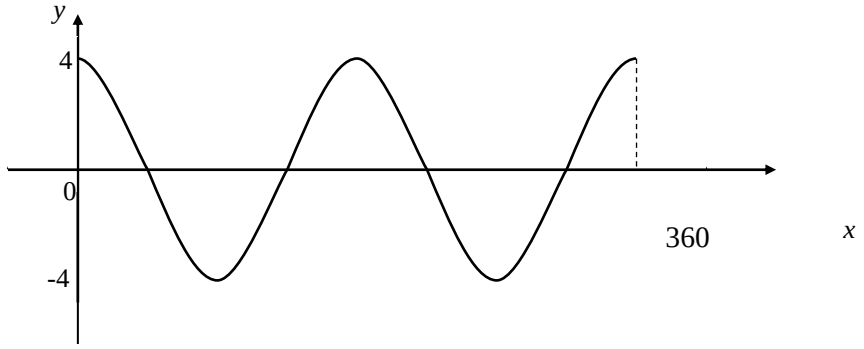
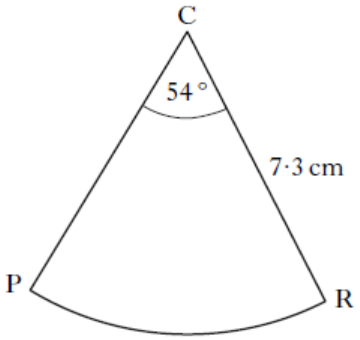
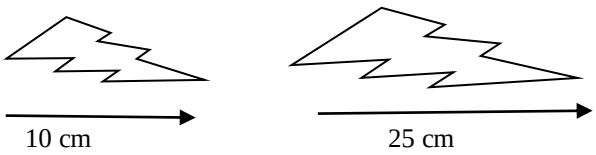
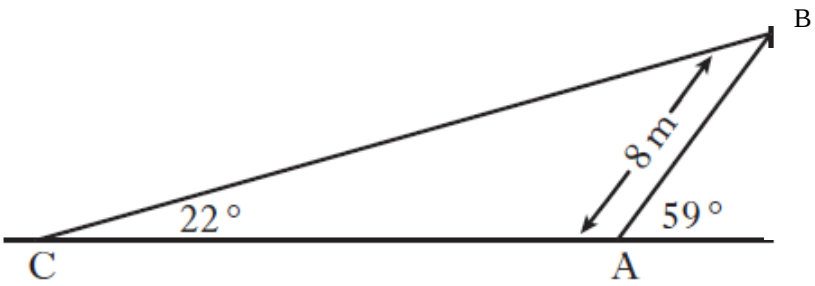
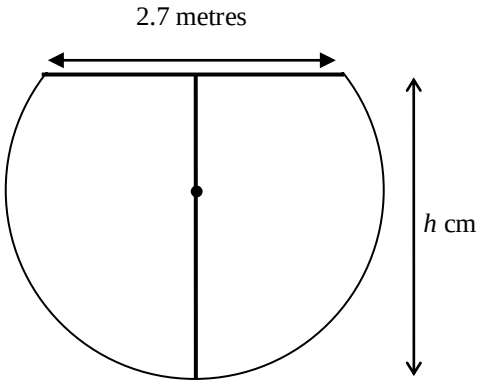
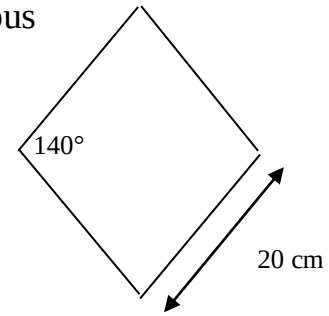
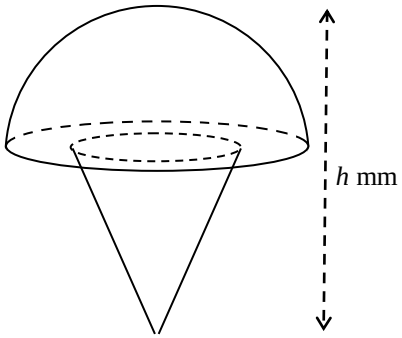
	S4 Nat 5 Prelim Paper A – Non-Calculator	**20**
1.	Multiply out the brackets and collect like terms $(3x + 2)(x^2 + 5x - 1)$	**2**
2.	A function is given as $f(x) = 8x - 20$. (a) Calculate $f(-3)$ (b) Find x when $f(x) = 12$	**3**
3.	A quadratic graph has equation $y = (x-4)^2 + 7$. **(a)** State the nature of the turning point of the graph? **(b)** Which of the following is the equation of its axis of symmetry? A $x = -4$ B $x = 4$ C $x = 7$ D $x = -7$	**1** **1**
4.	Simplify (a) $\frac{a^7b^3}{a^2b^5}$ (b) $\frac{3x-15}{x^2-25}$	**2** **3**
5.	Change the subject of the formula to r $A = 4\pi r^2$	**2**
6.	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**
7.	(a) Express $\frac{22}{\sqrt{2}}$ with a rational denominator. Write your answer in the simplest form (b) Evaluate $9^{\frac{3}{2}}$	**2** **2**

	S4 Nat 5 Prelim Paper A – Calculator	**35**
1.	Calculate the perimeter of the sector, PCR 	**3**
2.	The diagram below shows two shapes which are mathematically similar.  The smaller shape has a length of 10cm and an area of 135cm². The larger shape has a length of 25cm, calculate its area.	**3**
3.	Solve the quadratic equation $2x^2 + 7x - 3 = 0$ Give your answers **correct to 1 decimal place**	**4**
4.	For one of their performances a drama group charges different ticket prices for each evening. Sarah bought 3 tickets for Friday and 4 tickets for Saturday which cost her £57. **(a)** Using x to represent the Friday tickets and y to represent the Saturday tickets, write an equation to illustrate the above situation. Sean bought 4 tickets for Friday and 2 for Saturday. He was charged £46. **(b)** Write another equation in x and y to illustrate this situation. **(c)** How much did Stella pay when she bought 6 tickets for Friday and 3 for Saturday?	**1** **1** **4**

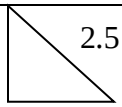
5.	Calculate the length of side CB  	**4**
6.	This shape is a circular cross section with a horizontal top. The original circle has a radius of 2.5 metres The top of the shape measures 2.7 metres Calculate the height of this shape  	**4**
7.	Solve $7\sin x° + 1 = 5$, $0° \leq x \leq 360°$	**3**
8.	Paving stones are laid in the shape of a rhombus Each side of the rhombus is 20cm and the obtuse angles are 140°. Calculate the area of one paving stone  	**4**

9.	The diagram below shows a steel rivet which consists of a hemisphere and a cone.  The radius of the hemisphere is 8 millimetres and the radius of the cone is 5 millimetres. The volume of the whole rivet is 1 334 mm^3. Calculate the **overall height ,** *h* mm**,** of the rivet. [Volume of a sphere = $\frac{4}{3}\pi r^3$, Volume of a cone = $\frac{1}{3}\pi r^2 h$,]	**4**

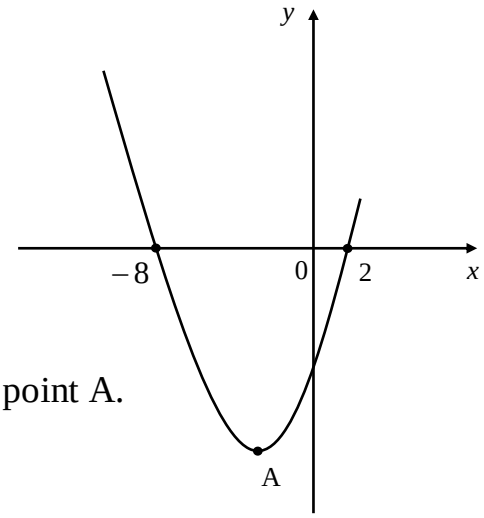
Answers – Paper 1

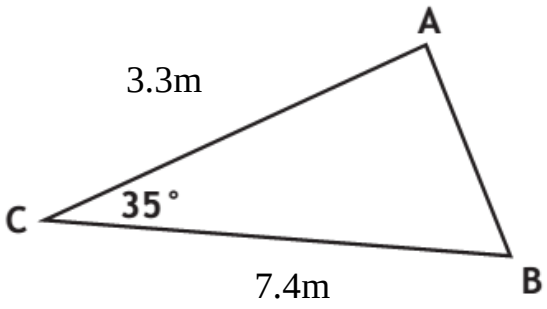
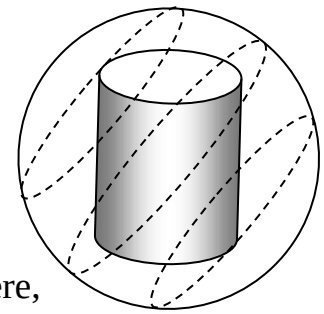
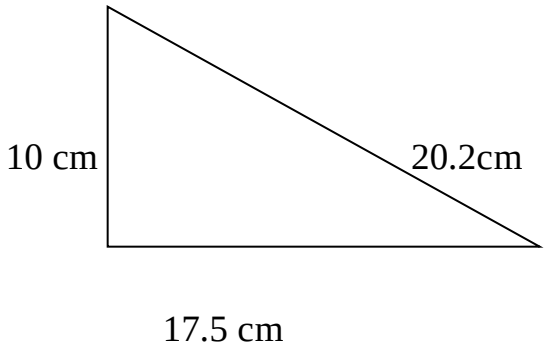
1.	$(3x + 2)(x^2 + 5x – 1) = 3x^3 + 15x^2 – 3x + 2x^2 + 10x – 2 =$ **$3x^3 + 17x^2 + 7x – 2$**	
2.	(a) $f(-3) = 8(-3) – 20 =$ **-44**	(b) $f(x) = 12 \rightarrow 8x – 20 = 12 \rightarrow 8x = 32 \rightarrow$ **$x = 4$**
3.	(a) **Minimum** turning point	(b) axis of symmetry is **$x = 4$** **B**
4.	(a) $\frac{a^5}{b^2}$	(b) $\frac{3x-15}{x^2-25} = \frac{3(x-5)}{(x-5)(x+5)} = \frac{3}{x+5}$
5.	$A = 4\pi r^2 \rightarrow \frac{A}{4\pi} = r^2 \rightarrow \sqrt{\frac{A}{4\pi}} = r$	6. y = 4cos2x **$a = 4$ and $b = 2$**
7.	(a) $\frac{22}{\sqrt{2}} = \frac{22\sqrt{2}}{\sqrt{2}\sqrt{2}} = \frac{22\sqrt{2}}{2} = 11\sqrt{2}$	(b) $9^{\frac{3}{2}} = \left(\sqrt{9}\right)^3 = 3^3 = 27$

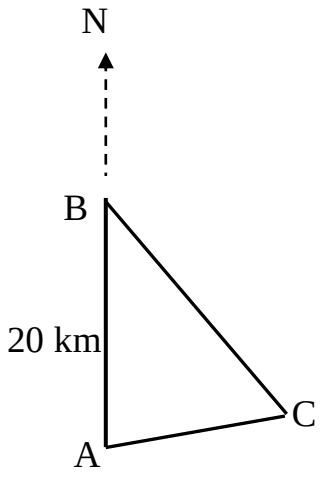
Answers – Paper 2

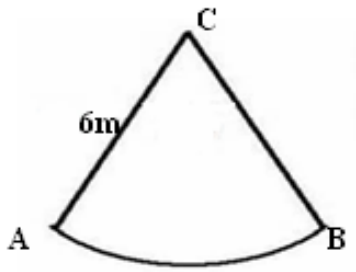
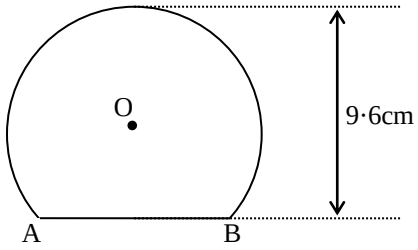
1.	Perimeter PCR = $7.3 + 7.3 + \frac{54}{360} \times \pi \times 14.6 = 14.6 + 6.88 =$ **21.5 cm**		
2.	LSF = $\frac{25}{10}$ *or* $\frac{5}{2}$	Area of larger shape is 135 x $\left(\frac{25}{10}\right)^2$ = **843.75 cm²**	
3.	a = 2, b = 7, c = -3, $b^2 – 4ac = (7)^2 – 4(2)(-3) = 79$	$x = \frac{7 \pm \sqrt{73}}{4} = 0.386\ldots$ and -3.886…	**$x = 0.4$ and -3.9**
4.	$3x + 4y = 57$ $4x + 2y = 46$	$3x + 4y = 57$ $\underline{8x + 4y = 92}$	$x = 7,\ y = 9$ Fri night £7, Sat night £9 **Stella paid £69**
5.	<CAB = 180° – 59° = 121°	$\frac{BC}{\sin 121} = \frac{8}{\sin 22} \rightarrow BC = \frac{8 \times \sin 121}{\sin 22}$ = **18.3 m**	
6.	Right-angled triangle x 	$x = \sqrt{2.5^2 – 1.35^2} = 2.1cm$ Height is 2.1 + 2.5 = **4.6cm**	
7.	$\sin x = 4/7 \rightarrow x = \sin^{-1}(4/7)$ and 180° - $\sin^{-1}(4/7)$	**$x = 34.8°$ and 145.2°**	
8.	Area of rhombus = 2 x area of triangle $= 2 \times \frac{1}{2} \times 20 \times 20 \times \sin 140 =$ **257 cm²**		
9.	Vol of hemisphere = $\left(\frac{4}{3} \times \pi \times 8^3\right) \times \frac{1}{2}$ = 1072 cm³ Vol of cone = 1334 – 1072 = 262cm³ $262 = \frac{1}{3} \times \pi \times 5^2 \times h$ **h** = 10 mm		

	S4 Nat 5 Prelim Paper B – Non-Calculator	**20**
1.	Remove the brackets and simplify $(2x + 3)^2 - 3(x^2 - 6)$	**2**
2.	(a) Calculate the gradient of the straight line between the points (-2, -7) and (3, 3) (b) State the equation of the straight line between these two points in the simplest form	**1** **2**
3.	Solve the inequation $2 - 2(1 + x) < 20$	**3**
4.	Sketch the graph of $y = 3\sin 2x$, $0° \leq x \leq 360°$	**2**
5.	Write in its simplest form $\frac{\sqrt{54}}{\sqrt{2}} - 2\sqrt{3}$	**3**
6.	**(a)** Simplify $a^{\frac{1}{2}} \times a^{\frac{1}{6}}$ **(b)** Hence find the value of $a^{\frac{1}{2}} \times a^{\frac{1}{6}}$ when $a = 27$.	**1** **2**
7.	The diagram shows part of the graph of $y = x^2 + 6x + c$. (6) Find the value of c. (6) Hence find the coordinates of the point A.	**2** **2**



	S4 Nat 5 Prelim Paper B – Non-Calculator	**35**
1.	Find the area of triangle ABC  	**2**
2.	A Christmas bauble is made from a sphere of perspex with a coloured cylinder in the middle. The volume round the cylinder is filled with a thick liquid.  The sphere has a diameter of 9 cm. The cylinder has a radius of 2·7 cm with a height of 4.9 cm. Calculate the volume of liquid needed to fill the sphere, giving your answer correct to 2 significant figures. [Volume of a sphere = $\frac{4}{3}\pi r^3$]	**5**
3.	A triangle has the dimensions shown below. Is this triangle right-angled?  	**3**

4.	There are 14 cars and 20 passengers on the first ferry from Mull and the total takings are £393.00 (a) Let x be the price in pounds for a car and y be the price in pounds for a passenger. Write an equation in x and y which satisfies this condition (b) On the last ferry of the day there were 9 cars and 15 passengers and the total takings were £261. Write down a second equation which satisfies these conditions (c) Find the cost for one car and the cost for one passenger	**1** **1** **4**
5.	Solve the equation $7\cos x° - 5 = 0$ for $0 \le x \le 360$	**3**
6.	Express $\frac{2}{x+5} + \frac{3}{x-1}$, $x \neq -5$, $x \neq 1$, as a single fraction in the simplest form	**3**
7.	Brunton is 30 Km due North of Appleby From Appleby, the bearing of Carltown is 060° From Brunton the bearing of Carltown is 130°  Calculate the distance between Brunton and Carltown	**4**

8.	The boat on a carnival ride travels along an arc of a circle, centre C.  The boat is attached to C by a rod which is 6 metres long. The rod swings from position CA to position CB. The length of the arc AB is 7 metres. Find the angle through which the rod swings from position A to position B	**4**
9.	The diagram shows the cross section of a paper weight. It consists of part of a circle with a horizontal base. The centre of the circle is O. AB is a chord of the circle. The height of the paper weight is 9·6cm. The radius of the circle is 5cm. Calculate the length of the chord AB.  	**4**
10.	Angle *a* can be described by the following statements • *a* is greater than zero and less than 360° • sin *a* is negative • tan *a* is is negative • cos *a* is positive Write down a possible value for *a*	**1**

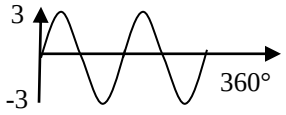
Answers – Paper 1

1. $(2x+3)(2x+3) - 3x^2 + 18 = 4x^2 + 6x + 6x + 9 - 3x^2 + 18 = x^2 + 12x + 27$

2. (a) $m = 10/5 =$ **2** (b) **y = 2x - 3**

3. $2 - 20 < 2(1+x) \rightarrow -18 < 2 + 2x \rightarrow -20 < 2x \rightarrow$ **$-10 < x$ or $x > -10$**

4. **Period is 180°,**
max value is 3, min value is –3



5. $\sqrt{\frac{54}{2}} - 2\sqrt{3} = \sqrt{27} - 2\sqrt{3} = 3\sqrt{3} - 2\sqrt{3} = \sqrt{3}$

6 (a) $a^{1/2+1/6} = a^{4/6} = a^{2/3}$ (b) $27^{2/3} = \left(\sqrt[3]{27}\right)^2 = 3^2 = 9$

7. (a) $y = (x+8)(x-2)$
$y = x^2 + 6x - 16$ **c = -16**

(b) $y = x^2 + 6x - 16$
$y = (x+3)^2 - 25$ **A = (-3, -25)**

Answers – Paper 2

1. Area triangle $= \frac{1}{2} \times 3.3 \times 7.4 \times \sin 35 =$ **7 cm²**

2. Vol of sphere $= \left(\frac{4}{3} \times \pi \times 4.5^3\right) = 381.70$ cm³ Vol of cylinder $= \pi \times 2.7^2 \times 4.9 = 112.22$ cm³
Vol of liquid = 381.70 – 112.22 = 269.48 cm³ = **270 cm³**

3. By Pythagoras $c^2 = a^2 + b^2 \rightarrow 20.2^2 = 10^2 + 17.5^2 \rightarrow 408.04 \neq 406.25$
By the converse of Pythagoras this is not a right-angled triangle

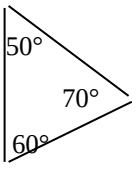
4.
$14x + 20y = 393$ x 9 $126x + 180y = 3537$
$9x + 15y = 261$ x 14 $126x + 210y = 3654$

$x = 22.5$, $y = 3.9$
Car £22.50
Passenger £3.90

5. $\cos x = 5/7 \rightarrow x = \cos^{-1}(5/7)$ and $360° - \cos^{-1}(5/7)$ **$x = 44.4°$ and $315.6°$**

6. $\frac{2(x-1)}{(x+5)(x-1)} + \frac{3(x+5)}{(x+5)(x-1)} = \frac{2x-2+3x+15}{(x+5)(x-1)} = \frac{5x+13}{(x+5)(x-1)}$

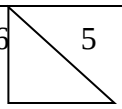
7.



Angle at B is 180° – 130° = 50° Angle at C is 180° - 50° - 60° = 70°

$\frac{BC}{\sin 60} = \frac{20}{\sin 70} \rightarrow BC = \frac{20 \times \sin 60}{\sin 70} =$ **18.4 km**

8. $7 = \frac{\theta}{360} \times \pi \times 12 \rightarrow \theta = \frac{7 \times 360}{\pi \times 12} =$ **66.8°**

9.	Right-angled triangle 	$x = \sqrt{5^2 - 4.6^2} = 1.96\,cm$ width is 2 x 1.96 = **3.92 cm**
10.	Angle is in the fourth quadrant	**270° < *a* < 360°**