



## 2016 National 5 Mathematics Paper 1

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### Question 1, (2)

$$\frac{1}{2}p + q = \frac{1}{2} \begin{pmatrix} 4 \\ -6 \end{pmatrix} + \begin{pmatrix} -5 \\ -1 \end{pmatrix} = \begin{pmatrix} 2 \\ -3 \end{pmatrix} + \begin{pmatrix} -5 \\ -1 \end{pmatrix} = \begin{pmatrix} -3 \\ -4 \end{pmatrix}$$

### Question 2, (2)

$$\frac{3}{4} \left( \frac{1}{3} + \frac{2}{7} \right) = \frac{3}{4} \left( \frac{7}{21} + \frac{6}{21} \right) = \frac{3}{4} \left( \frac{13}{21} \right) = \frac{39}{84} = \frac{13}{28}$$

### Question 3, (3)

$$\begin{aligned} \text{Area} &= \frac{45}{360} \times \pi \times 20^2 \\ &= \frac{1}{8} \times 400 \times 3.14 \\ &= 50 \times 3.14 \\ &= \frac{100 \times 3.14}{2} \\ &= \frac{314}{2} \\ &= 157 \text{ cm}^2. \end{aligned}$$

### Question 4, (1) (1) (4)

a)  $2c + 3d = 9.6$

b)  $3c + 4d = 13.3$

c)  $2c + 3d = 9.6$  (1)

$3c + 4d = 13.3$  (2)

Multiply (1) by 3 and (2) by 2 to give

$6c + 9d = 28.8$  (3)

$6c + 8d = 26.6$  (4)



(3) - (4) gives

$$d = 2.2$$

Substitute  $d = 2.2$  into (1) to give

$$2c + (3 \times 2.2) = 9.6$$

$$2c + 6.6 = 9.6$$

$$2c = 3$$

$$c = 1.5$$

Dress requires  $2.2 \text{ m}^2$  and cloak requires  $1.5 \text{ m}^2$ .

### Question 5, (3) (1)

a)  $D = (3, 100), E = (15, 340)$

$$\begin{aligned} m_{DE} &= \frac{340-100}{15-3} \\ &= \frac{240}{12} \\ &= 20 \end{aligned}$$

Using  $y - b = m(x - a)$  with  $(3, 100)$  gives

$$y - 100 = 20(x - 3)$$

$$y - 100 = 20x - 60$$

$$y = 20x + 40$$

$$W = 20A + 40$$

b)  $W = 20A + 40$

$$1 \text{ year} = 12 \text{ months}$$

$$W = (20 \times 12) + 40$$

$$= 280 \text{ kg}$$



**Question 6, (2)**

$$f(x) = 7x^2 + 5x - 1$$

$$a = 7, b = 5, c = -1$$

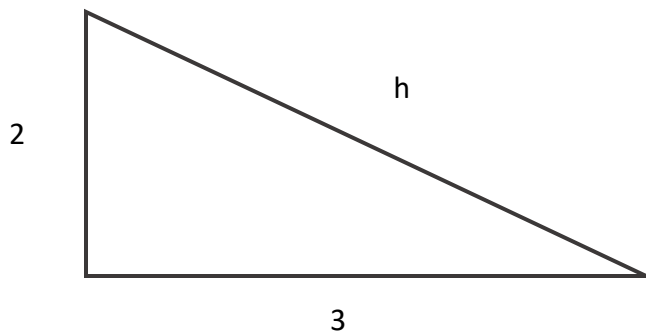
$$b^2 - 4ac = 25 - 4 \times 7 \times (-1) = 53$$

Since  $b^2 - 4ac > 0$  there are two roots.

**Question 7, (1) (3)**

a)  $B = (8, 4, 0)$  by inspection of the graph.

b) Create a right-angled triangle in the base.



Using Pythagoras, we have

$$h = \sqrt{2^2 + 3^2} = \sqrt{13}$$

$$(AV)^2 = 6^2 + (\sqrt{13})^2$$

$$= 49$$

$$AV = 7$$

**Question 8, (3)**

$$\frac{2x}{3} - \frac{5}{6} = 2x$$

Multiplying by 6 gives

$$4x - 5 = 12x$$

$$8x = -5, x = -\frac{5}{8}$$

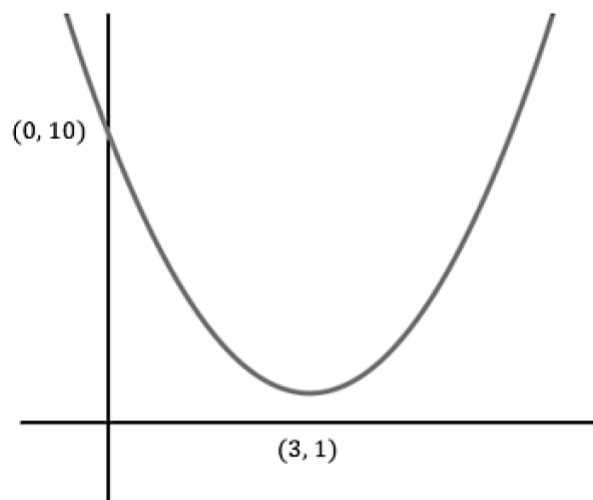


**Question 9, (2)**

$$f(x) = \frac{2}{\sqrt{x}}$$

$$\begin{aligned} f(5) &= \frac{2}{\sqrt{5}} \\ &= \frac{2}{\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}} \\ &= \frac{2\sqrt{5}}{5} \end{aligned}$$

**Question 10, (3)**



**Question 11, (2)**

$$\tan^2 x \cos^2 x$$

Use  $\tan x = \frac{\sin x}{\cos x}$  to give

$$\begin{aligned} &\left(\frac{\sin x}{\cos x}\right)^2 \cos^2 x \\ &= \frac{\sin^2 x}{\cos^2 x} \cdot \cos^2 x \\ &= \sin^2 x \end{aligned}$$



**Question 12, (1) (3) (3)**

**a)** Area of rectangle =  $(2x + 1)(x + 8)$

**b)** Area of triangle =  $\frac{1}{2}(3x)(2(x + 5))$   
 $= 3x(x + 5)$

Area of rectangle = area of triangle

$$(2x + 1)(x + 8) = 3x(x + 5)$$

$$2x^2 + 17x + 8 = 3x^2 + 15x$$

Simplifying gives  $x^2 - 2x - 8 = 0$

**c)**  $x^2 - 2x - 8 = 0$

$$(x - 4)(x + 2) = 0$$

$$x = -2, x = 4$$

Since  $x$  is a length it cannot be negative, so  $x = 4$

$$\text{Length} = 8 + 4 = 12 \text{ cm.}$$

$$\text{Breadth} = (2 \times 4) + 1 = 9 \text{ cm.}$$



## 2016 National 5 Mathematics Paper 2

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### Question 1, (3)

$$35 \times 0.92^3 = 27.25$$

Sugar content = 27.25 grams.

### Question 2, (2)

$$\begin{aligned} \text{Weight} &= 12 \div 1.5 \times 10^9 \\ &= 0.000000008 \\ &= 8 \times 10^{-9} \text{ grams.} \end{aligned}$$

### Question 3, (1)

$$\overrightarrow{BD} = \underline{v} - \underline{u}$$

### Question 4, (2)

$$\begin{aligned} 3x^2 - 48 \\ &= 3(x^2 - 16) \\ &= 3(x - 4)(x + 4) \end{aligned}$$

### Question 5, (3)

$$EOA = 180 - 143 = 37^\circ.$$

So,  $OAC = 37^\circ$  since Z angle.

So,  $CAB = 90 - 37 = 53^\circ$  since tangent to circle makes  $90^\circ$  angle with radius.

$ACB = 53^\circ$  since same angle as  $CAB$ .

$$\text{So, } B = 180 - (53 \times 2) = 74^\circ.$$



### Question 6, (4) (2)

a) Mean =  $\bar{x} = \frac{13 + 16 + 10 + 22 + 5 + 12}{6} = 13$

$x$	$x - \bar{x}$	$(x - \bar{x})^2$
13	0	0
16	3	9
10	-3	9
22	9	81
5	-8	64
12	-1	1
		$\sum (x - \bar{x})^2 = 164$

Standard Deviation =  $\sqrt{\frac{164}{5}} = 5.73$

b) The mean has increased and the standard deviation has decreased. This means that, on average, Sophie had to wait longer on the phone than Jack, but since the standard deviation has decreased her waiting times were more consistent than for Jack.

### Question 7, (5)

Volume of large cone =  $\frac{1}{3}\pi r^2 h$   
 $= \frac{1}{3} x \pi x 16^2 x 24$   
 $= 6,400 \text{ cm}^3$  to 2 s.f.

Volume of small cone =  $\frac{1}{3}\pi r^2 h$   
 $= \frac{1}{3} x \pi x 9^2 x 13.5$   
 $= 1,100 \text{ cm}^3$  to 2 s.f.

Volume of carton =  $6,400 - 1,100 = 5,300 \text{ cm}^3$  to 2 s.f.

**Question 8, (3)**

Using the Sine Rule gives

$$\frac{\sin x}{150} = \frac{\sin 66}{140}$$

$$\sin x = \frac{\sin 66}{140} \times 150$$

$$\sin x = 0.978 \dots$$

$$x = \sin^{-1}(0.978 \dots)$$

$$x = 78.2^\circ$$

**Question 9, (2)**

$$x^2 + 8x - 7 = (x + 4)^2 - 23$$

**Question 10, (3)**

$$(n^2)^3 \times n^{-10}$$

$$= n^6 \times n^{-10}$$

$$= n^{-4}$$

$$= \frac{1}{n^4}$$

**Question 11, (3)**

$$\text{Linear scale factor} = \frac{60}{100} = 0.6$$

$$\text{Area scale factor} = 0.6^2 = 0.36$$

$$\text{Cost} = \text{£}13.75 \times 0.36 = \text{£}4.95$$

**Question 12, (3)**

$$L = \sqrt{4kt - p}$$

$$L^2 = 4kt - p$$

$$L^2 + p = 4kt$$

$$\frac{L^2 + p}{4t} = k$$





**Question 13, (3)**

$$\begin{aligned} & \frac{3}{x-2} + \frac{5}{x+1} \\ &= \frac{3(x+1)}{(x-2)(x+1)} + \frac{5(x-2)}{(x-2)(x+1)} \\ &= \frac{3(x+1) + 5(x-2)}{(x-2)(x+1)} \\ &= \frac{8x-7}{(x-2)(x+1)} \end{aligned}$$

**Question 14, (3)**

$$2 \tan x + 5 = -4$$

$$2 \tan x = -9$$

$$\tan x = -4.5$$

$$x = \tan^{-1}(-4.5)$$

$$x = 77^\circ$$

Using CAST we have

$$x = 180 - 77 = 103^\circ$$

$$x = 360 - 77 = 283^\circ$$

**Question 15, (4)**

Let M be the midpoint of AB

$$MB = 4.5$$

Make a right triangle OMB giving

$$6.6^2 = (OM)^2 + 4.5^2 \quad \text{by Pythagoras}$$

$$(OM)^2 = 6.6^2 - 4.5^2 = 23.31$$

$$OM = \sqrt{23.31} = 4.8 \text{ cm.}$$

Height = OM + radius

$$= 4.8 + 6.6$$

$$= 11.4 \text{ cm.}$$



### Question 16, (4)

Using Pythagoras gives  $DE = \sqrt{4^2 - 3^2} = \sqrt{7}$

Using the Sine Rule on ADE gives

$$\frac{\sin A}{a} = \frac{\sin E}{e}$$

$$\frac{\sin A}{\sqrt{7}} = \frac{\sin 90}{4}$$

$$\sin A = \frac{\sqrt{7} \sin 90}{4}$$

$$= 0.661 \dots$$

$$A = \sin^{-1}(0.661 \dots)$$

$$= 41^\circ$$

Using the Cosine Rule on ABC gives

$$a^2 = b^2 + c^2 - 2bc \cos A$$

$$= 6^2 + 10^2 - 2 \times 6 \times 10 \times \cos 41^\circ$$

$$= 45.4$$

$$a = 6.7$$

So,  $BC = 6.7 \text{ cm}$ .