N5

Prelim Practice Paper B

MATHEMATICS
National Qualifications   -   National 5
Paper 1 (Non Calculator)
Testing EF and REL

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 = 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. Factorise fully

$$20x^2 + 6x - 8$$

3

2. Find the gradient of the line joining the points $(4, 6)$ and $(-3, 8)$.

2

3. Evaluate $\quad 9x^2 - 100y^2 \quad$ when $x = 1{\cdot}5$ and $y = 0{\cdot}55$.

3

4.   Change the subject of this formula to '*h*'.   **3**

$$r = \sqrt{\frac{V}{h}}$$

5.   Find the value of $3 \times 27^{\frac{1}{3}} \times 81^{-\frac{3}{4}}$ **3**

6.   **(a)**   Express $\dfrac{3}{\sqrt{5}}$ with a rational denominator.   **2**

   (b)   Simplify $\sqrt{150} - 3\sqrt{6}$.   **2**

7. **(a)** State the coordinates and nature of the turning point of the graph of the parabola with equation.
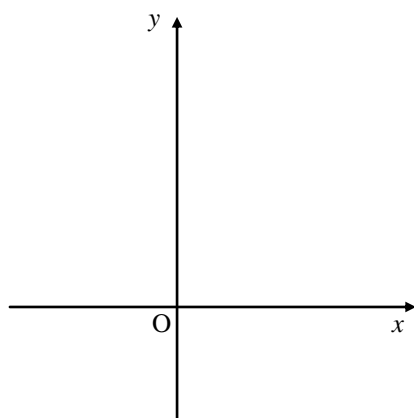
$$y = (x + 1)^2 - 1$$ **3**

(b) Find the coordinates of the point where the graph crosses the y – axis. **2**

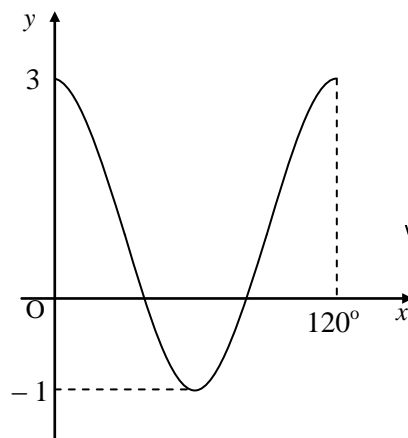**(c)** Make a sketch of the parabola on the grid below showing clearly its turning point and y – axis intercept. **2**

8. **(a)** If $f(x) = x^2 + 2x - 5,$ find the value of $f(-2)$. **2**

(b) Given that $f(a) = 3,$ find the value of a given that $a > 0$. **4**

9. The graph in the diagram has equation of the form $y = a\cos bx° + c$.

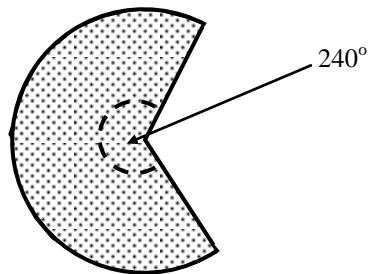Write down the values of a, b and c. **3**

10. Write as a single fraction in its simplest form: **3**

$$\frac{7}{k} - \frac{5}{(2k-3)}; \ k \neq 0; \ k \neq \frac{3}{2}$$

11. The logo for Cyril's Cars is shown below.
The logo is a sector of a circle of radius 9 cm. The reflex angle at the centre is 240°.

240°

Taking $\pi = 3 \cdot 14$, calculate the perimeter of the logo. **3**

End of Question Paper

ADDITIONAL SPACE FOR ANSWERS

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Qu	Give one mark for each ●	Illustrations for awarding mark
1	**ans: $2(5x + 4)(2x - 1)$** **3 marks** ●^{1} takes out common factor ●^{2} one bracket correct ●^{3} second bracket correct	●^{1} $2(10x^2 + 3x - 4)$ ●^{2} $2(5x + 4)\ldots\ldots$ ●^{3} $\ldots\ldots (2x - 1)$
2	**ans: $m - \dfrac{2}{7}$** **2 marks** ●^{1} knows how to find gradient ●^{2} states gradient	●^{1} $m = \dfrac{8 - 6}{-3 - 4}$ ●^{2} $m = -\dfrac{2}{7}$
3	**ans: -10** **3 marks** ●^{1} recognises difference of two squares ●^{2} substitutes values ●^{3} evaluates	●^{1} $(3x + 10y)(3x - 10y)$ ●^{2} $[3(1\cdot5) + 10(0\cdot55)][3(1\cdot5) - 10(0\cdot55)]$ ●^{3} $(10)(-1) = -10$
4	**ans: $h = \dfrac{V}{r^2}$** **3 marks** ●^{1} squares both sides ●^{2} multiplies through by h ●^{3} divides by r^2	●^{1} $r^2 = \dfrac{V}{h}$ ●^{2} $r^2 h = V$ ●^{3} $h = \dfrac{V}{r^2}$
5	**ans: 1/3** **3 marks** ●^{1} evaluates $27^{1/3}$ ●^{2} evaluates $81^{-3/4}$ ●^{3} evaluates	●^{1} $27^{1/3} = 3$ ●^{2} $81^{-3/4} = 1/27$ ●^{3} $1/3$
6a	**ans: $\dfrac{3\sqrt{5}}{5}$** **2 marks** ●^{1} knows to multiply by $\dfrac{\sqrt{5}}{\sqrt{5}}$ ●^{2} simplifies	●^{1} $\dfrac{3}{\sqrt{5}} \times \dfrac{\sqrt{5}}{\sqrt{5}}$ ●^{2} $\dfrac{3\sqrt{5}}{5}$
b	**ans: $2\sqrt{6}$** **2 marks** ●^{1} simplifies surd ●^{2} simplifies	●^{1} $5\sqrt{6}$ ●^{2} $2\sqrt{6}$

Qu	Give one mark for each ●	Illustrations for awarding mark
7a	**ans: (– 1, –1); minimum** **3 marks**	
	●[1] correct x – coordinate ●[2] correct y – coordinate ●[3] states nature	●[1] (–1, ……. ●[2] …….–1) ●[3] minimum
b	**ans: (0, 0)** **2 marks**	
	●[1] knows to substitute 0 for x ●[2] states coordinates	●[1] $y = (0 + 1)^2 - 1$ ●[2] (0, 0) [accept origin]
c	**ans: graph drawn** **2 marks**	
	●[1] parabola with minimum TP ●[2] turning point and origin marked	●[1] correct shape ●[2] **both** points marked clearly
8a	**ans: – 5** **2 marks**	
	●[1] knows to substitute value ●[2] evaluates	●[1] $f(-2) = (-2)^2 + 2(-2) - 5$ ●[2] –5
b	**ans: $a = 2$** **4 marks**	
	●[1] knows to substitute a for x and equates ●[2] brings all to LHS and factorises ●[3] solves ●[4] discards one value	●[1] $a^2 + 2a - 5 = 3$ ●[2] $a^2 + 2a - 8 = 0$; $(a + 4)(a - 2) = 0$ ●[3] $a = -4$ or 2 ●[4] $a = 2$
9	**ans: $a = 2; b = 3; c = 1$** **3 marks**	
	●[1] states value of a ●[2] states value of b ●[3] states value of c	●[1] $a = 2$ ●[2] $b = 3$ ●[3] $c = 1$
10	**ans: $\dfrac{9k - 21}{k(2k - 3)}$** **3 marks**	
	●[1] correct denominator ●[2] correct numerator ●[3] simplifies numerator	●[1] $k(2k - 3)$ ●[2] $7(2k - 3) - 5k$ ●[3] $9k - 21$
11	**ans: 55·68cm** **3 marks**	
	●[1] knows how to find perimeter ●[2] simplifies calculation ●[3] evaluates	●[1] $P = \dfrac{240}{360} \times 3 \cdot 14 \times 18$ [+ 18] ●[2] $P = 2 \times 3 \cdot 14 \times 6$ ●[3] 55·68cm
		Total **40 marks**

N5

Prelim Practice Paper B

MATHEMATICS
National Qualifications - National 5
Paper 2 (Calculator)
Testing EF and REL

Time allowed - 1 hour and 30 minutes

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Town

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Surname

Date of birth
Day   Month   Year

Candidate number

Seat number

Total marks - 50

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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.

All questions should be attempted

1. When $x^2 - 11x - 7$ is expressed in the form $(x-a)^2 + b$, what are the values of a and b?
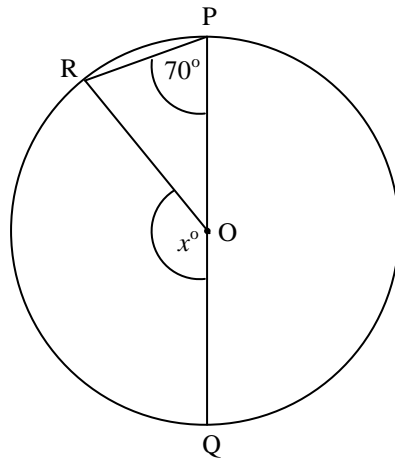
3

2. Simplify

$$\frac{2x^2 - 3x + 1}{6x^2 - 3x}$$

3

3. The circle in the diagram below has centre O. Points P, Q and R lie on its circumference. Angle RPO = 70°.

(a) Calculate the size of angle ROQ. **3**

(b) Given that the diameter of the circle above is 30 cm, calculate the area of minor sector ROQ giving your answer correct to 2 significant figures. **4**

4. A quadratic equation is given as $2x^2 - px + 4 = 0$.

Given that this quadratic has equal roots, find the **positive** value of p giving your answer as a surd in its simplest form. **4**

5. In a human being weighing 150 pounds there are $2\cdot3 \times 10^{-4}$ pounds of copper.

Calculate how much copper there would be in 1200 such people.

Give your answer in Scientific Notation. **2**

6. Multiply the brackets and simplify $(2x - 3)(3x^2 - 7x + 3)$ **3**

7. During one Saturday morning the charity car wash raised £121.50 by washing 20 cars and 6 vans.

    (a) Write an equation to illustrate this information.   **1**

The following Saturday they washed 21 cars and 2 vans and raised £105.

    (b) Write an equation to illustrate this information.   **1**

On the third Saturday they hoped to raise at least £130 by washing 5 vans and some cars.

    (c) What is the minimum number of cars that would have to be washed to raise this amount of money?   **4**

8. A Christmas decoration is formed from a cone and a hemisphere as shown in the diagram below.

The diameter of both is 20cm.

h cm

The volume of the decoration is 4293·5 cm³.

Calculate the height, *h* cm, of the decoration.

←——20 cm——→
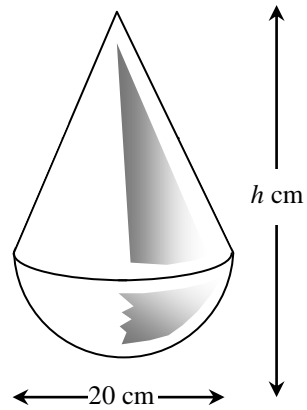
6

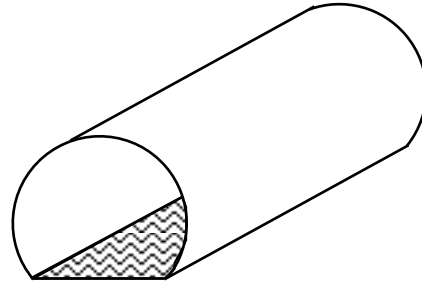**9.** Find the roots of the quadratic equation

$$4x^2 + 7x - 5 = 0$$

Give your answers correct to 1 decimal place.
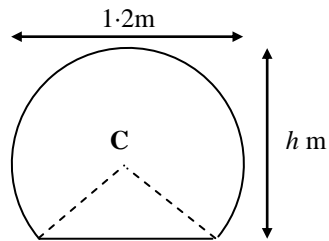
4

10. Shown is a children's play tunnel.

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

The width of the floor of the tunnel is 1 metre.

1·2m

C

h m

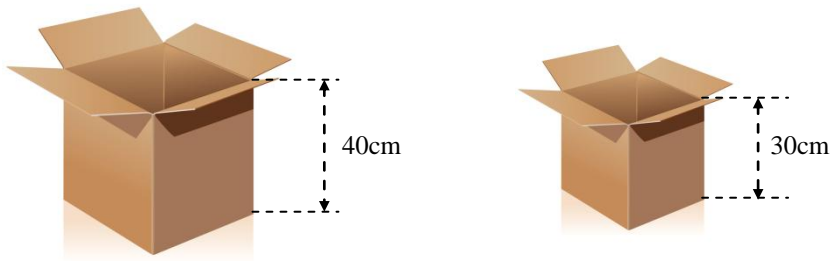Would a toddler of height 80cm be able to walk through the tunnel?   **5**

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

11. Solve the equation $\quad 5\sin x° + 3 = \sin x° \qquad 0 \le x \le 360$ **4**

12. The two boxes below are mathematically similar.

If it requires $2{\cdot}08$ m^2 [ignoring overlaps] of card to make the large box, calculate the amount of card needed to make the smaller box. **3**
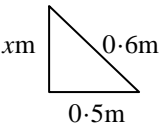
End of Question Paper

ADDITIONAL SPACE FOR ANSWERS

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Qu	Give one mark for each ●		Illustrations for awarding mark	
1	**ans:** $a = -5 \cdot 5$; $b = -37 \cdot 25$	**3 marks**		
	●¹ starts to complete square		●¹	$(x - 5 \cdot 5)^2$…….
	●² completes square		●²	$(x - 5 \cdot 5)^2 - 30 \cdot 25 - 7 = (x - 5 \cdot 5)^2 - 37 \cdot 25$
	●³ correct values of a and b		●³	$a = -5 \cdot 5$; $b = -37 \cdot 25$
2	**ans :** $\dfrac{x-1}{3x}$	**3 marks**		
			●¹	$(2x - 1)(x - 1)$
	●¹ factorises numerator		●²	$3x(2x - 1)$
	●² factorises denominator			
	●³ simplifies		●³	$\dfrac{x-1}{3x}$
3a	**ans: 140°**	**3 marks**		
	●¹ recognises isosceles triangle		●¹	angle PRO = 70°
	●² finds angle POR		●²	angle POR = 40°
	●³ states size of angle ROQ explicitly		●³	angle ROQ = 140°
b	**ans: 270cm³**	**4 marks**		
	●¹ correct fraction		●¹	$\dfrac{140}{360}$ ……
	●² correct radius in formula		●²	….. $\times \pi \times 15^2$
	●³ answer not rounded		●³	274·88935…..
	●⁴ correctly rounded answer		●⁴	270cm³
				Unrounded answer must be stated and correct units should also be stated.
4	**ans :** $p = 4\sqrt{2}$	**4 marks**		
	●¹ knows condition for equal roots		●¹	$b^2 - 4ac = 0$ [stated or implied]
	●² calculates $b^2 - 4ac$		●²	$(-p)^2 - 4 \times 2 \times 4 = 0$; $p^2 - 32 = 0$
	●³ solves for p		●³	$p = \sqrt{32}$
	●⁴ simplifies surd		●⁴	$p = 4\sqrt{2}$
5	**ans : $2 \cdot 76 \times 10^{-1}$**	**2 marks**		
	●¹ uses correct calculation		●¹	$2 \cdot 3 \times 10^{-4} \times 1200$
	●² answer in Scientific Notation		●²	$2 \cdot 76 \times 10^{-1}$
6	**ans : $6x^3 - 23x^2 + 27x - 9$**	**3 marks**		
			●¹	$6x^3 - 14x^2 + 6x$…..
	●¹ three terms correct		●²	….. $- 9x^2 + 21x - 9$
	●² further three terms correct		●³	$6x^3 - 23x^2 + 27x - 9$ [must have x^3 term]
	●³ simplifies			

Qu	Give one mark for each ●	Illustrations for awarding mark
7a	**ans:** $20c + 6v = 121\cdot50$ **1 mark** ●¹ constructs equation	 ●¹ $20c + 6v = 121\cdot50$
b	**ans:** $21c + 2v = 105$ **1 mark** ●¹ constructs equation	 ●¹ $21c + 2v = 105$
c	**ans:** **24 cars minimum** **4 marks** ●¹ knows to use system of equation ●² finds correct value for c ●³ finds correct value for t ●⁴ finds minimum number of cars	 ●¹ evidence of scaling equations ●² $c = 4\cdot5$ ●³ $v = 5\cdot25$ ●⁴ 24 cars
8	**ans:** **31cm** **6 marks** ●¹ knows to find volume of hemisphere ●² finds volume of hemisphere ●³ finds volume of cone ●⁴ subs values in formula for cone ●⁵ finds height of cone ●⁶ finds 'h'	 ●¹ $V_{HS} = \dfrac{2}{3} \times \pi \times 10^3$ ●² $= 2094\cdot3951\ldots\ldots$ ●³ $V_{cone} = 2199\cdot1048\ldots$ ●⁴ $2199\cdot1048 = \dfrac{1}{3} \times \pi \times 10^2$ ●⁵ 21cm ●⁶ $21 + 10 = 31\text{cm}$
9	**ans :** $-2\cdot3, 0\cdot5$ **4 marks** ●¹ knows to use quadratic formula ●² calculates $b^2 - 4ac$ ●³ subs correctly into formula ●⁴ states both roots correctly rounded	 ●¹ evidence ●² 129 ●³ $\dfrac{-7 \pm \sqrt{129}}{2 \times 4}$ ●⁴ $-2\cdot3, 0\cdot5$
10	**ans :** **yes since 0·93m > 0·8m** **5 marks** ●¹ assembles facts in right triangle ●² knows to use Pythagoras' ●³ uses Pythagoras' correctly ●⁴ finds height ●⁵ conclusion	●¹ ●² $x^2 = 0\cdot6^2 - 0\cdot5^2$ ●³ $x = 0\cdot33166\ldots..$ ●⁴ $h = 0\cdot933166$ ●⁵ yes since 0·93m > 0·8m [or equivalent]
11	**ans:** $228\cdot6^o, 311\cdot4^o$ **4 marks** ●¹ solves for $\sin x^o$ ●² finds relative angle ●³ finds one solution ●⁴ finds second solution	 ●¹ $\sin x^o = -3/4$ ●² $48\cdot6^o$ ●³ $228\cdot6^o$ ●⁴ $311\cdot4^o$
12	**ans:** **1·17m²** **3 marks** ●¹ finds linear scale factor for reduction ●² finds area scale factor ●³ multiplies by ASF to answer	 ●¹ 3/4 ●² $(3/4)^2$ ●³ $(3/4)^2 \times 2\cdot08 = 43\text{p}$
		Total 50 marks