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)	Candidate number	Seat number

Total marks - 40

1. You may <u>NOT</u> 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 $x = \dfrac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$

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

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

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

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

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

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

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

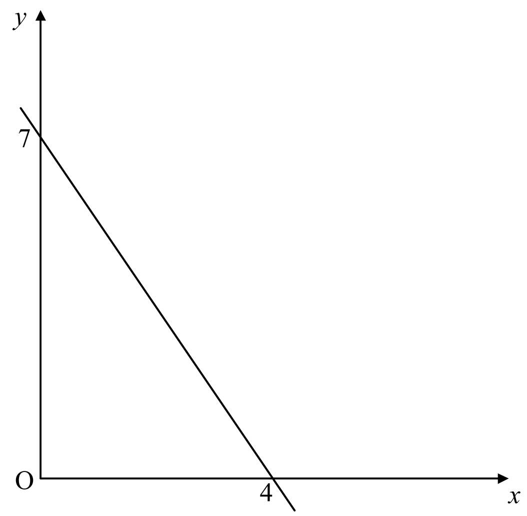
Do not write in this margin.

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**

Do not write in this margin.

Marks

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

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

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

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

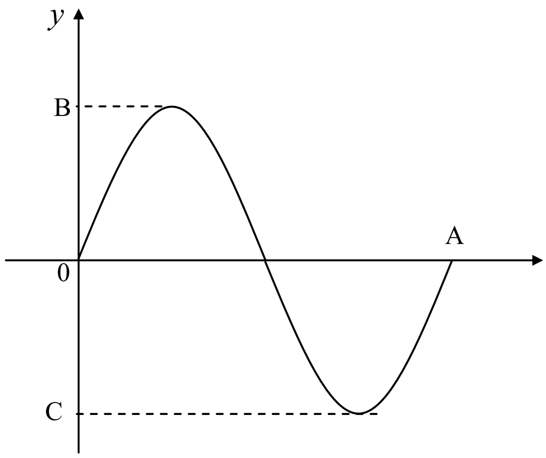
(a) Find the components of the vector represented by $2\boldsymbol{p} + \boldsymbol{q}$. **1**

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

6. Solve the system of equations

$$8x + 3y = 0$$
$$y = 1 - 3x$$ **3**

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



What numbers should be in positions A, B and C. **2**

8. Remove the brackets and simplify

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

Do not write in this margin.

Marks

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.

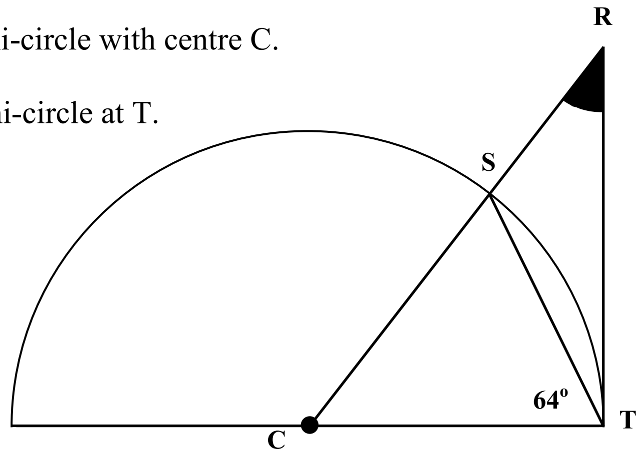
$$\frac{3x^2 \times 2x^4 y^2}{12x^7}$$ **3**

Do not write in this margin.

Marks

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** ●[1] evaluates bracket ●[2] knows how to complete calculation ●[3] completes calculation	 ●[1] 1/20 ●[2] 20/3 × 1/20 ●[3] 1/3
2	**ans : $y = -7/4x + 7$** **3 marks** ●[1] finds gradient ●[2] states y – intercept ●[3] states equation of line	 ●[1] $m = -7/4$ ●[2] $c = 7$ ●[3] $y = -7/4x + 7$
3	**ans:** $t = \sqrt{\dfrac{v-2u}{3}}$ **3 marks** ●[1] subtracts $2u$ from both sides ●[2] divides both sides by 3 ●[3] takes square root of both sides	 ●[1] $3t^2 = v - 2u$ ●[2] $t^2 = \dfrac{v-2u}{3}$ ●[3] $t = \sqrt{\dfrac{v-2u}{3}}$
4a b	**ans: $5(x-3)(x+3)$** **2 marks** ●[1] takes common factor ●[2] factorises difference of two squares **ans: $(3x+4)(2x-5)$** **2 marks** ●[1] first factor correct ●[2] second factor correct	 ●[1] $5(x^2 - 9)$ ●[2] $5(x-3)(x+3)$ ●[1] $(3x+4)$…… ●[2] …..$(2x-5)$
5a b	**ans:** $\begin{pmatrix} 3 \\ 4 \\ -5 \end{pmatrix}$ **1 mark** ●[1] states components **ans: $5\sqrt{2}$** **3 marks** ●[1] knows how to find magnitude ●[2] evaluates ●[3] correct simplification	 ●[1] $\begin{pmatrix} 3 \\ 4 \\ -5 \end{pmatrix}$ ●[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** ●[1] subs for y ●[2] solves for x ●[3] subs and solves for y	 ●[1] $8x + 3(1 - 3x) = 0$ ●[2] $x = 3$ ●[3] $y = -8$
7	**ans: A:180; B/C: 4/–4** **2 marks** ●[1] states value at A ●[2] states values at B and C	 ●[1] A:180 ●[2] B/C; 4/–4
8	**ans: $x^2 + 1$** **3 marks** ●[1] squares first bracket ●[2] multiplies second bracket ●[3] simplifies	 ●[1] $9x^2 - 6x + 1$…… ●[2] …… $- 8x^2 + 6x$ ●[3] $x^2 + 1$
9	**ans : $4x^2 - 4x + 16 / 3(2x - 1)$** **3 marks** ●[1] correct denominator ●[2] correct numerator ●[3] solves	 ●[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** ●[1] simplifies numerator ●[2] correct numerator ●[3] correct denominator	 ●[1] $6x^6y^2$ ●[2] y^2 ●[3] $2x$
11a b	**ans: reason** **1 mark** ●[1] gives reason **ans: 38°** **4 marks** ●[1] finds angle CST ●[2] finds angle RST ●[3] finds angle STR ●[4] finds required angle	 ●[1] tangent makes right angle with radius at point of contact ●[1] angle CST = 64° ●[2] angle RST = 116° ●[3] angle STR = 26° ●[4] 180 – (26 + 116) = 38°
12	**ans: $2\tan^2 x$** **3 marks** ●[1] factorises numerator ●[2] replaces numerator and denominator ●[3] correct denominator	 ●[1] $2(1 - \cos^2 x) / 1 - \sin^2 x$ ●[2] $2 \sin^2 x / \cos^2 x$ ●[3] $2\tan^2 x$
13	**ans: 7** **1 mark** ●[1] substitutes and evaluates	 ●[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

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Forename(s)	Surname

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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**

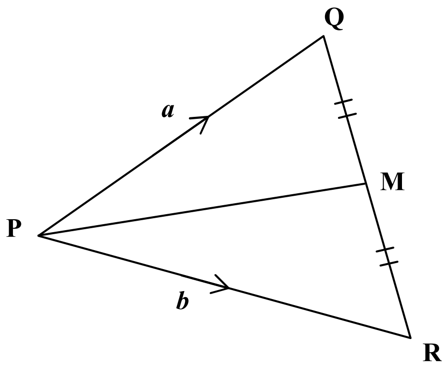
2. Uranium is a radioactive isotope which has a half-life of $4 \cdot 5 \times 10^9$ years. This means that only half of the original mass will be radioactive after $4 \cdot 5 \times 10^9$ years.

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**

Do not write in this margin.

Marks

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



(a) Express $\overrightarrow{QR}$ in terms of $\boldsymbol{a}$ and $\boldsymbol{b}$. **1**

(b) Show clearly that $\overrightarrow{PM}$ can be represented as $\frac{1}{2}(\boldsymbol{b}+\boldsymbol{a})$ **3**

4. Solve the quadratic equation

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

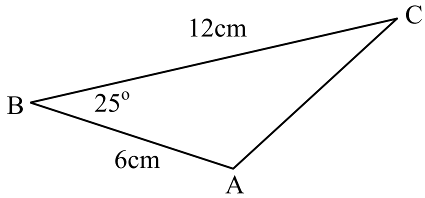
using an appropriate formula.

Give your answer(s) correct to 2 decimal places. **4**

Do not write in this margin.

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**

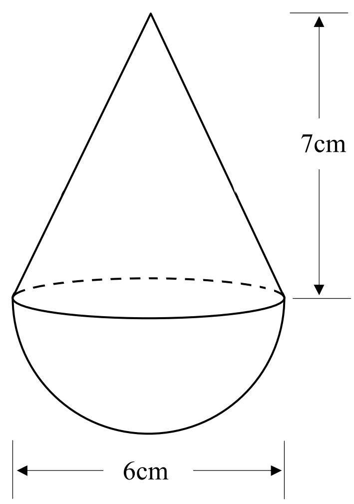
8. A child's spinning top is shown opposite.

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.

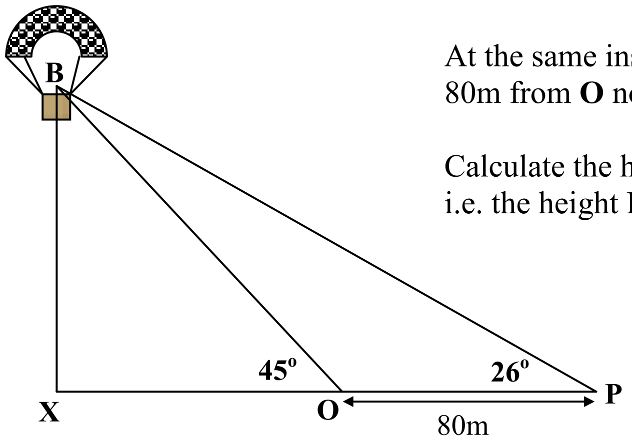


5

9. Solve **algebraically** the equation

$$3\cos x^0 + 2 = 1 \quad \text{for} \quad 0 \le x \le 360\,.$$ **3**

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

Do not write in this margin.

Marks

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. .

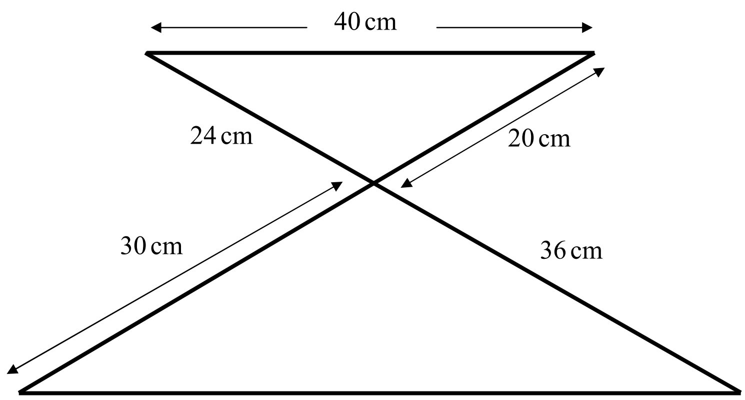
Which company should Fiona choose to supply her with mangoes?
You must give a reason for your answer. **2**

Marks

Do not write in this margin.

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** •[1] correct multiplier •[2] knows how to find amount •[3] answer with conclusion	 •[1] ………$1 \cdot 03$ •[2] $12000 \times 1 \cdot 03^{10}$ •[3] since £16127 < £17000
2	**ans: $1 \cdot 35 \times 10^{10}$ 3 marks** •[1] knowing to multiply by 3 •[2] correctly multiplying •[3] leaving answer in scientific notation	 •[1] $3 \times 4{\cdot}5 \times 10^9$ •[2] $13{\cdot}5 \times 10^9$ •[3] answer
3a	**ans : $\boldsymbol{b} - \boldsymbol{a}$ 1 mark** •[1] answer	 •[1] $\boldsymbol{b} - \boldsymbol{a}$
b	**ans: proof 3 marks** •[1] states pathway •[2] realises $\overrightarrow{QM}$ is half $\overrightarrow{QR}$ •[3] simplifies to answer	 •[1] $\overrightarrow{PM} = \overrightarrow{PQ} + \overrightarrow{QM}$ or $\overrightarrow{PM} = \overrightarrow{PR} + \overrightarrow{RM}$ •[2] $\boldsymbol{a} + \frac{1}{2}(\boldsymbol{b} - \boldsymbol{a})$ or $\boldsymbol{b} - \frac{1}{2}(\boldsymbol{b} - \boldsymbol{a})$ •[3] $\frac{1}{2}\boldsymbol{a} + \frac{1}{2}\boldsymbol{b} = \frac{1}{2}(\boldsymbol{a} + \boldsymbol{b})$
4	**ans : $x = 2{\cdot}37$, $0{\cdot}63$ 4 marks** •[1] knows to use quadratic formula •[2] substitutes into quadratic formula correctly •[3] evaluates $b^2 - 4ac$ •[4] evaluates values of x	 •[1] evidence •[2] $x = \dfrac{6 \pm \sqrt{(-6)^2 - 4 \times 2 \times 3}}{2 \times 2}$ •[3] $x = \dfrac{6 \pm \sqrt{12}}{4}$ •[4] $x = 2{\cdot}37$ and $0{\cdot}63$
5	**ans : 15·2cm² 2 marks** •[1] subs values into formula for area •[2] evaluates	 •[1] $A = \frac{1}{2} \times 12 \times 6 \times \sin 25°$ •[2] 15·2cm²
6	**ans : £180 3 marks** •[1] knows that 112% = £1680 •[2] knows to divide £1680 by 1·12 •[3] answer	 •[1] 112% = £1680 •[2] 100% = £1680 ÷ 1·12 = £1500 •[3] £180
7	**ans : £10.00 5 marks** •[1] create first equation •[2] create second equation •[3] begin to solve equations simultaneously •[4] correctly solve equations •[5] calculate cost	 •[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 : 122·5cm^3 5 marks** ●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	 ●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……. ●5 122·5cm^3
9	**ans: 109·5°, 250·5° 3 marks** ●1 rearranges to cos x^o ●2 finds 1st solution ●3 finds 2nd solution	 ●1 $\cos x = -\frac{1}{3}$ ●2 109·5° ●3 250·5°
10	**ans: 76·4 m 5 marks** ●1 finds third angle ●2 knows to use sine rule ●3 calculates side correctly ●4 attempts to calculate height ●5 calculates height correctly	 ●1 Δ side 80m, angles 26°, 135°, 19° ●2 evidence ●3 $\frac{80}{\sin 19^\circ}=\frac{BO}{\sin 26^\circ}\Rightarrow BO=108$ m ●4 $\sin 45^\circ=\frac{x}{108}$ ●5 BX = 76·4m
11a b	**ans: mean = 32; S.D. = 3·8 4 marks** ●1 finds mean ●2 finds $(\sum x)^2$ and $\sum x^2$ ●3 substitutes into formula ●4 answer Or ●1 finds mean ●2 finds deviations squared ●3 knows how to find SD ●4 answer **ans: Burtlets with reasons 2 marks** ●1 compares mean ●2 compares SD	 ●1 1840 ÷ 8 = 230g ●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] ●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] ●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** ●^{1} knows condition for equal roots ●^{2} substitutes values ●^{3} simplifies and solves for *p*	 ●^{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** ●^{1} finds scale factor of enlargement ●^{2} finds missing side ●^{3} finds total of sides and ●^{4} conclusion	 ●^{1} enlargement scale factor = 3/2 ●^{2} 40 × 3/2 = 60 cm ●^{3} 40 + 24 + 20 + 30 + 36 + 60 = 210 cm ●^{4} not enough since 210 > 200
		Total 50 marks

N5

Practice Paper B

MATHEMATICS

National Qualifications - National 5

Paper 1 (non-calculator)

Covering all Units

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FORMULAE LIST

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

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

Area of a triangle: Area = ½ $ab \sin C$

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

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

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

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

Do not write in this margin.

All questions should be attempted

Marks

1. Factorise fully

$$4x^2 - 10x - 6.$$ **3**

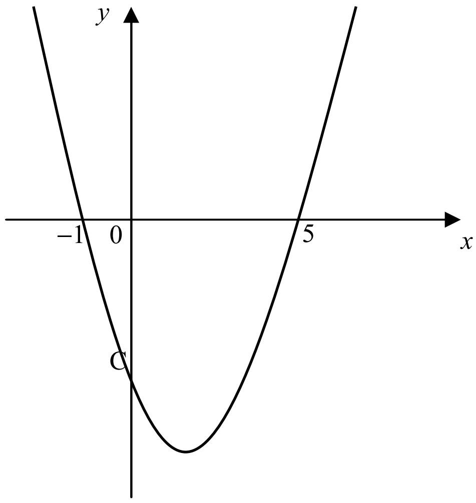
2. Two lines have equations

$$3y + 2x = -0{\cdot}1$$
$$2y + 5x = -11{\cdot}8$$

Find, **algebraically,** the point where these two lines meet. **4**

3. Given that $P = \dfrac{kQ}{r^2}$ express r in terms of P, Q and k. **3**

4. The graph shown has equation $y = (x + 1)(x - 5)$.



(a) Find the coordinates of the turning point. **2**

(b) State the equation of the axis of symmetry of the parabola. **1**

5. Express as a single fraction in its simplest form

$$\frac{3}{x} - \frac{2}{x-5}.$$ **3**

6. Sparks Electrical are having their annual clearance sale where everything is reduced by 40%.

Sparks Electrical

All items reduced by 40%

A Flat screen TV cost £480 in the sale.

How much did the TV originally cost? **3**

7. **(a)** A function is given as $f(x) = \dfrac{6}{\sqrt{x}}$, where $x > 0$.

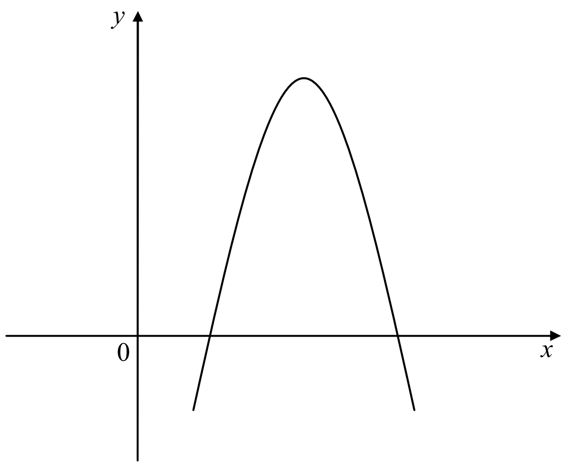
Find the exact value of $f(18)$, giving your answer as a **surd in its simplest form** <u>and</u> with **a rational denominator**. **4**

(b) Express $\dfrac{p^5 \times 8p}{2p^{-3}}$ in its simplest form. **2**

Do not write in this margin.

Marks

8. The diagram shows the graph of a function of the form $y = \boldsymbol{a}x^2 + \boldsymbol{b}x + c$.



Write down a possible value for $\boldsymbol{a}$ and a possible value for $\boldsymbol{b}^2 - 4\boldsymbol{ac}$. **2**

9. A function is given as $f(x) = 2x^2 - 3x$.

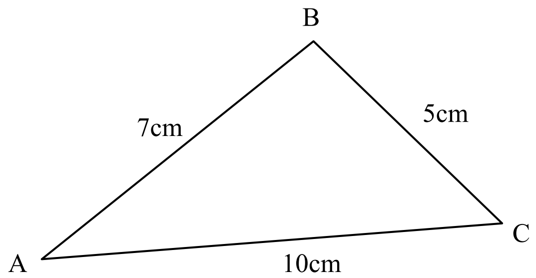
(a) Find $f(-2)$. **2**

(b) Given that $f(p) = 5$, find the two values of p. **3**

Do not write in this margin.

Marks

10. **(a)** Calculate the value of cos ABC in this triangle. **3**



(b) Without actually calculating the size of the angle a pupil was able to say that angle ABC was obtuse.

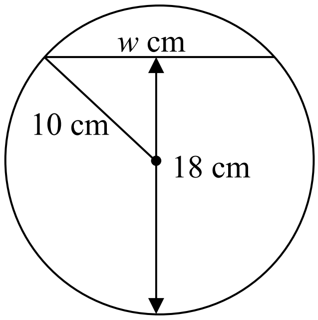
By referring to your answer in (a), explain why the pupil was able to do this. **1**

Marks

Do not write in this margin.

11. A goldfish bowl is filled with water to a depth of 18 cm.

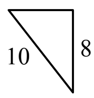
A cross section through the centre of the bowl is circular.



If the radius of the cross section is 10 cm, find the width of the water, w cm, in the bowl. **4**

End of Question Paper

Qu	Give one mark for each •	Illustrations for awarding mark
1	**ans:** $2(2x+1)(x-3)$ **3 marks**	
	•[1] extract common factor	•[1] $2(2x^2-5x-3)$
	•[2] attempt to factorise trinomial	•[2] $(2x+1)$
	•[3] complete factorisation	•[3] $(x-3)$
2	**ans:** **(– 3·2, 2·1)** **4 marks**	
	•[1] knows to use system of equations	•[1] scales equations
	•[2] finds value for y	•[2] $y = 2{\cdot}1$
	•[3] finds value for x	•[3] $x = -3{\cdot}2$
	•[4] states coordinates of intersection	•[4] (– 3·2, 2·1)
3	**ans:** $r = \sqrt{\frac{kQ}{P}}$ **3 marks**	
	•[1] remove fraction	•[1] $Pr^2 = kQ$
	•[2] manipulate formula	•[2] $r^2 = \frac{kQ}{P}$
	•[3] solve for r	•[3] answer
4a	**ans:** **(2, – 9)** **2 marks**	
	•[1] correct x - coordinate	•[1] (2, …..
	•[2] correct y - coordinate	•[2] ……– 9)
b	**ans:** $x = 2$ **1 mark**	
	•[1] states equation	•[1] $x = 2$
5	**ans:** $\frac{x-15}{x(x-5)}$ **3 marks**	
	•[1] common denominator	•[1] $x(x-5)$
	•[2] correct numerator	•[2] $\frac{3(x-5)-2x}{x(x-5)}$
	•[3] simplify fraction	•[3] answer
6	**ans:** **£800** **3 marks**	
	•[1] correct strategy	•[1] 60% = £480
	•[2] uses correct ratio	•[2] $\frac{100}{60} \times £480$
	•[3] calculations correct	•[3] answer

Qu	Give one mark for each ●	Illustrations for awarding mark
7a	**ans : √2** **4 marks** ●1 substitutes for x ●2 simplifies √18 and expression ●3 multiplies by √2 ●4 simplifies	●1 $f(x)=\frac{6}{\sqrt{18}}$ ●2 $f(x)=\frac{6}{3\sqrt{2}}=\frac{2}{\sqrt{2}}$ ●3 $\frac{2}{\sqrt{2}}\times\frac{\sqrt{2}}{\sqrt{2}}$ ●4 $\sqrt{2}$
b	**ans: $4p^9$** **2 marks** ●1 simplifies numerator ●2 simplifies fraction	●1 $8p^6$ ●2 $4p^9$
8	**ans: $a < 0$; $b^2 - 4ac > 0$** **2 marks** ●1 correct value for a ●2 correct value for $b^2 - 4ac$	●1 any value of a < 0 ●2 any value of $b^2 - 4ac > 0$
9a	**ans : 14** **2 marks** ●1 substitutes ●2 evaluates	●1 $f(x) = 2(-2)^2 - 3(-2)$ ●2 14
b	**ans : 5/2 or – 1** **3 marks** ●1 equates to 5 and rearranges ●2 factorises ●3 solves	●1 $2p^2 - 3p = 5;\ 2p^2 - 3p - 5 = 0$ ●2 $(2p - 5)(p + 1) = 0$ ●3 $p = 5/2$ or -1
10	**ans : $\frac{-26}{70}$ [or equivalent]** **3 marks** ●1 knows to use the cosine rule ●2 substitutes values ●3 answer	●1 evidence ●2 $\frac{7^2+5^2-10^2}{2\times7\times5}$ ●3 $\frac{-26}{70}$ [or equivalent]
	ans: cosine is negative **1 mark** ●1 gives valid reason	●1 cosine is negative so angle is obtuse
11	**ans: 12 cm** **4 marks** ●1 assembles facts in RAT ●2 knows to use Pythagoras ●3 calculates unknown side ●4 states width of water	 ●1 ●2 $\sqrt{(10^2 - 8^2)}$ ●3 6cm ●4 12cm
		Total **40 marks**

N5

Practice Paper B

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 (Day Month Year)	Candidate number	Seat number

Total marks - 50

1. **You may 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 If you use this space, write clearly the number of the question you are attempting. is provided at the end of the booklet.
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 $x = \dfrac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$

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

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

Area of a triangle: Area = ½ $ab \sin C$

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

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

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

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

Do not write in this margin.

Marks

All questions should be attempted

1. Remove the brackets and simplify

$$(2x-3)^2+3x(4x-3).$$ **3**

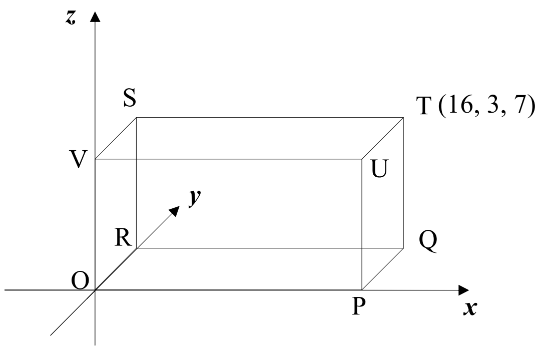
2. Halley's comet travels in a wide loop around our solar system.

At its closest point to the earth it is travelling at an average speed of $1\cdot 4\times 10^5$ miles per hour.

At this speed how far, in miles, will it travel in a week?

Give your answer in **scientific notation** correct to **2 significant figures**. **4**

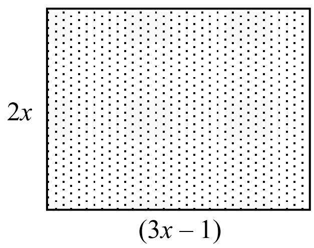
3. **(a)** Point U has coordinates (16, 3, 7) in the cuboid OPQR STUV shown below.



Write down the coordinates of point S **1**

(b) Calculate the length of vector $\boldsymbol{a}$ defined as $\boldsymbol{a} = 3\boldsymbol{i} + 5\boldsymbol{j} - \sqrt{2}\boldsymbol{k}$. **2**

4.

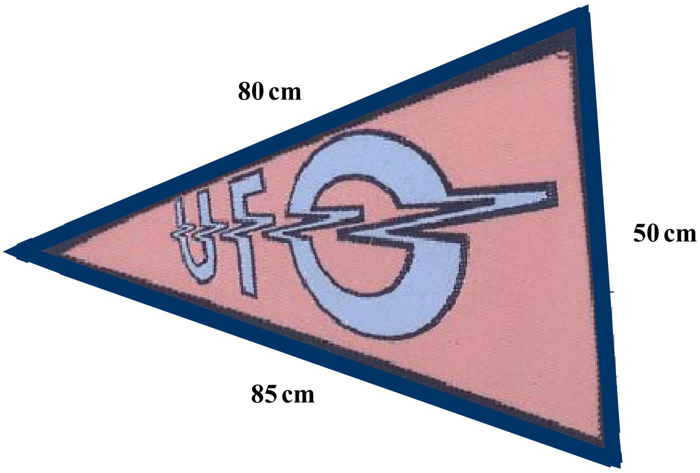


The area of the rectangle in the diagram is 31m^2

Calculate the value of x giving your answer **correct to 1 decimal place**. **5**

Marks

5. A large triangular flag advertising a UFO conference is shown below.



Calculate the **area** of the flag, giving your answer to the nearest square centimetre**.** **6**

6. Find the value of k for which the quadratic equation $kx^2 + kx + 6 = 0$; $k \neq 0$ has equal roots. **4**

7. The value of an industrial machine is expected to decrease each year by 14·2% of of its value at the beginning of the year.

If it was valued at £15500 at the **beginning** of 2011, what will its expected value be at the **end** of 2013?
Give your answer correct to the nearest pound. **4**

8. A survey of the number of hours that senior pupils had spent studying for a Maths exam gave a mean of 15 and a standard deviation of 3·4.

The following year, after a programme of supported study, the mean number of hours remained the same but the standard deviation fell to 2·3.

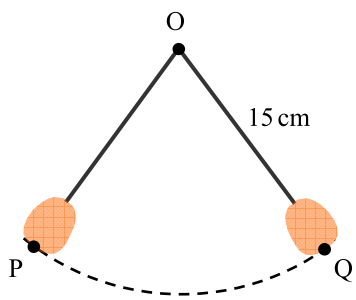
Make two comments about the effectiveness of the supported study programme. **2**

9. A clock has a pendulum swinging below it.

When the clock is ticking the pendulum travels along an arc of a circle, centre O.

The length of the connection cord OQ is 15 centimetres.

The length of the arc followed by the pendulum as it swings from **P to Q is 18cm**.

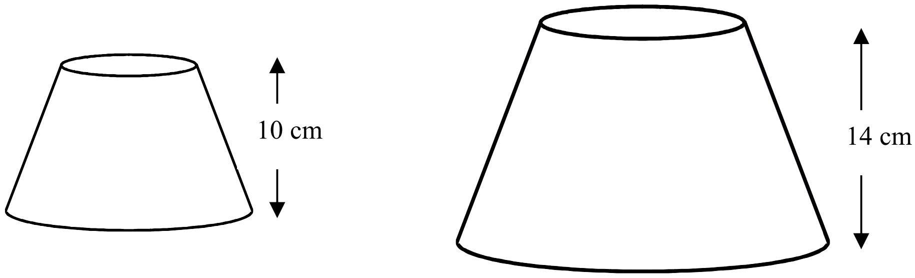


Find the size of angle POQ, the angle through which the pendulum swings from P to Q. **5**

10. Solve **algebraically** the equation

$$7\cos x^\circ + 4 = 2\cos x^\circ, \quad \text{for} \quad 0 \le x < 360.$$ **4**

11. A company sells boxed chocolates in two different sizes.
The boxes are mathematically similar truncated cones, as shown in the diagram below.



The cost of the chocolates should be in direct proportion to their weight.

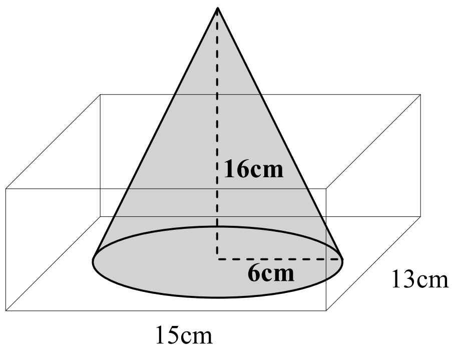
The chocolates in the larger box have been weighed and are priced at £5·45.

The company is considering pricing the smaller box at £2·25.

Is this a fair price ?

Your answer must be accompanied with appropriate working. **3**

12. A cone of ice with a base radius of 6cm and a height of 16cm is placed in a small rectangular glass tank as shown below.



(a) Calculate the volume of the cone giving your answer correct to **3 significant figures**. **3**

(b) If the cone is left to melt away completely, calculate the depth of water in the tank once all the ice has melted. **3**

End of Question Paper

Qu	Give one mark for each ●	Illustrations for awarding mark
1	**ans: $16x^2 - 21x + 9$** **3 marks**	
	●[1] multiplies first bracket	●[1] $4x^2 - 12x + 9$........
	●[2] multiplies second bracket	●[2] ..... $+ 12x^2 - 9x$
	●[3] simplifies	●[3] $16x^2 - 21x + 9$
2	**ans : $2{\cdot}4 \times 10^7$ miles** **4 marks**	
	●[1] knows to multiply by 24 and 7	●[1] $1{\cdot}4 \times 10^5 \times 24 \times 7$
	●[2] starts to evaluates	●[2] 23 520 000
	●[3] rounds to 2 sig. figs.	●[3] 24 000 000
	●[4] gives answer in Scientific notation	●[4] $2{\cdot}4 \times 10^7$ miles
3a	**ans : S(0, 3, 7)** **1 mark**	
	●[1] states coordinates of S	●[1] S(0, 3, 7)
b	**ans: 6 units** **3 marks**	
	●[1] finds components of vector ***a***	●[1] $\begin{pmatrix} 3 \\ 5 \\ -\sqrt{2} \end{pmatrix}$
	●[2] knows how to find magnitude	●[2] $\sqrt{3^2 + 5^2 + (-\sqrt{2})^2}$
	●[3] answer	●[3] 6 units
4	**ans : 2·4m** **5 marks**	
	●[1] equates areas	●[1] $2x(3x-1) = 31$; $6x^2 - 2x - 31 = 0$
	●[2] knows to use quadratic formula	●[2] evidence – could list values of a, b and c
	●[3] evaluates discriminant	●[3] $b^2 - 4ac = (-2)^2 - (4 \times 6 \times -31) = 748$
	●[4] finds values of x	●[4] 2·4 or −2·1
	●[5] discards	●[5] $x = 2{\cdot}4$m
5	**ans : 1 956 cm^2** **6 marks**	
	●[1] knows to find an angle and uses cosine rule	●[1] evidence of cosine rule for angle
	●[2] subs values	●[2] $\frac{80^2 + 85^2 - 50^2}{2 \times 80 \times 85}$ or $\frac{80^2 + 50^2 - 85^2}{2 \times 80 \times 50}$ or $\frac{85^2 + 50^2 - 80^2}{2 \times 85 \times 50}$
	●[3] evaluates for cosine of angle	●[3] 0·818.... or 0·209..... or 0·391....
	●[4] finds angle	●[4] $35{\cdot}11°$ or $77{\cdot}91°$ or $66{\cdot}97°$
	●[5] knows how to find area	●[5] $a = \frac{1}{2} \times 80 \times 85 \times \sin 35{\cdot}11°$ or $a = \frac{1}{2} \times 80 \times 50 \times \sin 77{\cdot}91°$ or $a = \frac{1}{2} \times 85 \times 50 \times \sin 66{\cdot}97°$
	●[6] answer properly rounded	●[6] 1 956 cm^2 Answers may vary depending on rounding. Do not penalise premature rounding

Qu	Give one mark for each ●	Illustrations for awarding mark
6	**ans : $k = 24$** **4 marks** ●1 knows condition for equal roots ●2 substitutes values ●3 simplifies and factorises ●4 solves for k and chooses correct value	 ●1 $b^2 - 4ac = 0$ [stated or implied] ●2 $k^2 - 4 \times 6 \times k = 0$ ●3 $k^2 - 24k = 0$; $k(k - 24) = 0$ ●4 $k = 24$
7	**ans: £9 790** **4 marks** ●1 correct multiplier ●2 knows how to decrease over 3 years ●3 answer ●4 correctly rounded	 ●1 ....0·858.... ●2 $15\,500 \times 0{\cdot}858^3$ ●3 £9 790.245036 ●4 £9 790
8	**ans: comments** **2 marks** ●1 comments on mean ●2 comments on distribution	 ●1 on average hours studied same ●2 more consistent
9	**ans : 68·8°** **5 marks** ●1 uses correct diameter ●2 calculates circumference ●3 sets up equal ratios ●4 starts to solve ●5 answer	 ●1 $d = 30$ cm [may be in formula] ●2 C = 3·14 × 30 = 94·2 ●3 18/94·2= angle/360 ●4 angle = (18 × 360) / 94·2 ●5 68·8°
10	**ans : 143·1° and 216·9°** **4 marks** ●1 evaluates $\cos x^\circ$ ●2 takes inverse ●3 finds one value for x ●4 finds second value for x	 ●1 $\cos x^\circ = -4/5$ ●2 $\cos^{-1}(4/5) = 36{\cdot}9^\circ$ ●3 143·1° ●4 216·9°
11	**ans: No, as £2.25 > £1.99** **3 marks** ●1 finding scale factor for reduction ●2 calculating cost ●3 comparing cost with £2.25	 ●1 linear S.F. $= \frac{10}{14} = \frac{5}{7}$ ●2 cost $= \left(\frac{5}{7}\right)^3 \times £5.45 = £1.99$ ●3 answer
12a b	**ans: 603 cm³** **3 marks** ●1 substitutes values in formula ●2 answer ●3 correct rounding **ans: 3·1 cm** **3 marks** ●1 subs know values into formula ●2 knows how to find height ●3 answer	 ●1 $\frac{1}{3} \times \pi \times 6^2 \times 16$ ●2 603·1857895 ●3 603 cm³ ●1 $603 = 15 \times 13 \times h$ ●2 $h = 603 \div 195$ ●3 3·1 cm
		Total 50 marks

N5

Practice Paper C

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) | **Candidate number** | **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 $x = \dfrac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$

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

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

Area of a triangle: Area = ½ $ab \sin C$

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

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

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

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

All questions should be attempted

Marks

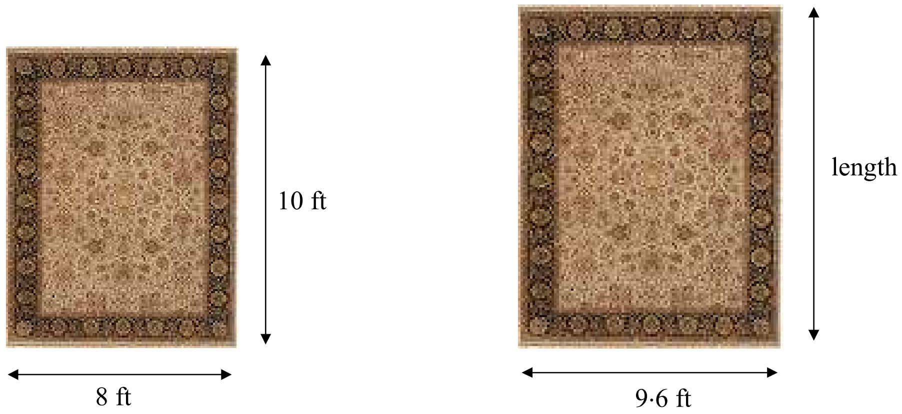
1. Lauren and Vicky record the amount of time they spend in the gym every day.

The Standard Deviation of the time Lauren spends is 4·4 and for Vicki is 5·7.

Compare the two sets of data making particular reference to the spread of the times the 2 girls spend in the gym. **1**

2. James is looking to buy a new rug.

The two rugs below are **mathematically similar** in shape.



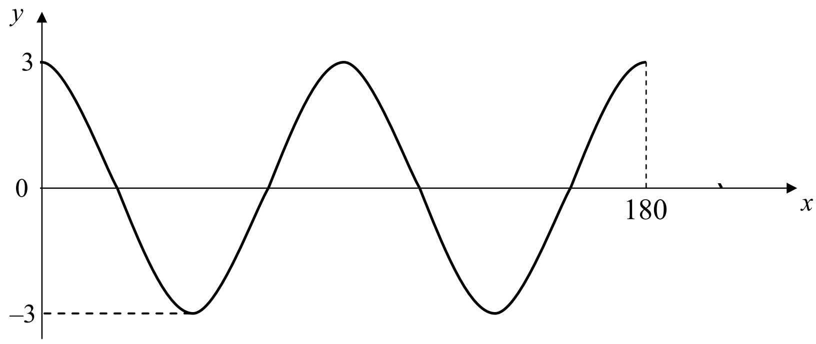
He is hoping that the length of the large rug will be enough to make the **area** of the large rug **at least 120 square feet**.

Does the large rug have the required area?

You must show appropriate working and give a reason for your answer. **4**

3. Evaluate $1\frac{1}{3} + \frac{3}{5}$ of $2\frac{1}{7}$ **3**

4. The diagram below shows the graph of $y = a\cos bx^\circ$ for $0 \le x \le 360$.

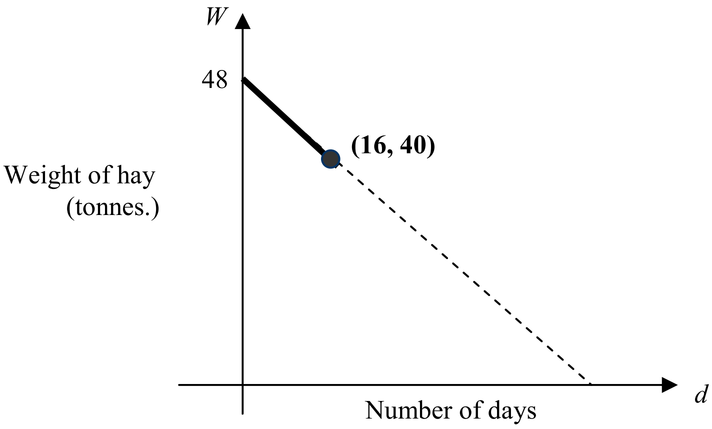


Write down the values of a and b. **2**

5. **(a)** Simplify $\dfrac{a^2 \times a^5}{a^{-3}}$ **2**

(b) Evaluate $125^{\frac{2}{3}}$ **2**

6. The local riding stables buy in 48 tonnes of hay to feed the horses during the winter season, which lasts for 93 days.
After 16 days they have 40 tonnes of hay left.
The graph below illustrates the situation.



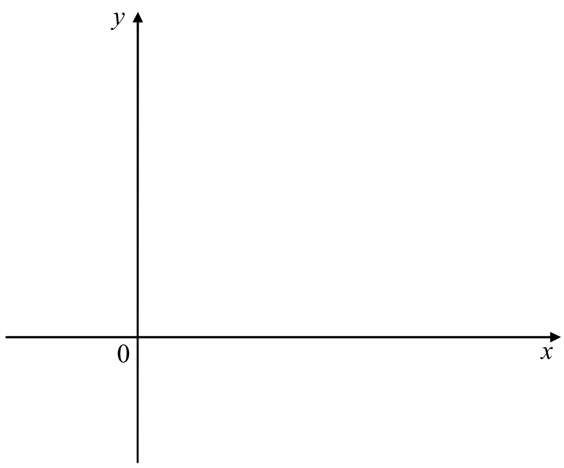
(a) Find the equation of the line shown above. **3**

(b) If the horses continue to consume the hay at this rate, will it last to the end of the winter season? **3**

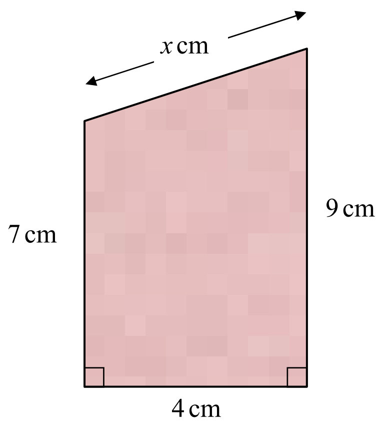
Marks

7. A graph has equation of the form $y = \boldsymbol{a}x^2 + \boldsymbol{b}x + c$.

Given that $\boldsymbol{a} > 0$ and $\boldsymbol{b}^2 - 4\boldsymbol{ac} < 0$, draw a possible graph for y. **3**

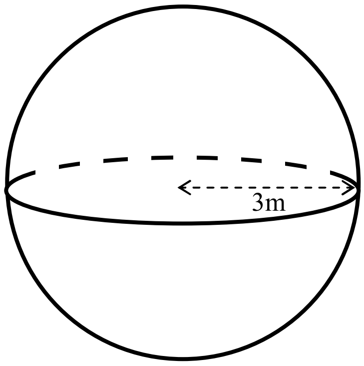


8. The diagram below shows the end view of a scale model of a garden shed.



Calculate the exact value of x, giving your answer as a surd in its simplest form. **4**

9. Calculate the volume of this sphere which has radius 3m. **3**
[Take $\pi = 3 \cdot 14$]



10. A quadratic graph has equation $y = 5 - (x+2)^2$.

(a) What are the coordinates **and** nature of the turning point of the graph? **3**

(b) Which of the following is the equation of its axis of symmetry? **1**

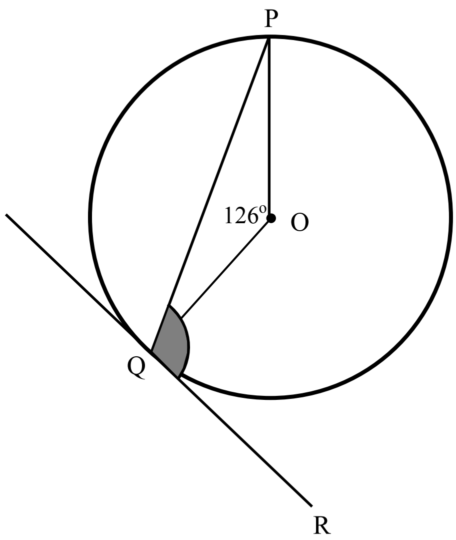
A $x = -2$
B $x = 2$
C $x = 5$
D $x = -5$

Do not write in this margin.

Marks

11. P and Q are points on the circumference of this circle with centre O.
PR is a tangent to the circle and angle AOB = 126°.

Calculate the size of angle PQR, the shaded area in the diagram. **2**



12. Solve the equation

$$x(x-3) = 10$$ **4**

End of Question Paper

Qu	Give one mark for each •	Illustrations for awarding mark
1	**ans : comment** **1 mark** •1 compares Standard Deviations	 •1 Vicki's times are less consistent than Lauren's [or equivalent].
2	**ans : will not be big enough** **4 marks** •1 finds linear scale factor •2 finds length of missing side •3 finds area of large rug •4 valid conclusion Area scale factor can also be used •1 finds linear scale factor •2 finds area scale factor •3 finds area of large rug •4 valid conclusion	 •1 L.S.F. = 9·6/8 = 1·2 [or equivalent] •2 $1{\cdot}2 \times 10 = 12$ •3 $9{\cdot}6 \times 12$ •4 realises area < 120 square feet •1 L.S.F. = 9·6/8 = 1·2 [or equivalent] •2 A.S.F. = $(1{\cdot}2)^2 = 1{\cdot}44$ •3 $1{\cdot}44 \times 80$ •4 realises area < 120 square feet
3	**ans:** $\frac{55}{21} = 2\frac{13}{21}$ **3 marks** •1 know order of calculations •2 multiply fractions correctly •3 add fractions correctly	 •1 $\frac{3}{5} \times \frac{15}{7}$ •2 $1\frac{1}{3} + \frac{9}{7}$ •3 $2\frac{13}{21}$
4	**ans:** $a = 3$; $b = 4$ **2 marks** •1 states value of a •2 states value of b	 •1 $a = 3$ •2 $b = 4$
5(a) 5(b)	**ans :** a^{10} **2 marks** •1 simplifies numerator •2 simplifies expression **ans: 25** **2 marks** •1 interprets index •2 evaluates	 •1 a^7 •2 a^{10} •1 $125^{\frac{2}{3}} = \sqrt[3]{125^2}$ •2 25
6(a) 6(b)	**ans:** $W = -0{\cdot}5d + 48$ **3 marks** •1 identifies y - intercept •2 calculates gradient •3 states equation **ans: Yes, 3 days spare** **3 marks** •1 correct strategy •2 solves equation •3 correct conclusion	 •1 $c = 48$ •2 $m = \frac{48-40}{0-16} = -0\cdot5$ •3 $W = -0{\cdot}5d + 48$ •1 $-0{\cdot}5d + 48 = 0$ •2 $d = 96$ •3 yes, 3 days to spare

Qu	Give one mark for each ●	Illustrations for awarding mark
7	**ans : suitable graph drawn 3 marks** ●[1] correct shape ●[2] correct nature of turning point ●[3] no roots	 ●[1] parabolic shape [accept any] ●[2] minimum turning point ●[3] graph above x – axis
8	**ans : 2√5 4 marks** ●[1] assembles facts in R A T ●[2] knows to use Pythagoras ●[3] finds length as surd ●[4] simplifies	 ●[1] ●[2] $x = \sqrt{(4^2 + 2^2)}$ ●[3] $x = \sqrt{20}$ ●[4] $x = 2\sqrt{5}$
9	**ans : 113·04cm³ 3 marks** ●[1] subs values in correct formula ●[2] starts to evaluate ●[3] answer	 ●[1] $V = \frac{4}{3} \times 3 \cdot 14 \times 3^3$ ●[2] evidence of carrying out part calculation ●[3] $113 \cdot 04\text{cm}^3$
10	**ans: (–2, 5); maximum 3 marks** ●[1] states x – coordinate of T.P. ●[2] states y – coordinate of T.P. ●[3] identifies nature **ans: A 1 mark** ●[1] correct axis of symmetry	 ●[1] (–2, ……. ●[2] ……, 5) ●[3] maximum ●[1] A
11	**ans : 117° 2 marks** ●[1] recognises isosceles triangle ●[2] recognises right angle	 ●[1] $\angle$ ABO = 27° ●[2] $\angle$ABC = 90 + 27 = 117°
12	**ans : $x = 5$ or $x = -2$ 4 marks** ●[1] multiplies brackets/collects terms to LHS ●[2] factorises ●[3] equate each bracket to zero ●[4] solves for x	 ●[1] $x^2 - 3x = 10$; $x^2 - 3x - 10 = 0$ ●[2] $(x - 5)(x + 2) = 0$ ●[3] $(x - 5) = 0$; $(x + 2) = 0$ ●[4] $x = 5$ or $x = -2$
		Total 40 marks

N5

Practice Paper C

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 Day Month Year | **Candidate number** | **Seat number**

Total marks - 50

1. **You may 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 If you use this space, write clearly the number of the question you are attempting. is provided at the end of the booklet.
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 $x = \dfrac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$

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

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

Area of a triangle: Area = ½ ab sin C

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

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

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

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

Marks

All questions should be attempted

1. A patient in a hospital is injected with 200 mg of a drug.

(a) It is known that for each hour after the injection the number of milligrams of the drug left in the body is 15% less than at the beginning of that hour.

How many milligrams of the drug are left in the patient's body at the end of 3 hours? **3**

(b) The patient is given a second drug.

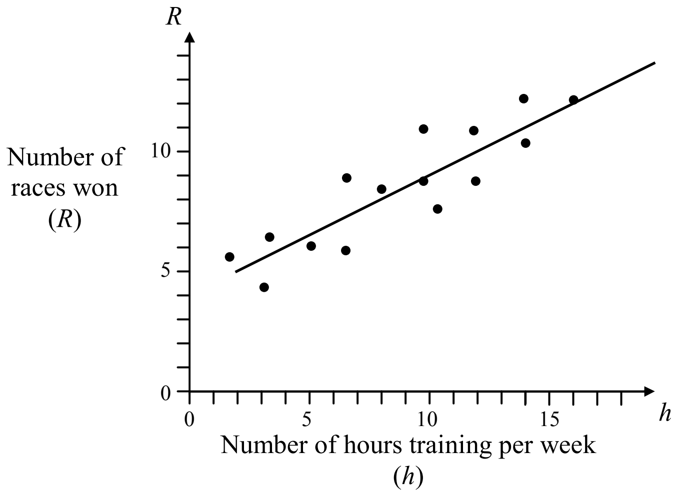
It is known that, for this second drug, at the end of each hour the number of milligrams of the drug left in the body is 12% less than at the beginning of that hour.

At the end of one hour the patient had $123 \cdot 2$ mg of the second drug left in his body.

Calculate the size of the initial dose, of this second drug, given to the patient. **2**

2. Vector ***a*** has components $\boldsymbol{u} = \begin{pmatrix} -4 \\ 2 \\ k \end{pmatrix}$. If $|\boldsymbol{u}| = 6$, calculate the values of k. **4**

3. The graph below shows the relationship between the number of hours (h) a swimmer trains per week and the number of races (R) they have won.

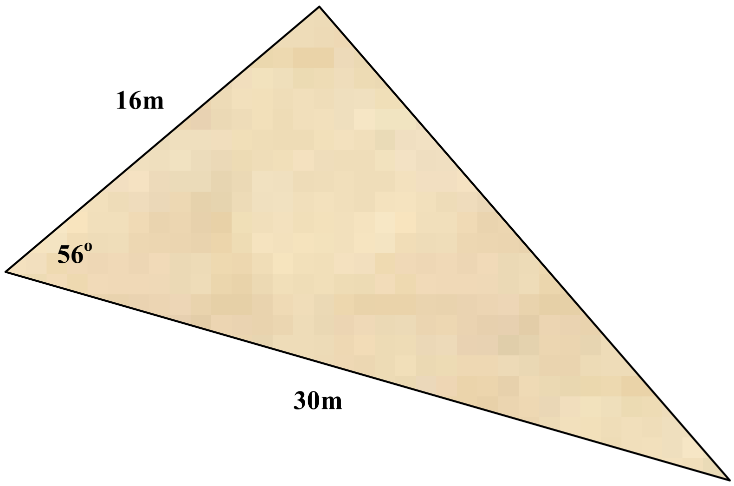


A best fitting straight line has been drawn.

(a) Use information from the graph to find the equation of this line of best fit. **3**

(b) Use the equation to predict how many races a swimmer who trains 22 hours per week should win. **1**

4. A building company has to fence off a triangular piece of waste ground. The plan of the ground is shown below. All lengths are in metres.



If the fence costs £18.50 per metre to erect, how much will the company have to pay in total to fence off this piece of ground?

Give your answer to the nearest ten pounds. **5**

5. Determine the nature of the roots of the quadratic equation

$$2x^2 - 3x + 7 = 0$$ **3**

Marks

6. Some friends stopped at a roadside café.

(a) Peter bought 3 bacon rolls and 2 cups of tea which cost him a total of £5.10. Taking the cost of a bacon roll as 'x' pence and 'y' as the cost of a cup of tea, write an equation to illustrate this. **1**

At the same café, Colin bought 2 bacon rolls and 1 cup of tea and was charged £3.15.

(b) Construct a second equation to illustrate this. **1**

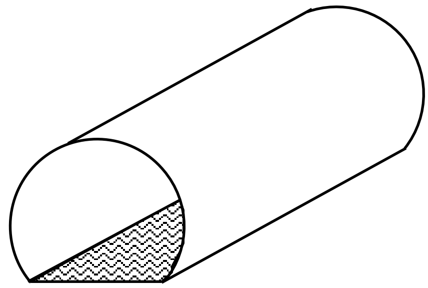
(c) How much did Stewart pay for 4 bacon rolls and 3 cups of tea? **4**

7. Simplify this fraction $\dfrac{10x^2 - 17x + 3}{4x^2 - 9}$ **3**

Do not write in this margin.

Marks

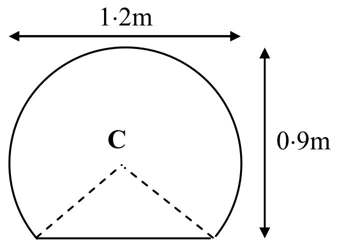
8. Shown is a children's play tunnel which has been fitted with a rectangular insulating mat .



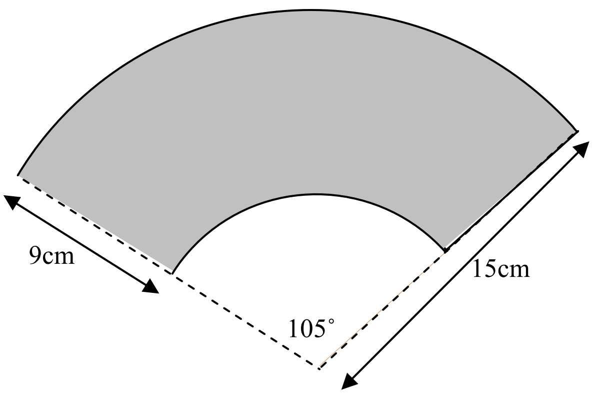
The end of the tunnel consists of part of a circle, centre **C**, with diameter 1·2 metres.

The height of the tunnel is 0·9 metres.

Calculate the area of the mat if the tunnel is 7 metres long. **4**



9. A hand fan is made of wooden slats with material on the outer edge.

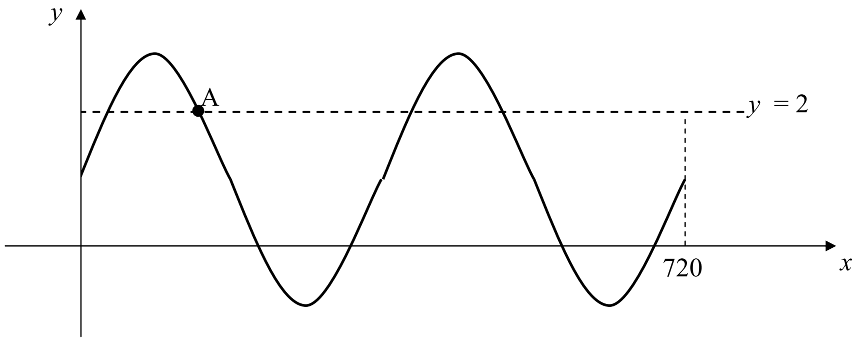


Calculate the area of material needed for the hand fan. **5**

10. Simplify $\dfrac{1-\cos^2 x}{\cos^2 x}$ **2**

11. The diagram below shows the graph of $y = 2\sin x^\circ + 1$ for $0 \le x \le 720$.

The line $y = 2$ has also been drawn on the diagram.

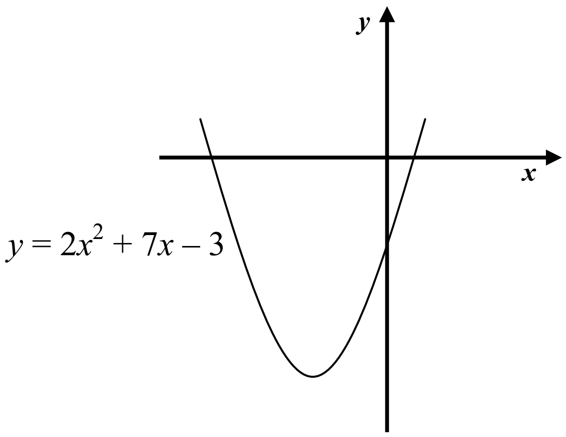


Find the coordinates of point A. **4**

Do not write in this margin.

Marks

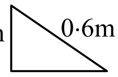
12. The diagram show the graph of $y = 2x^2 + 7x - 3$



Find the x - coordinates of the points where the graph crosses the x - axis giving your answers correct to 1 decimal place. **5**

End of Question Paper

Qu	Give one mark for each •	Illustrations for awarding mark
1a	**ans : 122·825 mg** **3 marks**	
	•[1] correct multiplier •[2] knows how to decrease for 3 hours •[3] answer	•[1] …… × 0·85 •[2] $200 \times 0{\cdot}85^3$ •[3] 122·825 mg
b	**ans: 140 mg** **2 marks**	
	•[1] method •[2] answer	•[1] 88% = 123·2 ÷ 0·88 •[2] 140 mg
2	**ans : 4 or – 4** **4 marks**	
	•[1] knows how to find magnitude •[2] equates to 6^2 •[3] removes roots signs and simplifies •[4] solves	•[1] $\sqrt{(-4)^2+(2)^2+k^2}$ •[2] $\sqrt{(-4)^2+(2)^2+k^2} = 6^2$ •[3] $20+k^2=36; k^2=16$ •[4] $k=\pm4$
3a	**ans : $R = ½h + 4$** **3 marks**	
	•[1] finds gradient of line •[2] finds y – intercept •[3] states equation of line	•[1] $m = ½$ •[2] (0, 4) •[3] $R = ½h + 4$
b	**ans: 15 races won** **1 mark**	
	•[1] subs into equation and evaluates	•[1] ½(22) + 4 = 15
4	**ans: £1 310** **5 marks**	
	•[1] knows to use Cosine rule •[2] subs values into formula •[3] evaluates •[4] finds perimeter •[5] calculates cost of fencing to nearest £	•[1] evidence •[2] $x^2 = 16^2 + 30^2 - 2\times16\times30\times\cos 56°$ •[3] 24·9 m •[4] 30 + 16 + 24·9 = 70·9 m •[5] 70·9 × £18.50 = £1 310 to nearest £10
5	**ans : no real roots** **3 marks**	
	•[1] knows to find discriminant •[2] finds discriminant •[3] valid conclusion	•[1] evidence of finding $b^2 - 4ac$ •[2] $(3)^2 - 4 \times 2 \times 7 = -47$ •[3] no real roots
6a	**ans: $3x + 2y = 5{\cdot}10$** **1 mark**	
	•[1] states equation	•[1] $3x + 2y = 5{\cdot}10$
b	**ans: $2x + y = 3{\cdot}15$** **1 mark**	
	•[1] states equation	•[1] $2x + y = 3{\cdot}15$

Qu	Give one mark for each ●	Illustrations for awarding mark
c	**ans: £7.05 4 marks** ●[1] knows to use sim. equations ●[2] prepares equations ●[3] finds value for x and y ●[4] calculates cost	 ●[1] evidence ●[2] equates x or y coefficients ●[3] $x = 1{\cdot}20$; $y = 0{\cdot}75$ ●[4] $£1.20 \times 4 + 0{\cdot}75 \times 3 = £7.05$
7	**ans : $(5x - 1)/(2x + 3)$ 3 marks** ●[1] factorises numerator ●[2] factorises denominator ●[3] simplifies	 ●[1] $(5x - 1)(2x - 3)$ ●[2] $(2x - 3)(2x + 3)$ ●[3] $(5x - 1)/(2x + 3)$
8	**ans : 7m^2 4 marks** ●[1] interpret information in rt. Triangle ●[2] calculate missing side ●[3] state breadth of mat ●[4] calculate area	●[1]  ●[2] $\sqrt{\left(0\cdot6^2 - 0\cdot3^2\right)} = 0\cdot5\text{ m}$ ●[3] breadth = 1m ●[4] 7m^2
9	**ans : 173·18 cm^2 5 marks** ●[1] knows how to calculate area of sector ●[2] calculates area of large sector ●[3] calculates radius of smaller sector ●[4] calculates area of small sector ●[5] subtracts areas	 ●[1] ${}^{105}/_{360} \times \pi \times \ldots^2$ ●[2] ${}^{105}/_{360} \times \pi \times 15^2 = 206{\cdot}17\text{ cm}^2$ ●[3] $15 - 9 = 6\text{cm}$ ●[4] ${}^{105}/_{360} \times \pi \times 6^2 = 32{\cdot}99\text{ cm}^2$ ●[5] $206{\cdot}17 - 32{\cdot}99 = 173{\cdot}18\text{ cm}^2$
10	**ans : $\tan^2 x^\circ$ 2 marks** ●[1] replaces $1 - \cos^2 x^\circ$ ●[2] simplifies	 ●[1] $\sin^2 x^\circ$ ●[2] $\tan^2 x^\circ$
11	**ans: A(150°, 2) 4 marks** ●[1] equates equation to 2 ●[2] solves for $\sin x^\circ$ ●[3] finds solution(s) ●[4] states coordinates of A	 ●[1] $2 = 2\sin x^\circ + 1$ ●[2] $\sin x^\circ = \frac{1}{2}$ ●[3] $x = 30^\circ$ or 150° ●[4] A(150°, 2)
12	**ans : 0·4; –3·9 5 marks** ●[1] equates equation to zero ●[2] knows to use quadratic formula ●[3] evaluates discriminant ●[4] finds roots [no rounding] ●[5] rounds correctly	 ●[1] $2x^2 + 7x - 3 = 0$ ●[2] evidence of substituting values ●[3] $\sqrt{73}$ ●[4] $(-7 + \sqrt{73}) \div 4$; $(-7 - \sqrt{73}) \div 4$ ●[5] 0·4; –3·9
		Total 50 marks

N5

Specimen Paper D

MATHEMATICS

National Qualifications - National 5

Paper 1 (non-calculator)

Covering Units 1, 2 and 3

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)	Candidate number	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 $x = \dfrac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$

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

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

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

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

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

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

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

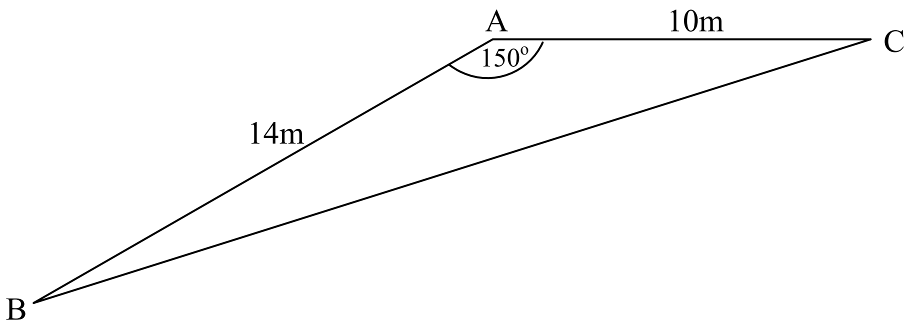
Do not write in this margin.

All questions should be attempted

Marks

1. Express $y = x^2 - 6x + 7$ in the form $y = (x - a)^2 + b$. **2**

2. In triangle ABC, AB = 14m and AC = 10m. Angle BAC = 150°.



Given that sin 150° = 0·5, calculate the area of triangle ABC. **3**

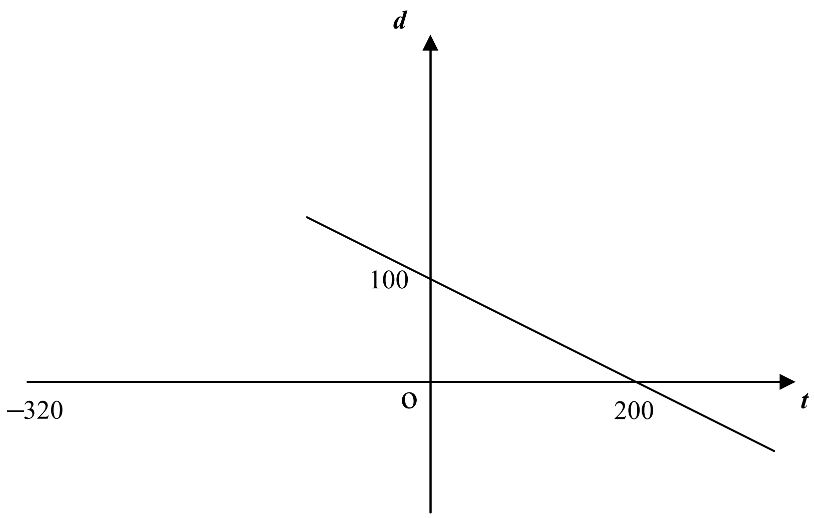
3. Evaluate $\frac{6}{7}$ of $\left(\frac{2}{3} - \frac{1}{2}\right)$ **2**

4. **(a)** If $h(x) = 5x - 2x^2$, find the value of $h(-2)$ **2**

(b) Factorise **fully** $15y^2 - 3y$ **1**

(c) Hence, or otherwise, express $\dfrac{15y^2 - 3y}{25y^2 - 1}$ in its simplest form. **2**

5.



(a) Find the equation of the line in terms of ***t*** and ***d***. **4**

(b) If the line were continued, would it pass through the point P(–320, 250)?
Give a reason for your answer. **2**

6. **(a)** Remove the brackets and simplify

$$(t - 5v)(3t + 2v)$$ **2**

(b) Solve the inequality:

$$3 - 4(3x - 4) \geq 3(2 - 3x)$$ **4**

(c) Solve **algebraically** the equation

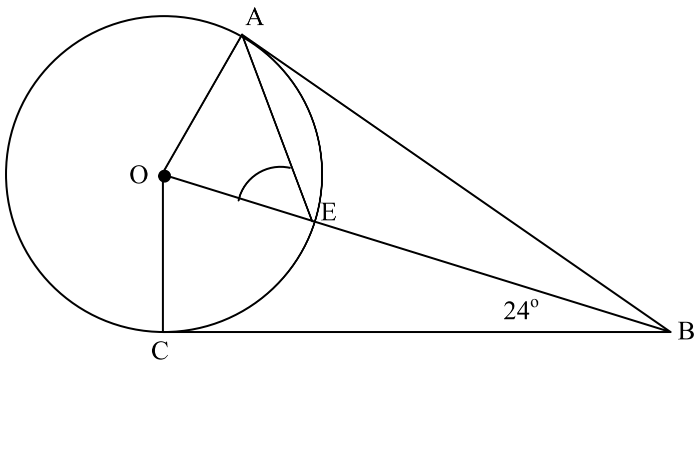
$$\frac{m}{3} - \frac{(m-3)}{2} = 1$$ **3**

7. Given the following vectors

$$\overrightarrow{AB} = \begin{pmatrix} 2 \\ 2 \\ 4 \end{pmatrix} \quad \text{and} \quad \overrightarrow{AC} = \begin{pmatrix} 2 \\ -1 \\ 1 \end{pmatrix}$$

Find $|2\overrightarrow{\mathbf{AB}} - 2\overrightarrow{\mathbf{AC}}|$, expressing the result as a surd in its simplest form **4**

8.



The diagram above shows a quadrilateral ABCO. BA and BC are tangents to the circle, centre O, and E is the point where OB meets the circle.

Find the size of angle OEA. **3**

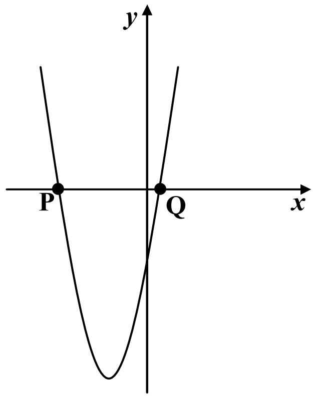
Marks

9. **(a)** Simplify $m^3 \times m^{-5}$ **1**

(b) Evaluate $81^{\frac{3}{4}}$ **2**

10. The graph in the diagram has equation

$y = 2x^2 + 5x - 3$ and cuts the x-axis at **P** and **Q**.



Find the coordinates of the points **P** and **Q**. **3**

End of Question Paper

	Give 1 mark for each •	Illustration(s) for awarding each mark
1	**ans: $y = (x - 3)^2 - 2$** **2 marks** •1 bracket correct •2 value of b correct	•1 $(x - 3)^2$……. •2 ……$- 2$
2	**ans : 35 cm^2** **3 marks** •1 knows to use area of triangle formula •2 subs values into formula •3 calculates area	•1 evidence •2 $A = \frac{1}{2}\times 14\times 10\times 0\cdot 5$ •3 $A = 35\text{cm}^2$
3	**ans: $\frac{1}{7}$** **2 marks** •1 subtract fractions •2 multiply fractions	•1 1/6 •2 1/7 or equivalent
4(a)	**ans: –18** **2 marks** •1 interpret function notation •2 evaluate function	•1 $5 \times (-2) - [\,2 - (-2) - (-2)\,]$ •2 -18
(b)	**ans: $3y(5y - 1)$** **1 mark** •1 factorises	•1 $3y\,(5y - 1)$
(c)	**ans: $\frac{3y}{5y+1}$** **2 marks** •1 factorise denominator •2 simplify	•1 $(5y - 1)(5y + 1)$ •2 $3y/(5y + 1)$
5(a)	**ans: $d = -1/2t + 100$** **4 marks** •1 for starting to find m •2 for calculating m •3 for finding c •4 for equation with ***d*** and ***t***	•1 $m = (100 - 0) / (0 - 200)$ •2 …. $= -\frac{1}{2}$ or equiv. •3 $c = 100$ •4 $d = -\frac{1}{2}\,t + 100$
(b)	**ans: No - point does *not* satisfy equation** **2 marks** •1 substitutes values in equation •2 valid conclusion	•1 $250 = -\frac{1}{2} \times (-320) + 100$ •2 $250 \neq 160 + 100$, so point *not* on line.

	Give 1 mark for each •	Illustration(s) for awarding each mark
6. (a)	**ans: $3t^2 - 13vt - 10v^2$ 2 marks**	
	•[1] for finding $3t^2 and -10v^2$ •[2] for finding $-13vt$	•[1] $3t^2 and -10v^2$ •[2] $-13vt$
(b)	**ans: $x \leq \frac{13}{3}$ 4 marks**	
	•[1] removing brackets •[2] collecting like terms •[3] knows to reverse inequality •[4] solving inequation	•[1] $3 - 12x + 16 \geq 6 - 9x$ •[2] $-3x \geq -13$ •[3] $x \leq$ •[4] $\frac{13}{3}$
(c)	**ans: $m = 3$ 3 marks**	
	•[1] add the fractions •[2] multiply expressions •[3] solve equation	•[1] multiply by 6 or take common denominator •[2] ………$-m + 9$ •[3] $m = 3$
7.	**ans: $6\sqrt{2}$ 4 marks**	
	•[1] finds $2\overrightarrow{AB} - 2\overrightarrow{AC}$ •[2] knows how to find the magnitude •[3] finds the magnitude •[4] expresses as a surd in its simplest form	•[1] $\begin{pmatrix} 0 \\ 6 \\ 6 \end{pmatrix}$ •[2] $\sqrt{(0^2 + 6^2 + 6^2)}$ •[3] $\sqrt{72}$ •[4] $6\sqrt{2}$
8.	**ans: 57° 3 marks**	Steps can be shown on diagram but angle OEA must be stated explicitly
	•[1] knows angle ABO = 24° and angle A is right •[2] finds angle AOB •[3] final answer.	•[1] evidence •[2] angle AOB = 56° •[3] angle OEA = 57°
9(a)	**ans: m^{-2} 1 mark**	
	•[1] follows rule for indices	•[1] m^{-2}
(b)	**ans: 27 2 marks**	
	•[1] interprets fractional index •[2] simplifies	•[1] $\sqrt[4]{81^3}$ •[2] 27
10	**ans: P(– 3, 0) and Q(0·5, 0) 3 marks**	
	•[1] equates to 0 and factorises •[2] solves equation •[3] states coordinates of P and Q	•[1] $(2x - 1)(x + 3) = 0$ •[2] $x = 0{\cdot}5$ or $x = -3$
		Total: 40 marks

N5

Practice Paper D

MATHEMATICS
National Qualifications - National 5
Paper 2 (Calculator)
Covering Units 1, 2 and 3

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 (Day Month Year)	Candidate number	Seat number

Total marks - 50

1. **You may use a calculator.**
2. Use **blue** or **black** ink. Pencil may be used for graphs and diagrams only.
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FORMULAE LIST

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

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

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

Area of a triangle: Area = ½ $ab \sin C$

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

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

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

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

All questions should be attempted

1. Multiply out the brackets and collect like terms

$$(x - 1)(x^2 + 5x - 2)$$ **3**

2. (a) A quality control examiner on a production line measures the weight in grams of cakes coming off the line. In a sample of eight cakes the weights were

150 147 148 153 149 143 145 151

Use appropriate formulae to calculate the mean and standard deviation. Show all your working clearly. **4**

(b) On a second production line, a sample of 8 cakes gives a mean of 148·25 and a standard deviation of 6·1.

Compare the two production lines by referring to the consistency of the weight. **1**

3. (a) Express $\frac{3}{x} - \frac{3}{x+1}$ as a single fraction in its simplest form $(x \neq 0, x \neq -1)$. **3**

(b) Change the subject of the formula to v in $b = \frac{v-u}{c}$ **2**

4. Solve the following trigonometric equation:

$$3\sin x° + 2 = 1, \quad 0 \leq x \leq 360$$ **3**

Do not write in this margin.

Marks

5. A charter aeroplane, when full, can carry 96 passengers. Some of these passengers will be travelling business class while others will be travelling economy class.

Let B be the number of business class passengers and E be the number of economy passengers.

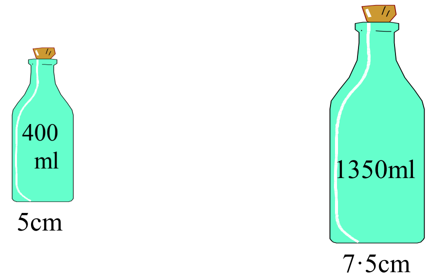
(a) Given that the plane is full, use the information above to write down a simple equation involving B and E. **1**

Each business class passenger is allowed to have 65kg of luggage but an economy passenger is allowed only 35kg. The total weight of luggage on board is 4140kg for one flight.

(b) Assuming that each passenger has taken their maximum amount of luggage, write down another equation involving B and E. **2**

(c) Find the number of business and the number of economy class passengers on board. **3**

6. The national soft drink of Spain is called " Elaborado del Hierro" and it is sold in two main bottle sizes.



The smaller bottle has a base diameter of 5cm and holds 400ml.

The larger bottle has a base diameter of 7·5cm and it holds 1350ml.

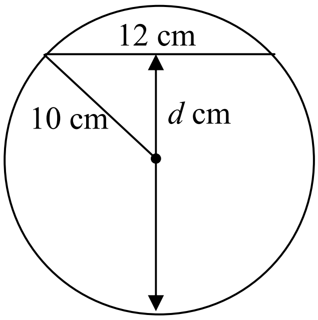
The bottles look alike but could they actually be **mathematically** similar?
(Show calculations to justify your answer.) **4**

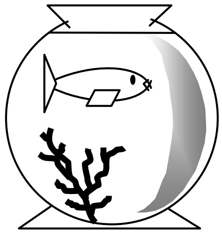
7. Solve the equation $2x^2 - x - 7 = 0$.

Give your answers **correct to 1 decimal place.** **4**

8. A goldfish bowl is filled with water to a certain level.

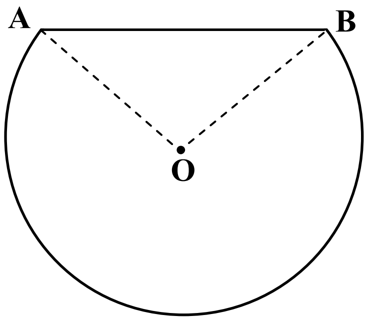
A cross section through the centre of the bowl is circular.

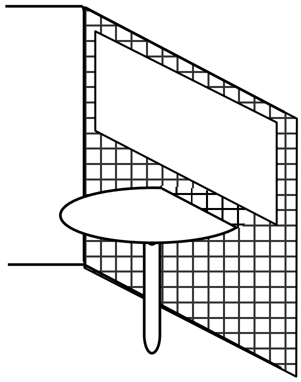




If the width of the water surface is 12 cm and the radius is 10 cm, find the depth of the water, d cm, in the bowl. **5**

9. The tables in Carlo's Coffee shop are circular with a segment removed so that they will fit against a wall.

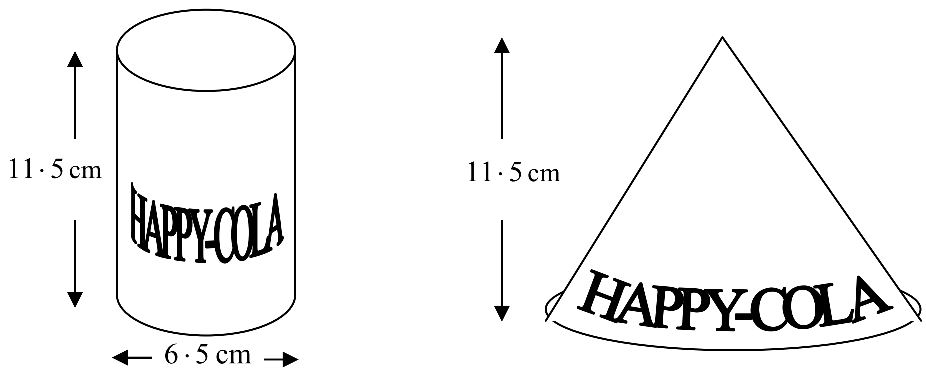




Angle AOB is 90°, where O is the centre of the circle, and the diameter of the tables is 120 cm.

The tables have to be covered in a heat resistant material. What area of material will be needed to exactly cover the table? **6**

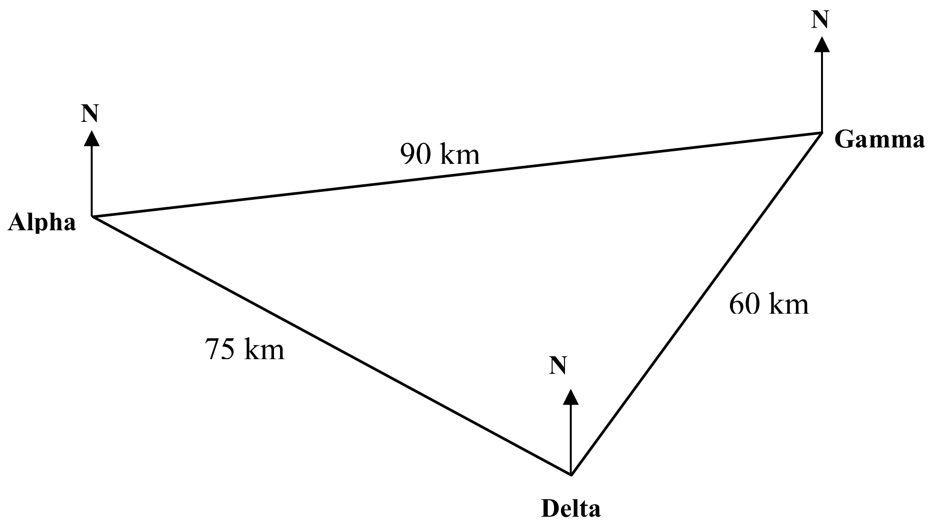
10. "HAPPY-COLA" have decided to issue a "limited edition" cone-shaped can to celebrate their 50th anniversary.
Their normal can is a cylinder whose height is $11 \cdot 5$ cm and whose **diameter** is $6 \cdot 5$ cm.



If the height of the cone is to be the same as the height of the cylinder, i.e. $11 \cdot 5$ cm, and the volume of the cone is to be the same as the volume of the cylinder, calculate the diameter of the cone.
(Answer in centimetres giving your answer correct **to 1 decimal place**) **4**

11. Three oil platforms, Alpha, Gamma and Delta are situated in the North Sea as shown in the diagram below.

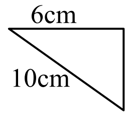
The distances between the oil platforms are shown in the diagram.



If the bearing of Delta from Alpha is 125^{o}, what is the bearing of Gamma from Alpha? **5**

End of Question Paper

Qu	Give one mark for each •	Illustrations for awarding mark
1	**ans : $x^3 + 4x^2 - 7x + 2$ 3 marks**	
	•¹ multiplies bracket by 1st term	•¹ $x^3 + 5x^2 - 2x$ . . .
	•² multiplies bracket by 2nd term	•² . . . $-x^2 - 5x + 2$
	•³ simplifies	•³ $x^3 + 4x^2 - 7x + 2$
2(a)	**ans : 148·25, 3·24 4 marks**	
	•¹ calculates mean	•¹ mean = 1186 ÷ 8 = 148·25
	•² calculates $(x - \bar{x})^2$ and totals	•² 3·0625, 1·5625, 0·0625, 22·5625, 0·5625, 27·5625, 10·5625, 7·5625; 73·5
	•³ substitutes into formula	•³ $s = \sqrt{\frac{73 \cdot 5}{7}}$ Alternative solution at end of marking scheme
	•⁴ calculates standard deviation	•⁴ s = 3·24
(b)	**ans : any suitable comment 1 mark**	
	•¹ compares samples	•¹ eg 2nd line has a larger spread of values
3(a)	**ans: $\frac{3}{x(x+1)}$ 3 marks**	
	•¹ correct numerator	•¹ $3(x + 1) - 3x$
	•² correct denominator	•² $x(x + 1)$
	•³ for simplifying numerator	•³ = 3
(b)	**ans: $v = bc + u$ 2 marks**	
	•¹ multiplies through by b	•¹ $v - u = bc$
	•² adds u to both sides	•² $v = bc + u$
4	**ans: 199·5°, 340·5° 3 marks**	
	•¹ manipulation to sin$x$° =…	•¹ sin$x$° = − 1/3
	•² finds one solution	•² x = 199·5°
	•³ finds second solution	•³ x = 340·5°
		N.B. x = −19·5° is not acceptable for •²
5(a)	**ans: B + E = 96 1 mark**	
	•¹ equation	•¹ B + E = 96
(b)	**ans: 65B + 35E = 4140 2 marks**	
	•¹ part of equation	•¹ 65B + 35E…
	•² further part of equation	•² 65B + 35E = 4140
(c)	**ans: B = 26, E = 70 3 marks**	
	•¹ scales sim. equations	•¹ 65B + 35E = 4140, 35B + 35E = 3360
	•² solves for both variables	•² B = 26; E = 70
	•³ states number of each passenger	•³ 26 business class and 70 economy class

Qu	Give one mark for each ●	Illustrations for awarding mark
6	**ans: Yes, bottles could be similar 4 marks** $\bullet^1$ calculating the linear scale factor $\bullet^2$ knowing to **cube** the S.F. $\bullet^3$ calculating the new volume $\bullet^4$ consistent conclusion	 $\bullet^1$ $7{\cdot}5 / 5 = \text{S.F.}$ $\bullet^2$ $1{\cdot}5^3 = 3{\cdot}375$ $\bullet^3$ $V = 400 \times 3{\cdot}375 = 1350$ $\bullet^4$ bottles **could** be similar since volumes are consistent with similar shapes
7	**ans: 2·1 or –1·6 4 marks** $\bullet^1$ knows to use quadratic formula $\bullet^2$ evaluates discriminant $\bullet^3$ substitutes values $\bullet^4$ finds values of *x* correctly rounded	 $\bullet^1$ evidence $\bullet^2$ $b^2 - 4ac = 57$ $\bullet^3$ $x = \dfrac{1 \pm \sqrt{57}}{4}$ $\bullet^4$ $x = 2{\cdot}1,\ -1{\cdot}6$
8	**ans : 18 cm 5 marks** $\bullet^1$ knows to use Pythagoras $\bullet^2$ assembles facts in right triangle $\bullet^3$ uses Pythagoras $\bullet^4$ calculates *x* $\bullet^5$ calculates depth	 $\bullet^1$ evidence $\bullet^2$ see diagram  $\bullet^3$ $x^2 + 6^2 = 10^2$ $\bullet^4$ $x = 8$ $\bullet^5$ $d = 8 + 10 = 18$ cm
9	**ans : $10282{\cdot}3\text{cm}^2$ 6 marks** $\bullet^1$ knows to find angle at centre $\bullet^2$ knows area of sector is ¾ circle $\bullet^3$ substitutes radius $\bullet^4$ calculates area $\bullet^5$ knows to calculate area of triangle $\bullet^6$ calculates total area	 $\bullet^1$ angle at centre is 270° $\bullet^2$ area of sector = $\frac{3}{4}\pi r^2$ $\bullet^3$ area of sector = $\frac{3}{4}\pi \times 60^2$ $\bullet^4$ area = $8482{\cdot}3\text{ cm}^2$ $\bullet^5$ Δ area = $\frac{1}{2} \times bh = \frac{1}{2} \times 60 \times 60 = 1800\text{ cm}^2$ $\bullet^6$ $10282{\cdot}3\text{ cm}^2$
10	**ans: Diameter ≈ 11·2 cm 4 marks** $\bullet^1$ volume of cylinder $\bullet^2$ vol. of cyl. = vol. of cone (strategy) $\bullet^3$ calculating r^2 $\bullet^4$ final answer	 $\bullet^1$ volume of cyl. = $381{\cdot}4\text{ cm}^3$ $[\pi = 3{\cdot}14]$ $\bullet^2$ $381{\cdot}4 = 1/3\pi r^2 h$ $\bullet^3$ $r^2 = 31{\cdot}7$cm $\bullet^4$ D = 11·2cm
11	**ans : 084° 5 marks** $\bullet^1$ knows to use cosine rule $\bullet^2$ substitutes correctly $\bullet^3$ calculates angle $\bullet^4$ subtracts to find angle $\bullet^5$ writes bearing	 $\bullet^1$ $\cos x^\circ = \ldots$ $\bullet^2$ $= (90^2 + 75^2 - 60^2)/(2 \times 90 \times 75)$ $\bullet^3$ $x = 41{\cdot}4^\circ$ $\bullet^4$ $125^\circ - 41^\circ = 84^\circ$ $\bullet^5$ 084°
		Total 50 marks

ALTERNATIVE SOLUTION TO QUESTION 2

2(a)	**ans : 148·25, 3·24** **4 marks**	
	•[1] calculates mean	•[1] mean = 1186 ÷ 8 = 148·25
	•[2] finds $\sum x^2$ and $(\sum x)^2$	•[2] $3\sum x^2 = 175898$; $(\sum x)^2 = 1406596$
	•[3] substitutes into formula	•[3] $s = \sqrt{\dfrac{175898 - (1406596/8)}{7}}$
	•[4] calculates standard deviation	•[4] s = 3·24
(b)	**ans : any suitable comment** **1 mark**	
	•[1] compares samples	•[1] eg 2nd line has a larger spread of values

N5

Specimen Paper E

MATHEMATICS
National Qualifications - National 5
Paper 1 (non-calculator)
Covering Units 1, 2 and 3

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 | **Candidate number** | **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 $x = \dfrac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$

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

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

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

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

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

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

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

Do not write in this margin.

All questions should be attempted

Marks

1. Multiply and simplify

$$(3x-4)(2x-7)$$ **2**

2. **(a)** The line AB passes through the points (0, 8) and (12, 0). On a coordinate diagram , plot A and B and find the equation of the line AB. **3**

(b) The equation of the line PQ is $2x + y = 12$. Draw this line onto the same diagram as the line AB. **2**

(c) Write down the coordinates of T, the point of intersection of these two lines. **1**

3. Ricky buys a pre-owned car for £4000. The value of the car depreciates at the rate of 10% per annum.

How much will the car be worth at the end of 3 years? **4**

4. The data shows the length of films on TV during one weekend in July.

145	120	110	105	130
105	100	95	100	105
100	115	90	115	100

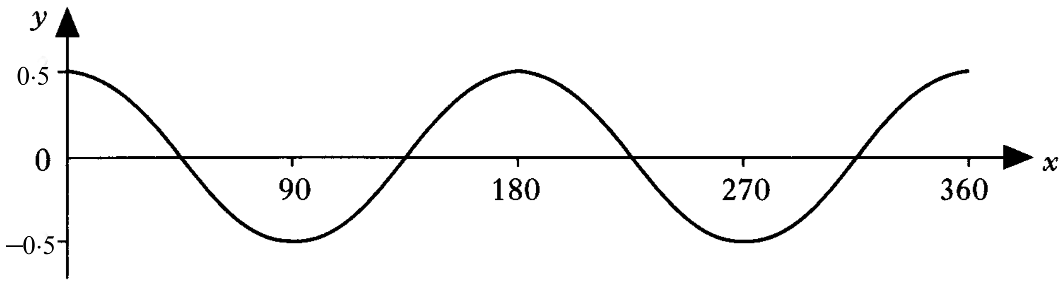
(a) Calculate the interquartile range for this data set. **4**

(b) The length of films during one weekend in December gave a interquartile range of 17.

Make a comment about the length of films in December compared to July. **1**

Do not write in this margin.

5. *Marks*

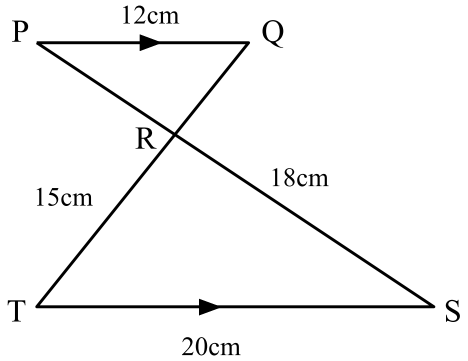


The diagram shows the graph of $y = a\cos bx^0$, $0 \leq x \leq 360$.
Find the values of *a* and *b*. **2**

6. Triangles PQR and RST, with some of their measurements, are shown in the diagram opposite.

PQ is parallel to TS.

Calculate the length of TQ. **4**



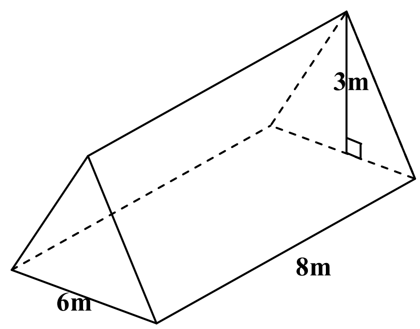
7. **(a)** Factorise $2x^2 + 5x - 12$. **2**

(b) Hence, simplify the fraction $\dfrac{x^2 - 16}{2x^2 + 5x - 12}$. **2**

8. Gareth wants to know the volume of the roof space in his house which is in the shape of a triangular prism.

He makes a sketch and takes these measurements.

Calculate the volume. **3**



9. Two adults and three children pay £17.40 for admission to their local school concert.

One adult and two children pay £10.20 for admission to the same concert.

How much would 3 adults and 1 child have to pay to be admitted to the concert? **5**

10. Two functions are defined as follows :

$$f(x) = x^2 + 2x - 6$$
$$g(x) = 7x + 8$$

Find the value(s) of x for which $3\big(f(x)\big) + g(x) = 0$. **4**

11. Simplify $\cos x^{\circ} \tan x^{\circ}$ **2**

End of Question Paper

Qu	Give one mark for each •	Illustrations for awarding mark
1.	**ans : $6x^2 - 29x + 28$ 2 marks** •[1] multiplies brackets •[2] simplifies	 •[1] $6x^2 - 21x - 8x + 28$ •[2] $6x^2 - 29x + 28$
2(a)	**ans : $y = -{}^{2}/_{3}\,x + 8$ 3 marks** •[1] points plotted •[2] calculates gradient •[3] writes equation	 •[1] diagram showing (0, 8) and (12. 0) •[2] $m = -{}^{8}/_{12} = -{}^{2}/_{3}$ •[3] $y = -{}^{2}/_{3}\,x + 8$
(b)	**ans : line drawn $y = -2x + 12$ 2 marks** •[1] line passes thro' (0, 12) •[2] line passes thro' (6, 0)	 •[1] (0, 12) plotted or suitable alternative •[2] (6, 0) plotted or suitable alternative
(c)	**ans : T (3, 6) 1 mark** •[1] point stated	 •[1] T(3, 6)
3.	**ans : £2916 4 marks** •[1] knows how to calculate a percentage •[2] calculates further percentages •[3] knows to subtract for depreciation •[4] calculates end of year values	 •[1] 10% of £4000 = £400 •[2] 360, 324 •[3] 4000 – 400, 3600 – 360, 3240 – 324 •[4] 3600, 3240, 2916
4(a)	**ans : 7·5 4 marks** •[1] orders data •[2] find Q_2 •[3] find Q_1 and Q_3 •[4] finds IQR	 •[1] 90, 95, 100, 100, ... 130, 145 •[2] 105 •[3] 100; 115 •[4] (115 – 100) = 15
(b)	**ans: less consistent 1 mark** •[1] suitable comment	 •[1] December films times less consistent
5.	**ans: $a = 0{\cdot}5$, $b = 2$ 2 marks** •[1] recognizing max/min •[2] recognizing period	 •[1] $a = 0{\cdot}5$ •[2] $b = 2$

Qu	Give one mark for each ●	Illustrations for awarding mark
6.	**ans: 24cm** **3 marks** ●1 recognising similar triangles ●2 calculating scale factor ●3 calculating RQ then TQ	 ●1 $\frac{PQ}{TS} = \frac{PR}{RS} = \frac{QR}{RT}$ ●2 S.F. = $\frac{3}{5}$ ●3 RQ = $\frac{3}{5} \times 15 = 9$; TQ = 24cm
7(a)	**ans: $(2x - 3)(x + 4)$** **2 marks** ●1 first factor correct ●2 second factor correct	 ●1 $(2x - 3)$…… ●2 …… $(x + 4)$
(b)	**ans: $\frac{x-4}{2x-3}$** **2 marks** ●1 factorising numerator ●2 simplifying fraction	 ●1 $(x+4)(x-4)$ ●2 answer
8.	**ans : 72 m^3** **3 marks** ●1 knows how to find volume of prism ●2 calculates area of cross section ●3 calculates volume	 ●1 V = area of X-section × length ●2 A = ½ b × h = ½ × 6 × 3 = 9 m^2 ●3 V = Al = 9 × 8 = 72 m^3
9.	**ans: £15.60** **5 marks** ●1 creating two equations ●2 knowing to solve system of equations ●3 evaluating one variable ●4 evaluating second variable ●5 calculating cost	 ●1 $2A + 3C = 17.40$ $A + 2C = 10.20$ ●2 scales equations ●3 $A = 4.20$ ●4 $C = 3.00$ ●5 3(£4.20) + £3.00 = £15.60
10.	**ans: $x = -5, \frac{2}{3}$** **4 marks** ●1 substituting correctly ●2 creating standard quadratic equation ●3 factorising ●4 solving equation	 ●1 $3(x^2 + 2x - 6) + 7x + 8 = 0$ ●2 $3x^2 + 13x - 10 = 0$ ●3 $(3x - 2)(x + 5) = 0$ ●4 answer
11.	**ans: sinx^o** **2 marks** ●1 replaces tanx^o ●1 simplifies	 ●1 cosx^o(sinx^o / cosx^o) ●1 sinx^o
		Total **40 marks**

N5

Practice Paper E

MATHEMATICS

National Qualifications - National 5

Paper 2 (Calculator)

Covering Units 1, 2 and 3

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
Day Month Year

Candidate number

Seat number

Total marks - 50

1. **You may 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
If you use this space, write clearly the number of the question you are attempting.
is provided at the end of the booklet.
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 $x = \dfrac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$

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

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

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

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

Do not write in this margin.

Marks

All questions should be attempted

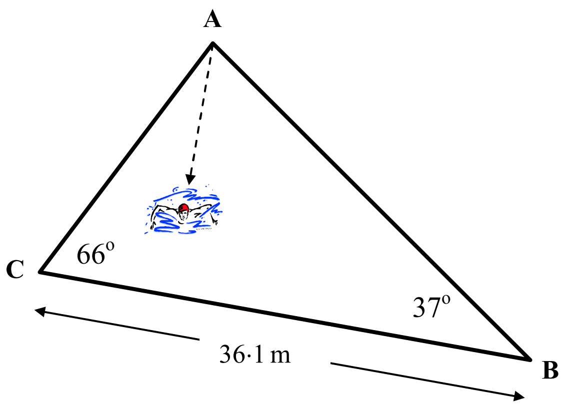
1. The circumference of the earth is approximately $4 \cdot 01 \times 10^4$ km.

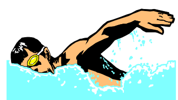
Calculate, correct to three significant figures, the radius of the earth, expressing your answer in standard form.

3

2. House prices are predicted to rise approximately $2 \cdot 5\%$ per year, for the next few years.
A cottage bought in January 2014 cost £87 000.
How much, to the nearest £, would the same cottage be worth in January 2017? **3**

3. In the triangular shaped swimming pool shown below a swimmer dives in at **A** and swims directly to the opposite side **BC**. Angle ABC = 37^o and angle BCA = 66^o.
The length of BC is 36·1 metres.





Calculate, correct to three significant figures, the shortest possible distance the swimmer has to cover.

5

4. Solve, **algebraically**, the equation

$$5\cos x^0 + 3 = 0, \text{ for } 0 \leq x < 360.$$ **3**

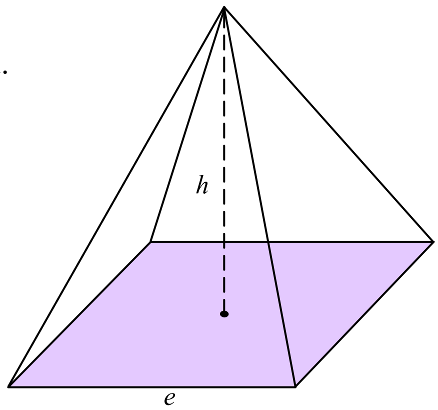
Marks

5. Express $\dfrac{6x}{y(x-2y)} - \dfrac{6}{y}$ as a single fraction in its simplest form. **3**

6. The volume of a square based pyramid, of base side *e* and height *h,* as shown, is given by the formula $V = \frac{1}{3}e^2 h$.

The base length is **doubled** and the height is **halved**.

What happens to the volume of the cone?

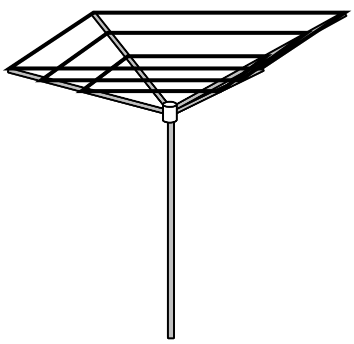


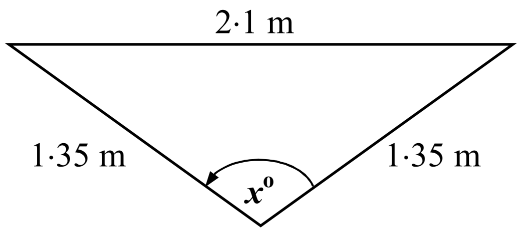
3

7. Find the value of *k* so that

$x^2 - 3kx + 36 = 0$ has equal roots. **4**

8. The arms of a rotary clothes drier are 1·35 m long and the clothes line between them is 2·1 m long.





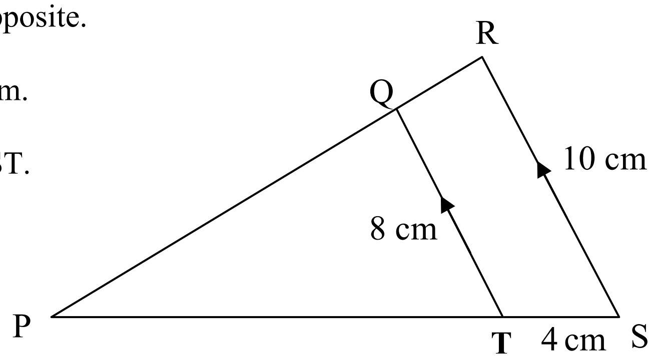
Calculate the angle, x°, between the arms. **4**

9. Triangles PQT and PRS are shown opposite.

QT = 8 cm, RS = 10 cm and TS = 4 cm.

Triangle PQR is similar to triangle PST.

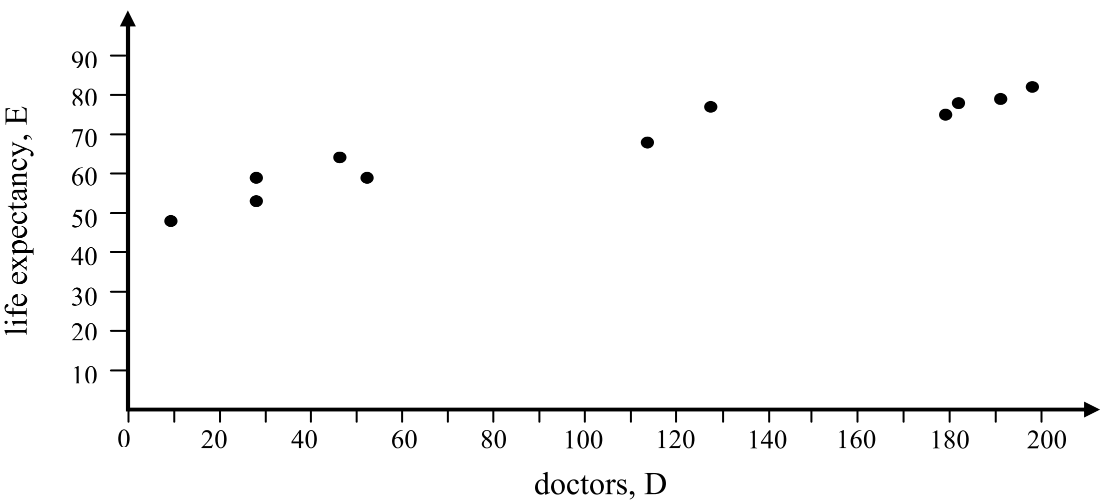
Calculate the length of PT.



3

10. The table and graph below show the relationship between the number of doctors per 10 000 of population (D) and life expectancy (E) in eleven countries.

doctors, D	9	28	28	47	53	113	128	179	182	191	198
life expectancy, E	48	53	59	64	59	68	77	75	78	79	82



(a) Draw the line of best fit onto the diagram. **1**

(b) Find the equation of the line of best fit. **3**

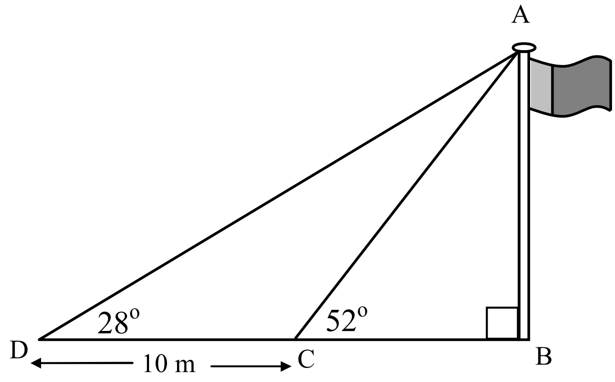
(c) Use your answer to part (b) to predict the life expectancy in a country which has 80 doctors per 10 000 of population. **2**

Marks

11. The diagram shows a vertical flagpole AB with two support wires AC and AD .

$\angle ADC = 28^o$ and $\angle ACB = 52^o$

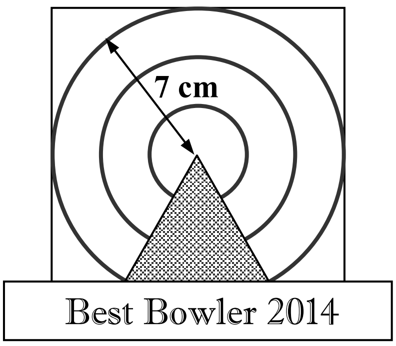
C and D are 10 metres apart.

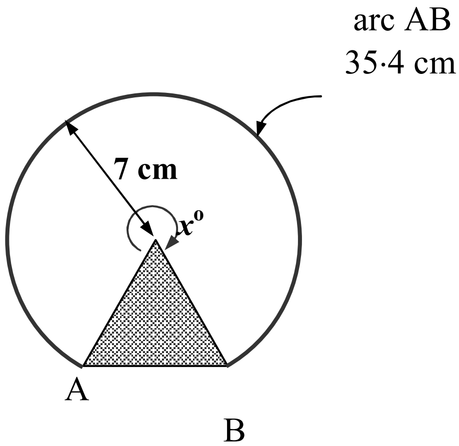


(a) Calculate the length of the support wire AC. **5**

(b) Calculate the height of the flagpole AB. **2**

12. A bowling trophy is a plaque with arcs of concentric circles engraved in gold with a gold triangle at the bottom.





The largest circle has a radius of 7 centimetres and the largest arc, AB, is 35·4 cm in length.

(a) Calculate the angle x^o at the centre. **3**

(b) Calculate the area of the gold triangle. **3**

End of Question Paper

Do not write in this margin.

Qu	Give one mark for each ●	Illustrations for awarding mark
1	**ans : 6·38 × 10^3 km** **3 marks** ●[1] using $d=\frac{C}{\pi}$ ●[2] calculating radius ●[3] answer in standard form	●[1] $d=\frac{4\cdot01\times10^4}{\pi}=12764\cdot23$ ●[2] $r=\frac{12764\cdot23}{2}=6382\cdot11$ ●[3] 6·38 × 10^3 km
2	**ans: £93689** **3 marks** ●[1] correct multiplier ●[2] knowing how to increase for3 years ●[3] calculating answer	●[1] 1·025 ●[2] $1\cdot025^3$ × £87 000 ●[3] £93689
3	**ans: 20·4 m** **5 marks** ●[1] attempting to calculate side AC or AB ●[2] calculating AC or AB using Sine Rule ●[3] knowing shortest dist is at 90^o to BC ●[4] using SOH to calculate shortest dist ●[5] calculating correctly	●[1] $\frac{36\cdot1}{\sin77°}=\frac{AC}{\sin37°}=\frac{AB}{\sin66°}$ ●[2] AC = 22·3 m; AB = 33·8 m ●[3] evidence of SOH CAH TOA ●[4] $\sin66°=\frac{dist}{22\cdot3}$; $\sin37°=\frac{dist}{33\cdot8}$ ●[5] 20·4 m
4	**ans: $126\cdot9^o$, $233\cdot1^o$** **3 marks** ●[1] rearranging to find $\cos x°$ ●[2] finds one solution ●[3] finds second solution	●[1] $\cos x°=-\frac{3}{5}$ ●[2] $126\cdot9^o$ ●[3] $233\cdot1^o$
5	**ans: $\frac{12}{x-2y}$** **3 marks** ●[1] correct numerator ●[2] correct denominator ●[3] simplifying	●[1] $6x-6(x-2y)=12y$ ●[2] $y(x-2y)$ ●[3] answer
6	**ans: Volume is doubled** **3 marks** ●[1] replacing *e* with 2*e,* and *h* with $\frac{1}{2}h$ ●[2] simplifying expression ●[3] conclusion	●[1] $V=\frac{1}{3}\times(2e)^2\times\left(\frac{1}{2}h\right)$ ●[2] $V=\frac{2}{3}e^2h$ ●[3] answer

Qu	Give one mark for each ●	Illustrations for awarding mark
7	**ans:** $k = \pm 4$ **4 marks** ●[1] states condition for equal root ●[2] substitutes values ●[3] starts to solve ●[4] solves	 ●[1] $b^2 - 4ac = 0$ ●[2] $(3k)^2 - 4 \times 1 \times 36 = 0$ ●[3] $9k^2 = 144$ ●[4] $k = \pm 4$
8	**ans : 102°** **4 marks** ●[1] uses cosine rule ●[2] substitutes values ●[3] evaluates expression ●[4] calculates required angle	 ●[1] $\cos A = \dfrac{b^2 + c^2 - a^2}{2bc}$ ●[2] $\cos x^\circ = \dfrac{1\cdot35^2 + 1\cdot35^2 - 2\cdot1^2}{2 \times 1\cdot35 \times 1\cdot35}$ ●[3] $\cos x^\circ = -0\cdot210$ ●[4] $x = 102^\circ$
9	**ans: 16cm** **3 marks** ●[1] sets up equal ratios ●[2] begins to solve for x ●[3] solves for x	 ●[1] $\dfrac{10}{8} = \dfrac{x+4}{x}$ ●[2] $8(x+4) = 10x$ ●[3] $x = 16$
10 (a) **(b)**	**ans : line of best fit** **1 mark** ●[1] draws line of best fit **ans : E =0·15D + 52** **3 marks** ●[1] finds gradient ●[2] finds E-intercept ●[3] writes equation **ans : 64 years** **2 marks** ●[1] substitutes value ●[2] evaluates equation	 ●[1] line drawn ●[1] $m = 0\cdot15$ (or suitable alternative) ●[2] c = 52 (or suitable alternative) ●[3] E = 0·15D + 52 ●[1] E = 0·15 × 80 + 52 ●[2] = 64
11 (a) **(b)**	**ans : 11·5 m** **5 marks** ●[1] calculates supplementary angle ●[2] calculates third angle of triangle ●[3] knows to use sine rule ●[4] substitutes correctly ●[5] evaluates length **ans : 9·1 m** **2 marks** ●[1] uses SOHCAHTOA ●[2] calculates length	 ●[1] ∠ACD = 180° – 52° = 128° ●[2] ∠DAC = 180° – (128° + 28°) = 24° ●[3] a/sin A = d/sinD ●[4] 10/sin 24 = AC/ sin 28 ●[5] AC = 11·5 m ●[1] sin 52° = AB/11·5 ●[2] AB = 11·5 × sin 52° = 9·1

Qu	Give one mark for each ●	Illustrations for awarding mark
12 (a)	**ans : 290°** **3 marks** ●[1] sets up ratio ●[2] substitutes values ●[3] evaluates x°	●[1] $\dfrac{\text{angle at centre}}{360} = \dfrac{\text{arc}}{\text{circumferemce}}$ ●[2] $\dfrac{x}{360} = \dfrac{35\cdot4}{14\pi}$ ●[3] $\boldsymbol{x} = 290^{\circ}$
(b)	**ans : 23cm²** **3 marks** ●[1] calculates angle in triangle ●[2] uses triangle formula ●[3] evaluates area	●[1] $360^{\circ} - 290^{\circ} = 70^{\circ}$ ●[2] A = ½ ab sinC = ½ × 7 × 7 × sin 70° ●[3] 23 cm²
		Total **50 marks**

N5

Specimen Paper F

MATHEMATICS
National Qualifications - National 5
Paper 1 (non-calculator)
Covering Units 1, 2 and 3

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

Candidate number

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 $x = \dfrac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$

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

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

Area of a triangle: Area = ½ $ab \sin C$

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

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

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

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

Do not write in this margin.

All questions should be attempted

Marks

1. Solve algebraically the system of equations

$$y = 3x + 2$$
$$2x + 3y = 50$$ **3**

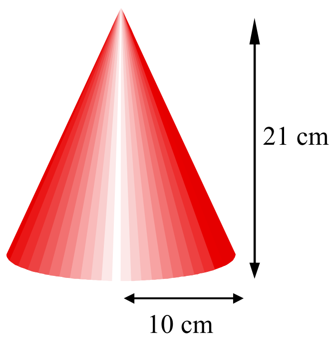
2. Simplify $\dfrac{\sqrt{72} - \sqrt{8}}{16}$ expressing your answer as a surd in its simplest form. **2**

3. The function $f(x)$ is given by the formula $f(x) = 2x^2 - 5$, where x is a real number.

(a) Find the value of $f(-3)$. **2**

(b) Find the **values** of a for which $f(a) = 45$. **3**

4. The diagram shows a cone with radius 10 centimetres and height 21 centimetres.



Taking $\pi = 3{\cdot}14$, calculate the volume of the cone. **3**

5. Simplify $\dfrac{(x+2)^2}{x^2 - 2x - 8}$ **2**

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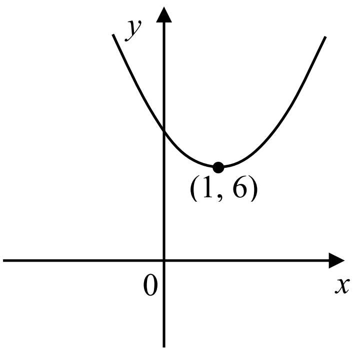
Marks

6.

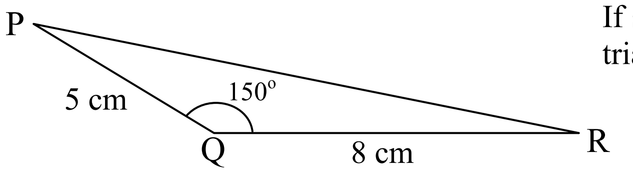


The equation of the parabola is of the form

$$y = (x + p)^2 + q.$$

Write down the equation of the parabola and state the equation of the axis of symmetry **2**

7.



If sin 150° = ½, calculate the area of triangle PQR. **2**

8. **(a)** Simplify $\dfrac{6x^3y^{-\frac{2}{3}}}{3xy^{-\frac{1}{3}}}$ **2**

(b) Evaluate the expression if $x = -2$ and $y = 27$ **3**

9. Given that $P = \dfrac{3b - c}{b}$, express b in terms of A and c. **3**

10. Sketch the graph of $f(x) = \sin(x - 60)^\circ$, $0 \le x \le 360$ **3**

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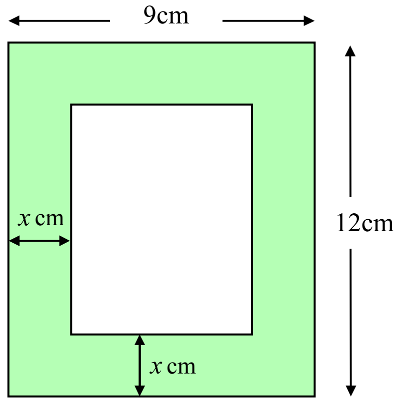
Marks

11. Sandy found a small photo-frame and decided to put one of her favourite photographs in it. The diagram below shows the dimensions of the frame.



The width of the wooden surround is x cm.

Unfortunately the glass in the centre of the frame was cracked and had to be replaced.

(a) Show that the area of glass needed for the centre of the frame can be given by the formula

$$A = \left(4x^2 - 42x + 108\right)\ \text{cm}^2$$ **3**

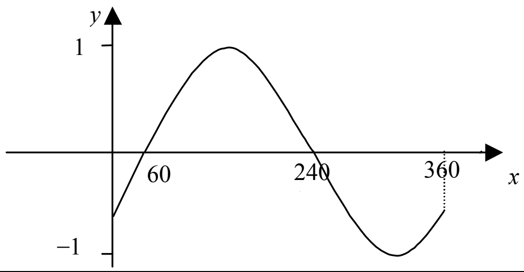
(b) If the area of glass needed was 54cm^2, find a possible value for x. **4**

12. Simplify $\dfrac{6 - 6\sin^2 x}{3\cos x}$ **3**

End of question paper

National 5 ***Practice Paper F*** **Paper 1** **Marking Scheme**

Qu	Give one mark for each ●	Illustrations for awarding mark
1	**ans : $x = 4, y = 14$ 3 marks** •[1] substitutes for y in second equation •[2] solves for x •[3] solves for y	 •[1] $2x + 3(3x + 2) = 50$ •[2] $11x = 44 \Rightarrow x = 4$ •[3] $y = (3 \times 4) + 2 = 14$
2	**ans : $\sqrt{2}/4$ 2 marks** •[1] simplifies surds •[2] simplifies fraction	 •[1] $6\sqrt{2} - 2\sqrt{2} = 4\sqrt{2}$ •[2] $\sqrt{2}/4$
3a	**ans: 13 2 marks** •[1] interpret function notation •[2] evaluate function	 •[1] $2(-3)^2 - 5$ •[2] 13
b	**ans: –5, 5 3 marks** •[1] substitute correctly •[2] attempts to solve equation •[3] correctly solves equation	 •[1] $2a^2 - 5 = 45$ •[2] $a = \sqrt{25}$ •[3] $a = \pm 5$
4	**ans : 2198cm³ 3 marks** •[1] knows how to calculate volume •[2] starts to evaluate •[3] calculates volume	 •[1] $V = \frac{1}{3} \times \pi \times 10^2 \times 21$ •[2] $V = 314 \times 7$ •[3] 2198cm³
5	**ans : $(x + 2)/(x - 4)$ 2 marks** •[1] factorises denominator •[2] simplifies fraction	 •[1] $(x - 4)(x + 2)$ •[2] $(x + 2)/(x - 4)$
6	**ans : $y = (x - 1)^2 + 6$; $x = 1$ 2 marks** •[1] states equation •[2] states equation of axis of symmetry	 •[1] $y = (x - 1)^2 + 6$ •[2] $x = 1$
7	**ans : 10 cm² 2 marks** •[1] knows to use area formula •[2] calculates area	 •[1] A = ½ ab sin C = ½ × 5 × 8 × ½ •[2] 10
8(a)	**ans : $2x^2 y^{-\frac{1}{3}}$ 2 marks** •[1] simplifies numbers and terms in x •[2] simplifies terms in y	 •[1] $6x^3/3x = 2x^2$ •[2] $y^{-\frac{2}{3}} / y^{-\frac{1}{3}} = y^{-\frac{1}{3}}$
(b)	**ans : $^8/_3$ 3 marks** •[1] substitutes values •[2] evaluates numerator •[3] evaluates numerator	 •[1] $2 \times (-2)^2 \times 27^{-\frac{1}{3}}$ •[2] $8 \times \ldots$ •[3] $\ldots \times {}^1/_3$

Qu	Give one mark for each •	Illustrations for awarding mark
9	**ans: $b = \dfrac{-c}{P-3}$ or $b = \dfrac{c}{3+P}$ 3 marks** •[1] eliminates the fractions •[2] collects like terms and takes c.f. •[3] divides to state answer	 •[1] $Pb = 3b - c$, •[2] $Pb - 3b = -c$; $b(P-3) = -c$, •[3] $b = \dfrac{-c}{P-3}$ or $b = \dfrac{c}{3+P}$
10	**ans : graph 3 marks** •[1] graph has sine shape •[2] graph shifted 60° right •[3] graph drawn within correct limits	
11 (a)	**ans: proof 3 marks** •[1] finding an expression for length •[2] finding an expression for breadth •[3] calculating area and simplifies to answer	 •[1] $12 - 2x$ •[2] $9 - 2x$ •[3] $A = (12-2x)(9-2x)$
(b)	**ans: 1·5 cm 4 marks** •[1] equating expression to 54 •[2] attempting to solve the quadratic equation •[3] correctly solving equation •[4] selects appropriate solution	 •[1] $4x^2 - 42x + 54 = 0$ •[2] $2(x-9)(2x-3) = 0$ •[3] $x = 1\cdot5$ or 9 •[4] 1·5cm
12	**ans : 2 cos x° 3 marks** •[1] factorises numerator •[2] substitutes •[3] simplifies	 •[1] $6(1 - \sin^2 x^\circ)$ •[2] $6\cos^2 x^\circ$ •[3] $2\cos x^\circ$
		Total: 40 marks

N5

Practice Paper F

MATHEMATICS

National Qualifications - National 5

Paper 2 (Calculator)

Covering Units 1, 2 and 3

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 (Day Month Year)	Candidate number	Seat number

Total marks - 50

1. **You may 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 If you use this space, write clearly the number of the question you are attempting. is provided at the end of the booklet.
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 $x = \dfrac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$

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

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

Area of a triangle: Area = ½ $ab \sin C$

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

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

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

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

Do not write in this margin.

Marks

All questions should be attempted

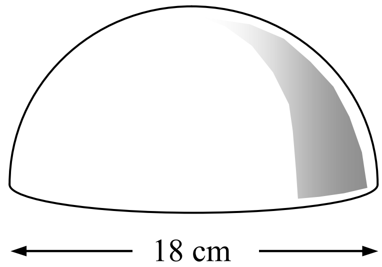
1. Multiply out the brackets and simplify the expression

$$3x^3 - 2x(x^2 - 5x + 4)$$ **3**

2. A lime-flavoured jelly is in the shape of a hemisphere. The diameter is 18 centimetres.

As the jelly sits in a warm room it begins to melt and loses 5% of its solid volume every hour.

What would be the solid volume of the jelly left after 3 hours? **6**



3. **Thermogreen Ltd** are developing a new greenhouse which claims to maintain an average interior temperature of 18^0 C.

Over a period of time the following temperatures (in degrees Celsius) were recorded:

16·8 20·3 17·4 18·2 19·5 17·6 19·1 17·8 16·5 18·8

(a) Calculate the mean temperature **1**

(b) Calculate the standard deviation correct to 1 decimal place. **3**

(c) Trading Standards expect the mean temperature to be within $0 \cdot 4^0$ C of the stated temperature and the standard deviation to be less than $1 \cdot 5^0$ C.
Will **Thermogreen** be able to market their new greenhouse? **1**

4. Brendan's golf fees have increased by 14% from last year and he now has to pay £741.

How much did he have to pay last year? **2**

5. Solve the equation

$$3x^2 + 4x - 3 = 0\,.$$

Give your answers **correct to 1 decimal place** **4**

6. Two vectors are defined as $V_1 = 4\boldsymbol{i} + \boldsymbol{j} + \sqrt{8}\,\boldsymbol{k}$ and $V_2 = 8a\,\underset{\sim}{\boldsymbol{i}} + 6a\,\underset{\sim}{\boldsymbol{k}}$,

where a is a constant and <u>all</u> coefficients of $\boldsymbol{i}$, $\boldsymbol{j}$ and $\underset{\sim}{\boldsymbol{k}}$ are greater than zero..

Given that $|V_2| = 2|V_1|$, calculate the value of a. **3**

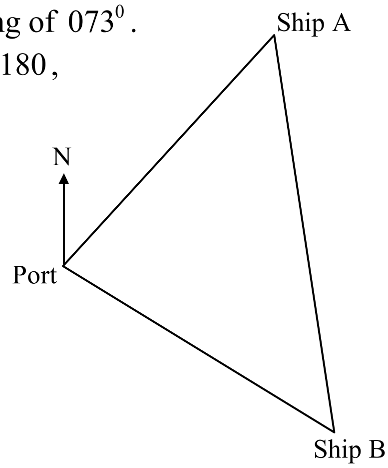
7. Solve, **algebraically**, the equation

$$3\tan x^0 + 4 = 3,\ \text{for } 0 \le x < 360.$$ **3**

8. Two ships leave port at exactly the same time.
Ship A travels at 12 kilometres per hour on a bearing of 073^0.
Ship B sets out on a bearing of x^0, where $90 \le x \le 180$,
at 15 kilometres per hour.

After 3 hours the two ships are 30km apart.

Calculate, correct to three significant figures, the bearing Ship B must have followed when leaving port.



5

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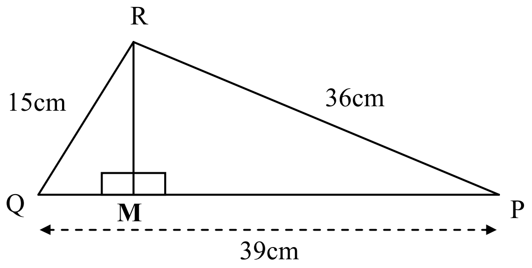
Marks

9. Triangle PQR has sides as shown.
PQ = 39cm, PR = 15cm, RQ = 36cm.



(a) Prove that angle PRQ is a right angle. **2**

(b) If the area of triangle PQR is 270cm^2, calculate the length of altitude RM, correct to 1 decimal place. **3**

10. The petrol tank in a car is cylindrical in shape as shown in diagram 1 below.
The tank is 85cm long and has a radius of 18cm.

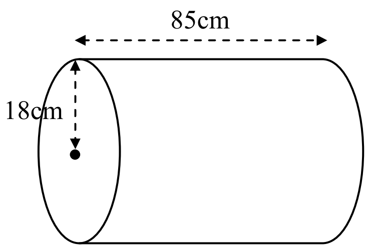


diagram 1

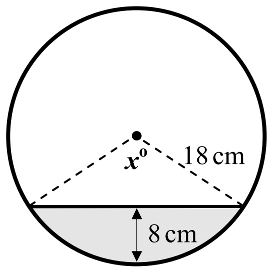


diagram 2

Diagram 2 shows the cross-sectional view of the tank. There is petrol in the tank to a maximum depth of 8cm as shown.

(a) Find the size of the angle marked, x^o, in diagram 2. **2**

(b) Calculate the volume of petrol in the tank. **4**

11. Here are words which are used to describe the roots of a quadratic equation.

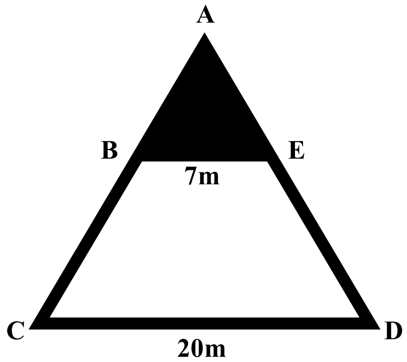
REAL NOT REAL EQUAL UNEQUAL RATIONAL IRRATIONAL

Which of them describe(s) the roots of the quadratic equation $3x^2 - 4x - 5 = 0$? **4**

Marks

Do not write in this margin.

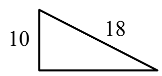
12. A triangular shaped poster is split into a black section and a white section as shown in the diagram. BE is parallel to CD. BE = 7cm and CD = 20cm.



Given that the area of the black section is 147cm^2, calculate the area of the white section. **4**

End of Question Paper

Qu	Give one mark for each ●	Illustrations for awarding mark
1	**ans : $x^3 + 10x^2 - 8x$ 3 marks** ●[1] terms correctly evaluated ●[2] applies negative sign ●[3] simplifies	 ●[1] $2x^3 - 10x^2 + 8x$ ●[2] $-2x^3 + 10x^2 - 8x$ ●[3] $x^3 + 10x^2 - 8x$
2	**ans : 1309·1 cm^3 6 marks** ●[1] knows to calculate volume of hemisphere ●[2] substitutes radius correctly ●[3] evaluates volume of hemisphere ●[4] calculates percentages ●[5] knows to subtract ●[6] evaluates remaining volume	 ●[1] $V_{hemisphere} = \frac{1}{2} \times \frac{4}{3} \pi \times r^3$ ●[2] $V_{hemisphere} = \frac{1}{2} \times \frac{4}{3} \pi \times 9^3$ ●[3] 1526·8 cm^3 ●[4] 76·5, 72·5, 68·9 ●[5] 1451·5, 1378 ●[6] 1309·1
3(a)	**ans: 18·2 1 mark** ●[1] calculating mean	 ●[1] $\frac{182}{10} = 18\cdot 2$
(b)	**ans : 1·2 3 marks** ●[1] knowing how to calculate sd ●[2] correctly calculating sd ●[3] rounding	 ●[1] $\sum x = 182 \quad \sum x^2 = 3325\cdot 68$ ●[2] sd = $\sqrt{\dfrac{3325\cdot 68 - \frac{182^2}{10}}{9}}$ ●[3] answer
(c)	**ans : Yes as mean and sd < standard set** **1 mark** ●[1] makes comparison	 ●[1] suitable answer
4	**ans: £650 2 marks** ●[1] suitable strategy ●[2] answer	 ●[1] £741 ÷ 1·14 ●[2] £650
5	**ans: 0·5 and –1·9 4 marks** ●[1] knows to use quadratic formula ●[2] calculates discriminant ●[3] finds first solution ●[4] finds second solution	 ●[1] evidence ●[2] $b^2 - 4ac = 52$ ●[3] $x = 0\cdot 5$ ●[4] $x = -1\cdot 9$

Qu	Give one mark for each ●	Illustrations for awarding mark
6	**ans: $a = 1$ 3 marks** ●[1] finds magnitude of V_1 ●[2] finds expression for magnitude of V_2 ●[3] equates $2V_1 = V_2$ and solves for a	 ●[1] $\lvert V_1\rvert = 5$ ●[2] $\lvert V_2\rvert = 10a$ ●[3] $2 \times 5 = 10 \times a$; $a = 1$
7	**ans: $161{\cdot}6^0$, $341{\cdot}6^o$ 3 marks** ●[1] rearranging to find $\tan x =$ ●[2] finds first solution ●[3] finds second solution	 ●[1] $\tan x = -\frac{1}{3}$ ●[2] $161{\cdot}6^o$ ●[3] $341{\cdot}6^o$
8	**ans : 115^o 5 marks** ●[1] interpreting information ●[2] using suitable formula ●[3] substituting correctly ●[4] calculating interior angle ●[5] stating bearing	 ●[1] triangle with sides 36, 45 &30 ●[2] cosine rule $\cos a = \frac{b^2 + c^2 - a^2}{2bc}$ ●[3] $\cos a = \frac{36^2 + 45^2 - 30^2}{2 \times 36 \times 45}$ ●[4] angle = 42^0 ●[5] answer
9(a) (b)	**ans: proof 2 marks** ●[1] knowing to use Converse of Pythagoras ●[2] completing proof **ans : 13·8cm 3 marks** ●[1] knowing to use area of Δ ●[2] knowing QP(base) and RM(height) ●[3] calculations	 ●[1] If Δ is R.A. then $a^2 = b^2 + c^2$ ●[2] LHS = RHS = 1521 ●[1] $\frac{1}{2} b \times h = 270$ ●[2] $\frac{1}{2} \times 39 \times \text{RM} = 270$ ●[3] answer
10 (a) (b)	**ans: 112^o 2 marks** ●[1] identifying R.A. triangle ●[2] finding angle at apex **ans: 14195 cm^3 4 marks** ●[1] calculating area of sector ●[2] calculating area of triangle ●[3] calculating cross sectional area ●[4] calculating volume of fuel	 ●[1]  ●[2] $\cos x° = \frac{10}{18} \Rightarrow x = 56°,\ 2x = 112°$ ●[1] sector $= \frac{112}{360} \times \pi \times 18^2 = 317\,\text{cm}^2$ ●[2] $\frac{1}{2} \times 18 \times 18 \times \sin 112 = 150\ \text{cm}^2$ ●[3] CSA = 317 – 150 = 167 cm^2 ●[4] 14195 cm^3

Qu	Give one mark for each ●	Illustrations for awarding mark
11	**ans: real, unequal, irrational** **4 marks** ●^{1} knows to calculate discriminant ●^{2} calculates discriminant ●^{3} chooses any two suitable words ●^{4} chooses a third suitable word	 ●^{1} evidence ●^{2} $b^2 - 4ac = 76$ ●^{3} real, unequal ●^{4} irrational
12	**ans: 1053 cm^2** **4 marks** ●^{1} finds linear scale factor ●^{2} calculating area scale factor ●^{3} calculating area of whole poster ●^{4} calculating area of larger section	 ●^{1} linear scale factor = $\frac{20}{7}$ ●^{2} area scale factor = $\left(\frac{20}{7}\right)^2$ ●^{3} area(poster) = $\left(\frac{20}{7}\right)^2 \times 147 = 1200$ ●^{4} area(section) = answer
		Total 50 marks