^2 + bx + c = 0$ are $x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$

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

Cosine rule: $a^2 = b^2 + c^2 - 2bc \cos A$ or $\cos A = \frac{b^2 + c^2 - a^2}{2bc}$

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

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

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

Volume of a Pyramid: $\text{Volume} = \frac{1}{3} Ah$

Standard deviation: $s = \sqrt{\frac{\sum (x - \bar{x})^2}{n-1}} = \sqrt{\frac{\sum x^2 - (\sum x)^2 / n}{n-1}}$, where n is the sample size.

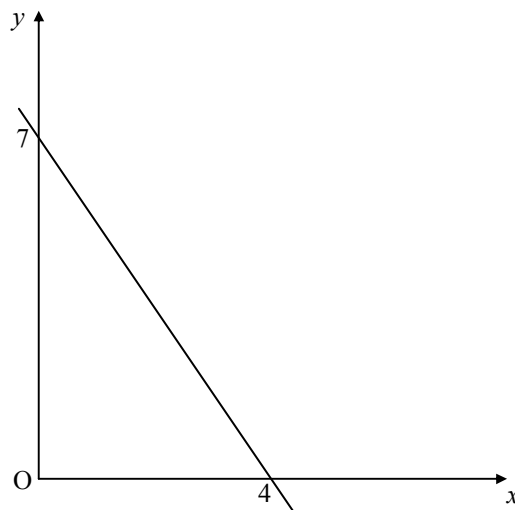
All questions should be attempted

Marks

1. Evaluate $6\frac{2}{3}$ of $\left(\frac{4}{5} - \frac{3}{4}\right)$.

3

2. Find the equation of the line in the diagram.



3

3. A formula is given as $V = 2u + 3t^2$.
Change the subject of the formula to t .

3

4. (a) Factorise $5x^2 - 45$ 2

(b) Factorise $6x^2 - 7x - 20$ 2

5. Vectors \mathbf{p} and \mathbf{q} have components as follows:

$$\mathbf{p} = \begin{pmatrix} 1 \\ 4 \\ -5 \end{pmatrix} \quad \text{and} \quad \mathbf{q} = \begin{pmatrix} 1 \\ -4 \\ 5 \end{pmatrix}$$

(a) Find the components of the vector represented by $2\mathbf{p} + \mathbf{q}$. 1

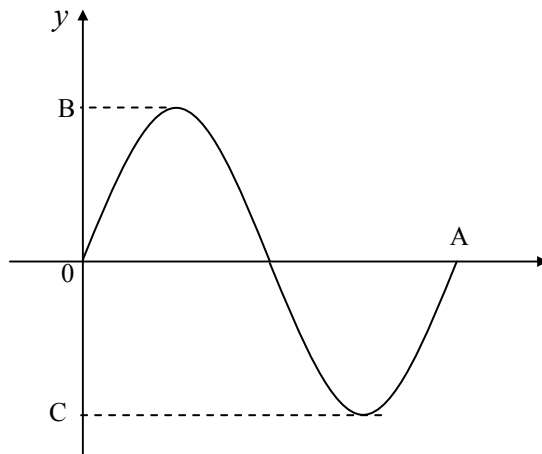
(b) Calculate the magnitude of the vector represented by $2\mathbf{p} + \mathbf{q}$ leaving your answer as a surd in its simplest form. 3

6. Solve the system of equations

$$\begin{aligned}8x + 3y &= 0 \\ y &= 1 - 3x\end{aligned}$$

3

7. The diagram shows part of the graph of $y = 4 \sin 2x^\circ$ for $0 \leq x \leq 360$.



What numbers should be in positions A, B and C.

2

8. Remove the brackets and simplify

$$(3x - 1)^2 - 2x(4x - 3)$$

3

9. Express as a single fraction in its simplest form:

$$\frac{5}{2x-1} + \frac{2x-1}{3}$$

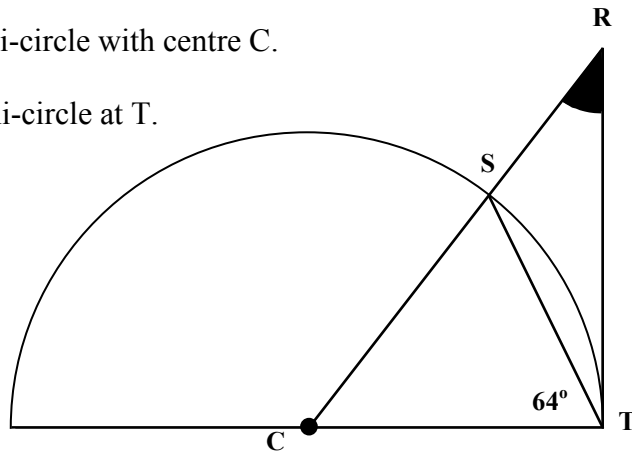
3

10. Simplify the following fraction, giving your answer in positive index form.

$$\frac{3x^2 \times 2x^4 y^2}{12x^7}$$

3

11. The diagram shows a semi-circle with centre C.
RT is a tangent to the semi-circle at T.



- (a) Explain why angle RTC is a right angle. 1
- (b) Calculate the size of the shaded angle. 4

12. Simplify

$$\frac{2 - 2 \cos^2 x}{1 - \sin^2 x}$$

3

13. A function is given as $f(x) = x^3 - 20$.

Find $f(3)$.

1

End of Question Paper

| Qu | Give one mark for each • | Illustrations for awarding mark |
|----|--|---|
| 1 | ans : $1/3$ 3 marks <ul style="list-style-type: none"> •¹ evaluates bracket •² knows how to complete calculation •³ completes calculation | <ul style="list-style-type: none"> •¹ $1/20$ •² $20/3 \times 1/20$ •³ $1/3$ |
| 2 | ans : $y = -7/4x + 7$ 3 marks <ul style="list-style-type: none"> •¹ finds gradient •² states y – intercept •³ states equation of line | <ul style="list-style-type: none"> •¹ $m = -7/4$ •² $c = 7$ •³ $y = -7/4x + 7$ |
| 3 | ans: $t = \sqrt{\frac{v-2u}{3}}$ 3 marks <ul style="list-style-type: none"> •¹ subtracts $2u$ from both sides •² divides both sides by 3 •³ takes square root of both sides | <ul style="list-style-type: none"> •¹ $3t^2 = v - 2u$ •² $t^2 = \frac{v-2u}{3}$ •³ $t = \sqrt{\frac{v-2u}{3}}$ |
| 4a | ans: $5(x-3)(x+3)$ 2 marks <ul style="list-style-type: none"> •¹ takes common factor •² factorises difference of two squares | <ul style="list-style-type: none"> •¹ $5(x^2 - 9)$ •² $5(x-3)(x+3)$ |
| b | ans: $(3x+4)(2x-5)$ 2 marks <ul style="list-style-type: none"> •¹ first factor correct •² second factor correct | <ul style="list-style-type: none"> •¹ $(3x+4).....$ •² $.....(2x-5)$ |
| 5a | ans: $\begin{pmatrix} 3 \\ 4 \\ -5 \end{pmatrix}$ 1 mark <ul style="list-style-type: none"> •¹ states components | <ul style="list-style-type: none"> •¹ $\begin{pmatrix} 3 \\ 4 \\ -5 \end{pmatrix}$ |
| b | ans: $5\sqrt{2}$ 3 marks <ul style="list-style-type: none"> •¹ knows how to find magnitude •² evaluates •³ correct simplification | <ul style="list-style-type: none"> •¹ $\sqrt{3^2 + 4^2 + (-5)^2}$ •² $\sqrt{50}$ •³ $5\sqrt{2}$ |

| Qu | Give one mark for each • | Illustrations for awarding mark |
|-----|---|---|
| 6 | ans: $x = 3; y = -8$ 3 marks <ul style="list-style-type: none"> •¹ subs for y •² solves for x •³ subs and solves for y | <ul style="list-style-type: none"> •¹ $8x + 3(1 - 3x) = 0$ •² $x = 3$ •³ $y = -8$ |
| 7 | ans: A:180; B/C: 4/-4 2 marks <ul style="list-style-type: none"> •¹ states value at A •² states values at B and C | <ul style="list-style-type: none"> •¹ A:180 •² B/C; 4/-4 |
| 8 | ans: $x^2 + 1$ 3 marks <ul style="list-style-type: none"> •¹ squares first bracket •² multiplies second bracket •³ simplifies | <ul style="list-style-type: none"> •¹ $9x^2 - 6x + 1 \dots\dots$ •² $\dots\dots - 8x^2 + 6x$ •³ $x^2 + 1$ |
| 9 | ans: $4x^2 - 4x + 16 / 3(2x - 1)$ 3 marks <ul style="list-style-type: none"> •¹ correct denominator •² correct numerator •³ solves | <ul style="list-style-type: none"> •¹ $3(2x - 1)$ [or equivalent] •² $15 + (2x - 1)^2$ •³ $4x^2 - 4x + 16 / 3(2x - 1)$ |
| 10 | ans: $y^2/2x$ 3 marks <ul style="list-style-type: none"> •¹ simplifies numerator •² correct numerator •³ correct denominator | <ul style="list-style-type: none"> •¹ $6x^6y^2$ •² y^2 •³ $2x$ |
| 11a | ans: reason 1 mark <ul style="list-style-type: none"> •¹ gives reason | <ul style="list-style-type: none"> •¹ tangent makes right angle with radius at point of contact |
| b | ans: 38° 4 marks <ul style="list-style-type: none"> •¹ finds angle CST •² finds angle RST •³ finds angle STR •⁴ finds required angle | <ul style="list-style-type: none"> •¹ angle CST = 64° •² angle RST = 116° •³ angle STR = 26° •⁴ $180 - (26 + 116) = 38°$ |
| 12 | ans: $2\tan^2x$ 3 marks <ul style="list-style-type: none"> •¹ factorises numerator •² replaces numerator and denominator •³ correct denominator | <ul style="list-style-type: none"> •¹ $2(1 - \cos^2x) / 1 - \sin^2x$ •² $2 \sin^2x / \cos^2x$ •³ $2\tan^2x$ |
| 13 | ans: 7 1 mark <ul style="list-style-type: none"> •¹ substitutes and evaluates | <ul style="list-style-type: none"> •¹ 7 |
| | | Total 40 marks |

N5

Practice Paper A

MATHEMATICS **National Qualifications - National 5** **Paper 2 (Calculator)** Covering all Units

Time allowed - 1 hour and 30 minutes

Fill in these boxes and read carefully what is printed below

Full name of centre

Town

Forename(s)

Surname

Date of birth

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Total marks - 50

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All questions should be attempted

1. A bank pays interest of 3% per annum on a special investment account.

Carly's parents invested £12 000 in this account for her when she was 11 years old and hoped that by the time she was 21 she would have enough to pay a deposit of £17 000 to buy a flat.

Would Carly have enough for her deposit?

You must show all your working and give a reason for your answer.

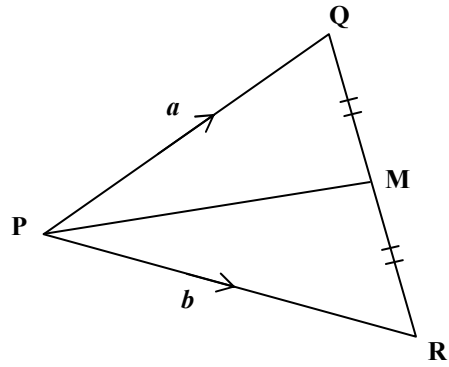
3

2. Uranium is a radioactive isotope which has a half-life of 4.5×10^9 years. This means that only half of the original mass will be radioactive after 4.5×10^9 years.

How long will it take for the radioactivity of a piece of Uranium to reduce to **one eighth** of its original level? Give your answer in **scientific notation**.

3

3. In the diagram 'M' is the mid – point of QR.



- (a) Express \vec{QR} in terms of a and b .

1

- (b) Show clearly that \vec{PM} can be represented as $\frac{1}{2}(b + a)$

3

4. Solve the quadratic equation

$$2x^2 - 6x + 3 = 0$$

using an appropriate formula.

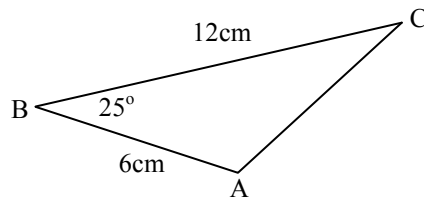
Give your answer(s) correct to 2 decimal places.

4

Marks

5. Calculate the area of triangle ABC.

2



6. John bought an antique watch last year.
Over the next year it increased in value by 12% and is now worth £1680.

By how much had the watch increased in value over that year?
You must show all working.

3

7. Sam, Roisin and Fieza are studying Law at University.

At the beginning of term Sam buys 3 hardback notebooks and 4 loose leaf pads for £10.25.

Roisin buys 6 hardback notebooks and 2 loose leaf pads for £13.00.

How much will Fieza pay for 5 hardback notebooks and 1 loose leaf pad?

5

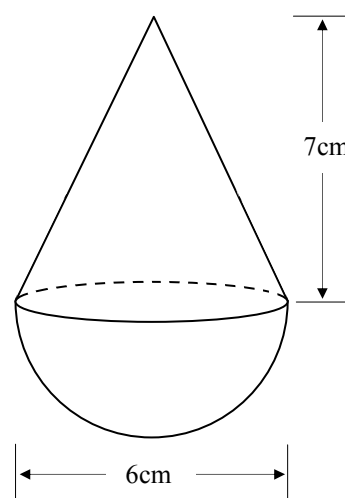
8. A child's spinning top is shown opposite.

It is made from solid wood.

The shape consists of a hemisphere base with a cone on top.

Calculate the volume of the spinning top if the hemisphere has a diameter of 6 centimetres and the cone has a height of 7 centimetres.

Give your answer correct to 1 decimal place.



5

9. Solve **algebraically** the equation

$$3 \cos x^\circ + 2 = 1 \quad \text{for} \quad 0 \leq x \leq 360.$$

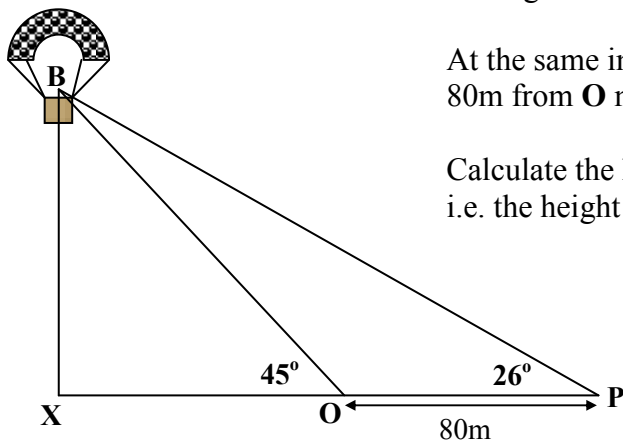
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10. A basket, **B**, containing medical supplies is descending vertically at a constant speed over a point **X**.

An observer, **O**, notes that at a certain instant the angle of elevation to **B** is 45° .

At the same instant a second observer, **P**, standing 80m from **O** notes the angle of elevation to **B** is 26° .

Calculate the height of the basket above the ground. i.e. the height **BX** in the diagram.



5

11. Fiona Baxter discovered that to make the best mango chutney the mango should weigh as close to 230 grams as possible. Less than 230g the mango becomes sour and more than 230g the mango becomes too sweet.

Fruit-to-go have sent a sample of 8 mangoes, their weights are shown in the table below.

| | | | | | | | | |
|-------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| Mango | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Weight (g) | 231 | 228 | 230 | 235 | 231 | 227 | 230 | 228 |

- (a) Calculate the mean and standard deviation of this batch of mangoes, giving your answers correct to one decimal place where necessary.

4

- (b) Burtlets Fruit also sent a sample of 8 mangoes. The mean weight of this batch is 230g and the standard deviation is 0.8.

Which company should Fiona choose to supply her with mangoes?

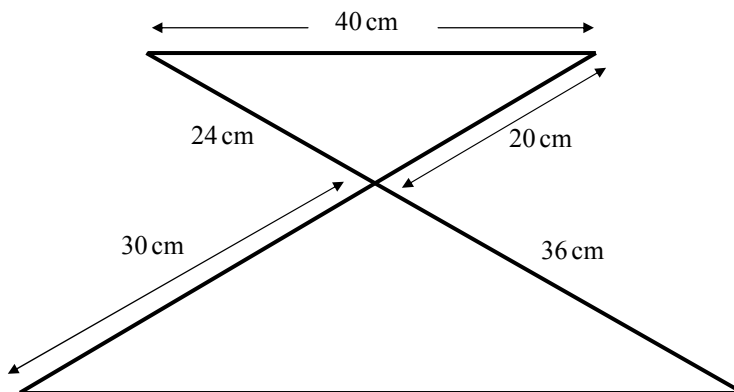
You must give a reason for your answer.

2

12. Find the value of p for which the quadratic equation $px^2 - 6x + 1 = 0$ has equal roots.

3

13. The flat wire framework below shows two **similar** triangles.



It is made from a single length of wire which has been bent to this shape.

Would a **two metre** length of wire be enough to make this framework?

You must show all your working and give a reason for your answer.

4

End of Question Paper

| Qu | Give one mark for each • | Illustrations for awarding mark |
|----|---|---|
| 1 | ans: no; since £16127 < £17000 3 marks <ul style="list-style-type: none"> •¹ correct multiplier •² knows how to find amount •³ answer with conclusion | <ul style="list-style-type: none"> •¹1· 03 •² 12000 × 1· 03¹⁰ •³ since £16127 < £17000 |
| 2 | ans: 1·35 × 10 ¹⁰ 3 marks <ul style="list-style-type: none"> •¹ knowing to multiply by 3 •² correctly multiplying •³ leaving answer in scientific notation | <ul style="list-style-type: none"> •¹ 3 × 4·5 × 10⁹ •² 13·5 × 10⁹ •³ answer |
| 3a | ans : b - a 1 mark <ul style="list-style-type: none"> •¹ answer | <ul style="list-style-type: none"> •¹ b - a |
| b | ans: proof 3 marks <ul style="list-style-type: none"> •¹ states pathway •² realises \vec{QM} is half \vec{QR} •³ simplifies to answer | <ul style="list-style-type: none"> •¹ $\vec{PM} = \vec{PQ} + \vec{QM}$ or $\vec{PM} = \vec{PR} + \vec{RM}$ •² $a + \frac{1}{2}(b - a)$ or $b - \frac{1}{2}(b - a)$ •³ $\frac{1}{2}a + \frac{1}{2}b = \frac{1}{2}(a + b)$ |
| 4 | ans : x = 2·37 , 0·63 4 marks <ul style="list-style-type: none"> •¹ knows to use quadratic formula •² substitutes into quadratic formula correctly •³ evaluates $b^2 - 4ac$ •⁴ evaluates values of x | <ul style="list-style-type: none"> •¹ evidence •² $x = \frac{6 \pm \sqrt{(-6)^2 - 4 \times 2 \times 3}}{2 \times 2}$ •³ $x = \frac{6 \pm \sqrt{12}}{4}$ •⁴ x = 2·37 and 0·63 |
| 5 | ans : 15·2cm ² 2 marks <ul style="list-style-type: none"> •¹ subs values into formula for area •² evaluates | <ul style="list-style-type: none"> •¹ $A = \frac{1}{2} \times 12 \times 6 \times \sin 25^\circ$ •² 15·2cm² |
| 6 | ans : £180 3 marks <ul style="list-style-type: none"> •¹ knows that 112% = £1680 •² knows to divide £1680 by 1·12 •³ answer | <ul style="list-style-type: none"> •¹ 112% = £1680 •² 100% = £1680 ÷ 1·12 = £1500 •³ £180 |
| 7 | ans : £10·00 5 marks <ul style="list-style-type: none"> •¹ create first equation •² create second equation •³ begin to solve equations simultaneously •⁴ correctly solve equations •⁵ calculate cost | <ul style="list-style-type: none"> •¹ 3H + 4L = £10·25 •² 6H + 2L = £13·00 •³ H = £1·75 •⁴ L = £1·25 •⁵ 5H + L = £10·00 |

| Qu | Give one mark for each • | Illustrations for awarding mark |
|-----|--|--|
| 8 | ans : 122.5cm³ 5 marks <ul style="list-style-type: none"> •¹ subs to find volume of cone •² subs to find volume of hemisphere •³ finds both volumes •⁴ adds to total •⁵ correct rounding | <ul style="list-style-type: none"> •¹ $\frac{1}{3} \times \pi \times 3^2 \times 7$ •² $\frac{2}{3} \times \pi \times 3^3$ •³ 65.973 and 56.548 •⁴ 122.521..... •⁵ 122.5cm³ |
| 9 | ans: 109.5° 250.5° 3 marks <ul style="list-style-type: none"> •¹ rearranges to $\cos x^\circ$ •² finds 1st solution •³ finds 2nd solution | <ul style="list-style-type: none"> •¹ $\cos x = -\frac{1}{3}$ •² 109.5° •³ 250.5° |
| 10 | ans: 76.4 m 5 marks <ul style="list-style-type: none"> •¹ finds third angle •² knows to use sine rule •³ calculates side correctly •⁴ attempts to calculate height •⁵ calculates height correctly | <ul style="list-style-type: none"> •¹ Δ side 80m, angles 26°, 135°, 19° •² evidence •³ $\frac{80}{\sin 19^\circ} = \frac{BO}{\sin 26^\circ} \Rightarrow BO = 108 \text{ m}$ •⁴ $\sin 45^\circ = \frac{x}{108}$ •⁵ BX = 76.4m |
| 11a | ans: mean = 32; S.D. = 3.8 4 marks <ul style="list-style-type: none"> •¹ finds mean •² finds $(\sum x)^2$ and $\sum x^2$ •³ substitutes into formula •⁴ answer <p>Or</p> <ul style="list-style-type: none"> •¹ finds mean •² finds deviations squared •³ knows how to find SD •⁴ answer | <ul style="list-style-type: none"> •¹ $1840 \div 8 = 230\text{g}$ •² $\sum x = 1840, \sum x^2 = 423244$ •³ $sd = \sqrt{\frac{423244 - \frac{1840^2}{8}}{7}}$ •⁴ 2.5 [accept any correct rounding] |
| b | ans: Burtlets with reasons 2 marks <ul style="list-style-type: none"> •¹ compares mean •² compares SD | <ul style="list-style-type: none"> •¹ 1840 ÷ 8 = 230g •² 1 + 4 + 0 + 25 + 1 + 9 + 0 + 4 = 44 •³ $\sqrt{\frac{44}{7}}$ •⁴ 2.5 [accept any correct rounding] <ul style="list-style-type: none"> •¹ same mean •² interpret SD as spread of weights |

| Qu | Give one mark for each ● | Illustrations for awarding mark |
|----|---|--|
| 12 | ans : $p = 9$ 3 marks <ul style="list-style-type: none"> ●¹ knows condition for equal roots ●² substitutes values ●³ simplifies and solves for p | <ul style="list-style-type: none"> ●¹ $b^2 - 4ac = 0$ [stated or implied] ●² $(-6)^2 - 4 \times p \times 1 = 0$ ●³ $p = 9$ |
| 13 | ans : 10 cm short 4 marks <ul style="list-style-type: none"> ●¹ finds scale factor of enlargement ●² finds missing side ●³ finds total of sides and ●⁴ conclusion | <ul style="list-style-type: none"> ●¹ enlargement scale factor = $3/2$ ●² $40 \times 3/2 = 60$ cm ●³ $40 + 24 + 20 + 30 + 36 + 60 = 210$ cm ●⁴ not enough since $210 > 200$ |
| | | Total 50 marks |