2014 National 5 Paper 1

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Marks are indicated in brackets after each question number

Question 1, (2)

$$\frac{5}{12} x\, 2\frac{2}{9} = \frac{5}{12}\, x\, \frac{20}{9}$$

$$= \frac{100}{108}$$

$$= \frac{25}{27}$$

Question 2, (2)

$$(2x-5)(3x+1) = 6x^2 - 15x + 2x - 5$$

$$= 6x^2 - 13x - 5$$

Question 3, (2)

$$x^2 - 14x + 44 = (x-7)^2 - 5$$

Question 4, (2)

$$2\underline{u} - \underline{v} = 2\begin{pmatrix} -2 \\ 3 \\ 5 \end{pmatrix} - \begin{pmatrix} 0 \\ -4 \\ 7 \end{pmatrix} = \begin{pmatrix} -4 \\ 6 \\ 10 \end{pmatrix} - \begin{pmatrix} 0 \\ -4 \\ 7 \end{pmatrix} = \begin{pmatrix} -4 \\ 10 \\ 3 \end{pmatrix}$$

Question 5, (3)

Using the Sine Rule gives

$$\frac{k}{\sin K} = \frac{l}{\sin L}$$

$$\frac{LM}{0.4} = \frac{18}{0.9}$$

$$LM = 0.4\ x\ \frac{18}{0.9}$$

$$LM = 0.4\ x\ 20$$

$$LM = 8$$

Question 6, (3) (1)

a) $A = \left(5, 200\right),\ B = (25, 500)$

$$m_{AB} = \frac{500 - 200}{25 - 5} = 15$$

Using $y - b = m(x - a)$ with $(5, 200)$ gives

$$y - 200 = 15(x - 5)$$

$$y - 200 = 15x - 75$$

$$y = 15x + 125$$

$$C = 15F + 125$$

$b)\ C = 15F + 125$

Substitute $F = 40$ to give

$$C = (15\ x\ 40) + 125$$

$$= 725$$

Question 7, (2)

$y = ax^2$

Substituting $(-3, 45)$ gives

$45 = a(-3)^2$

$= 9a$

$a = 5$

Question 8, (3)

$$\sqrt{40} + 4\sqrt{10} + \sqrt{90} = \sqrt{4\ x\ 10} + 4\sqrt{10} + \sqrt{9\ x\ 10}$$
$$= 2\sqrt{10} + 4\sqrt{10} + 3\sqrt{10}$$
$$= 9\sqrt{10}$$

Question 9, (3)

$80\% = 480,000$

So, $1\% = 480,000 \div 80 = 6,000$

So, $100\% = 600,000$

Question 10, (2)

The graph has been stretched vertically by a factor of 3 so $a = 3$

The graph has been moved to the right by $40°$ so $b = -40$

Question 11, (2) (2)

a) $4x + 3y = 12$

$3y = -4x + 12$

$y = -\frac{4}{3}x + 4$

So, the gradient is $-\frac{4}{3}$

b) On the x-axis $y = 0$, so let $y = 0$ to give

$$0 = -\frac{4}{3}x + 4$$

$$x = 3$$

Giving, the point $(3, 0)$

Question 12, (4)

Consider the right-angled triangle PAC

$PC = 15$ since it is the radius

$AC = 27 - 15 = 12$ since $CB = 15$

Using Pythagoras' Theorem gives

$$(PC)^2 = (PA)^2 + (AC)^2$$

$$15^2 = (PA)^2 + 12^2$$

$$15^2 - 12^2 = (PA)^2$$

$$81 = (PA)^2$$

$$PA = 9$$

So, $PQ = 2\,x\,9 = 18\,cm$

Question 13, (4) (3)

a) Let $h = 60$ to give

$$60 = 16t - t^2$$

Rearranging gives

$$t^2 - 16t + 60 = 0$$

$$(t - 10)\big(t - 6\big) = 0$$

$$t = 6\,seconds,\ t = 10\,seconds$$

So, the rocket will <u>first</u> be at a height of 60 metres after 6 seconds

b) Since the path of the rocket is a parabola (since the equation is quadratic) the turning point occurs at the midpoint of the values $t = 6$, $t = 10$ - i.e. at $t = 8$

So, the maximum height of the rocket occurs when $t = 8$

Let $t = 8$ to give

$$h(8) = \left(16\, x\, 8\right) - 8^2$$
$$= 128 - 64$$
$$= 64$$

So, the maximum height the rocket gets to is 64 metres, so does not reach a height of 70 metres

2014 National 5 Paper 2

Question 1, (3)

A 15% decrease is the same as 85% of the original roll

So, after three years the roll will be given by

$964 \; x \; 0.85^3 = 592$

Question 2, (2)

$B = (8, 4, 10), \; C = (4, 0, 10)$

Question 3, (2)

a) $5a + 3c = 158.25$

b) $3a + 2c = 98$

c) $5a + 3c = 158.25$ (1)

$3a + 2c = 98$ (2)

Multiplying (1) by 2 and (2) by 3 gives

$10a + 6c = 316.5$ (3)

$9a + 6c = 294$ (4)

$(3) - (4)$ gives

$a = 316.5 - 294 = 22.5$

Substituting $a = 22.5$ into (2) gives

$\left(3 \; x \; 22.5\right) + 2c = 98$

$c = 15.25$

So, an adult ticket costs £22.50 and a child ticket costs £15.25

Question 4, (1) (3) (1)

a) i) Mean $= \dfrac{53 + 57 + 58 + 60 + 55 + 56}{6} = 56.5$

ii) Mean $= \bar{x} = 56.5$

x	$x - \bar{x}$	$(x - \bar{x})^2$
53	-3.5	12.25
57	0.5	0.25
58	1.5	2.25
60	3.5	12.25
55	-1.5	2.25
56	-0.5	0.25
		$\sum (x - \bar{x})^2 = 29.5$

Standard Deviation $= \sqrt{\dfrac{29.5}{6 - 1}} = 2.4$

b) In the new training routine, the mean is lower and the standard deviation is higher. Since the standard deviation is higher she is now less consistent despite the fact that her average time is lower.

Question 5, (3)

Linear scale factor $= \frac{24}{15}$

Volume scale factor $= (\frac{24}{15})^3$

Volume of the larger jar $= 750\ x\ (\frac{24}{15})^3 = 3,072\ cm^3$

Question 6, (4)

Since Lowtown is due west of Midtown then Hightown can only be directly north of Lowtown if the triangle is right-angled.

Let H = Hightown, L = Lowtown, M = Midtown

Then $(LH)^2 + (LM)^2 = 85^2 + 75^2 = 12,850$

$(HM)^2 = 110^2 = 12,100$

Since $(LH)^2 + (LM)^2 \neq (HM)^2$ the triangle is not right-angled

Therefore, Hightown is not directly north of Lowtown

Question 7, (5)

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

$= \frac{1}{3}\pi\ x\ 4^2\ x\ 15 = 251.3\ cm^3$

Volume of hemisphere $= \frac{4}{3}\pi r^3 \div 2$

$= \frac{4}{3}\pi\ x\ 3.7^3 \div 2$

$= 106.1\ cm^3$

Volume of glass part $= 251.3 - 106.1 = 145.2\ cm^3$

Question 8, (3)

$$\frac{n^5\ x\ 10n}{2n^2} = \frac{10n^6}{2n^2} = 5n^4$$

Question 9, (3)

$$\frac{7}{x+5} - \frac{3}{x} = \frac{7x}{x(x+5)} - \frac{3(x+5)}{x(x+5)}$$

$$= \frac{7x - 3(x+5)}{x(x+5)}$$

$$= \frac{7x - 3x - 15}{x(x+5)}$$

$$= \frac{4x - 15}{x(x+5)}$$

Question 10, (3) (2)

a) Using the Cosine Rule, we have

$$\cos B = \frac{a^2 + c^2 - b^2}{2ac}$$

$$= \frac{11^2 + 8^2 - 13^2}{2x11x8}$$

$$= 0.09\ldots.$$

$$B = cos^{-1}(0.09\ldots)$$

$$= 85^\circ$$

b) Extending the line AB gives 'F' angles with the two North lines, with the 'F' angles being 60° and 120°

So, shaded angle $= 360 - 85 - 120 = 155^\circ$

Question 11, (3)

$$s = ut + \frac{1}{2}at^2$$

$$s - ut = \frac{1}{2}at^2$$

$$2s - 2ut = at^2$$

$$\frac{2s - 2ut}{t^2} = a$$

Question 12, (3)

$$11\cos x^\circ - 2 = 3$$

$$11\cos x^\circ = 5$$

$$\cos x^\circ = \frac{5}{11}$$

$$x = cos^{-1}\left(\frac{5}{11}\right) = 63^\circ$$

Second solution is $360 - 63 = 297^\circ$

Question 13, (5)

Area of sector MON $= \frac{50}{360}\, x\, \pi\, x\, 7^2 = 21.4\ m^2$

Area of triangle MON $= \frac{1}{2}\, x\, 7\, x\, 7\, x \sin 50^\circ = 18.8\ m^2$

Area of Chord at MN $= 2.6\ m^2$

Area of circle $= \pi\, x\, 7^2 = 153.9\ m^2$

Area of cross-section $= 153.9 - 2.6 = 151.3\ m^2$