FOR OFFICIAL USE

N5 National Qualifications 2019

Mark

X847/75/01

Mathematics
Paper 1 (Non-calculator)

FRIDAY, 3 MAY

9:00 AM – 10:15 AM

X847750 1

Fill in these boxes and read what is printed below.

Full name of centre: WORKED SOLUTIONS

Town:

Forename(s)

Surname

Number of seat

Date of birth

Day Month Year

Scottish candidate number

Total marks — 50

Attempt ALL questions.

You may NOT use a calculator.

To earn full marks you must show your working in your answers.

State the units for your answer where appropriate.

Write your answers clearly in the spaces provided in this booklet. Additional space for answers is provided at the end of this booklet. If you use this space you must clearly identify the question number you are attempting.

Use **blue** or **black** ink.

Before leaving the examination room you must give 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 $A = \frac{1}{2}ab\sin C$

Volume of a sphere $V = \frac{4}{3}\pi r^3$

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

Volume of a pyramid $V = \frac{1}{3}Ah$

Standard deviation $s = \sqrt{\dfrac{\Sigma(x - \bar{x})^2}{n - 1}}$

or $s = \sqrt{\dfrac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n - 1}}$, where n is the sample size.

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Total marks — 50

Attempt ALL questions

1. Given that $f(x) = 5x^3$, evaluate $f(-2)$. **2**

$$f(-2) = 5(-2)^3$$
$$= 5(-8)$$
$$f(-2) = -40$$

2. Evaluate $\frac{3}{8} \times 1\frac{5}{7}$.

Give your answer in its simplest form. **2**

$$\frac{3}{8} \times \frac{12}{7}$$

$\div 4$ $\div 4$

$$\frac{3}{2} \times \frac{3}{7}$$

$$\frac{9}{14}$$

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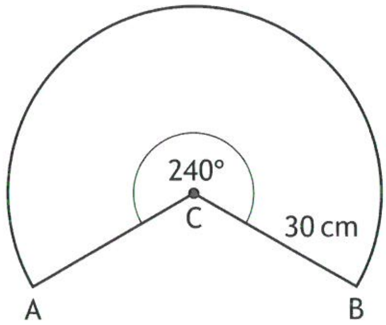
3. Expand and simplify $(x+5)(2x^2-7x-3)$. **3**

$x(2x^2-7x-3) + 5(2x^2-7x-3)$

$2x^3 - 7x^2 - 3x + 10x^2 - 35x - 15$

$2x^3 + 3x^2 - 38x - 15$

4. The diagram below shows a sector of a circle, centre C.



diameter
60cm

The radius of the circle is 30 centimetres.

Calculate the length of the major arc AB.

Take $\pi = 3{\cdot}14$. **3**

$$\text{Arc length} = \frac{\theta}{360} \times \pi d$$

$$= \frac{240}{360} \times \pi \times 60$$

$$= \frac{2}{3} \times 60\pi$$

$$= 40\pi$$

$$= 40 \times 3.14$$

$$\text{Arc Length} = 125.6 \text{ cm}$$

31.4
$\times 4$
125.6

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5. The midday temperatures in Grantford were recorded over a nine day period.

The temperatures, in °C, were

4 7 4 3 6 10 9 5 3

(a) Calculate the median and semi-interquartile range for these temperatures. **3**

Numerical order

3 3 | 4 4 $\boxed{5}$ 6 7 | 9 10

Q_1 3.5 Q_2 Q_3 8

Median = 5°C

IQR = 8 − 3.5
= 4.5

SIQR = 2.25°C

Over the same nine day period the midday temperatures in Endoch were also recorded.

The median temperature was 8 °C, and the semi-interquartile range was 1·5 °C.

(b) Make two valid comments comparing the midday temperatures of Grantford and Endoch during this period. **2**

Grantford	5	2.25
Endoch	8	1.5

- On average, it was warmer in Endoch than Grantford over the nine day period.
- The midday temperatures in Grantford were more variable than those in Endoch across the nine-day period.

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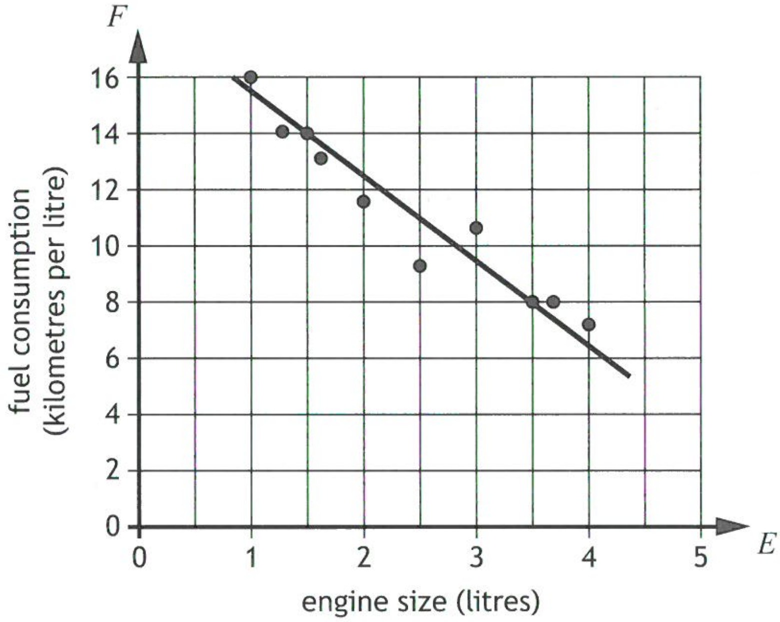
6. The fuel consumption of a group of cars is recorded.

The scattergraph shows the relationship between the fuel consumption, F kilometres per litre, and the engine size, E litres, of the cars.



A line of best fit has been drawn.

(a) Find the equation of the line of best fit in terms of F and E.

Give the equation in its simplest form. **3**

Points $(1.5, 14)$ and $(3.5, 8)$

$m = \frac{8 - 14}{3.5 - 1.5} = \frac{-6}{2} = -3$

$y - b = m(x - a)$

$y - 14 = -3(x - 1.5)$

$y - 14 = -3x + 4.5$

$y = -3x + 18.5$

$F = -3E + 18.5$

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6. (continued)

Amaar's car has an engine size of 1·1 litres.

(b) Use your equation from part (a) to estimate how many kilometres per litre he should expect to get. **1**

$F = -3(1.1) + 18.5$

$= -3.3 + 18.5$

$F = 15.2$ km per litre

7. The area of a trapezium is given by the formula

$$A = \frac{1}{2}h(x+y).$$

Make x the subject of the formula. **3**

$\frac{1}{2}h(x+y) = A$

$h(x+y) = 2A$

$x+y = \frac{2A}{h}$

$x = \frac{2A}{h} - y.$

* X 8 4 7 7 5 0 1 0 7 *

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8. John bought 7 bags of cement and 3 bags of gravel.

The total weight of these bags was 215 kilograms.

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

Let c = weight of one bag of cement
g = weight of one bag of gravel

$$7c + 3g = 215$$

Shona bought 5 bags of cement and 4 bags of gravel.

The total weight of her bags was 200 kilograms.

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

$$5c + 4g = 200$$

(c) Calculate the weight of one bag of cement and the weight of one bag of gravel. **4**

$$7c + 3g = 215 \quad \times 4$$
$$5c + 4g = 200 \quad \times 3$$

$$28c + 12g = 860$$
$$- \quad 15c + 12g = 600$$
$$13c = 260$$
$$c = 20.$$

$$5c + 4g = 200$$
$$5(20) + 4g = 200$$
$$100 + 4g = 200$$
$$4g = 100$$
$$g = 25$$

One bag of cement weighs 20kg,

one bag of gravel weighs 25kg.

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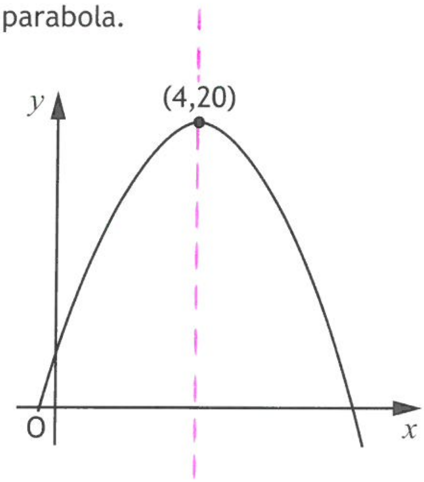
9. The graph shows a parabola.



The maximum turning point has coordinates (4,20) as shown in the diagram.

(a) Write down the equation of the axis of symmetry of the graph. **1**

$x = 4$

The equation of the parabola is of the form $y = b - (x + a)^2$.

(b) State the values of

$y = 20 - (x - 4)^2$

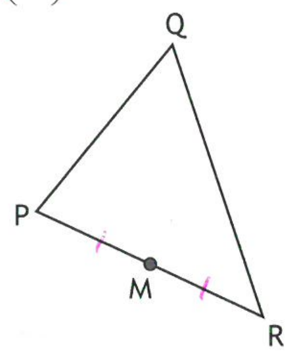
(i) a **1**

$a = -4$

(ii) b. **1**

$b = 20$

10. In triangle PQR, $\overrightarrow{PR} = \begin{pmatrix} 6 \\ -4 \end{pmatrix}$ and $\overrightarrow{RQ} = \begin{pmatrix} -1 \\ 8 \end{pmatrix}$.



(a) Express $\overrightarrow{PQ}$ in component form. **1**

$$\overrightarrow{PQ} = \overrightarrow{PR} + \overrightarrow{RQ} = \begin{pmatrix} 6 \\ -4 \end{pmatrix} + \begin{pmatrix} -1 \\ 8 \end{pmatrix}$$

$$\overrightarrow{PQ} = \begin{pmatrix} 5 \\ 4 \end{pmatrix}$$

M is the midpoint of PR.

(b) Express $\overrightarrow{MQ}$ in component form. **2**

$$\overrightarrow{MQ} = \tfrac{1}{2}\overrightarrow{PR} + \overrightarrow{RQ}$$

$$= \tfrac{1}{2}\begin{pmatrix} 6 \\ -4 \end{pmatrix} + \begin{pmatrix} -1 \\ 8 \end{pmatrix}$$

$$= \begin{pmatrix} 3 \\ -2 \end{pmatrix} + \begin{pmatrix} -1 \\ 8 \end{pmatrix}$$

$$\overrightarrow{MQ} = \begin{pmatrix} 2 \\ 6 \end{pmatrix}$$

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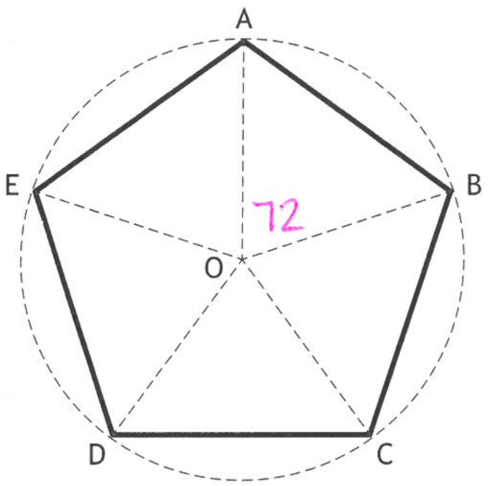
11. Pam is designing a company logo.

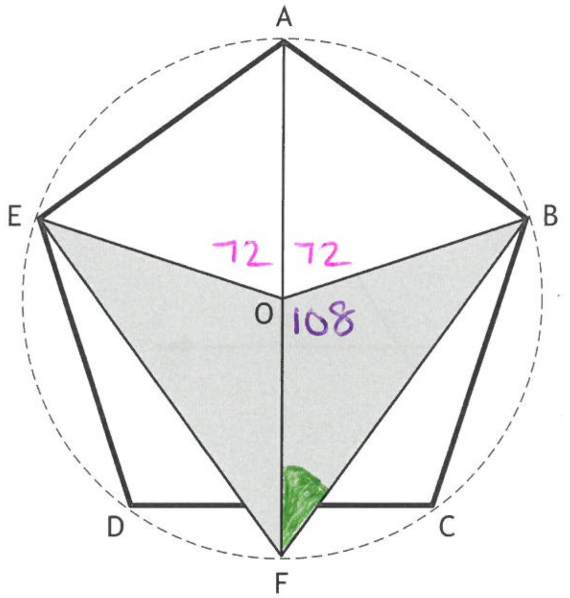
She starts by drawing a regular pentagon ABCDE.

The vertices of the pentagon lie on the circumference of a circle with centre O.



$360 \div 5 = 72$

She then adds to the design as shown in the diagram below.



$180 - 72 = 108$

$\frac{180-108}{2}$

$\frac{72}{2} = 36$

AF is a diameter of the circle.

Calculate the size of angle OFB. **3**

Angle OFB = 36°

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12. Express $\frac{\sqrt{2}}{\sqrt{40}}$ as a fraction with a rational denominator.

Give your answer in its simplest form. **3**

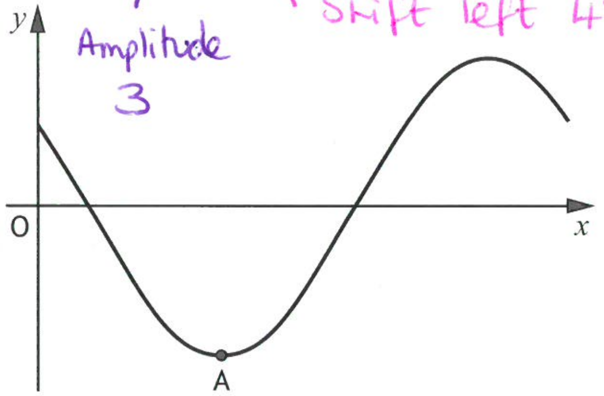
$$\frac{\sqrt{2}}{\sqrt{40}} = \sqrt{\frac{2}{40}} = \sqrt{\frac{1}{20}} = \frac{1}{\sqrt{20}}$$

$$\frac{1}{\sqrt{20}} = \frac{1}{\sqrt{4}\sqrt{5}} = \frac{1}{2\sqrt{5}} = \frac{\sqrt{5}}{10}$$

13. Part of the graph of $y = 3\cos(x + 45)°$ is shown in the diagram.

Amplitude 3

Shift left 45°.



The graph has a minimum turning point at A.

State the coordinates of A. **2**

Min. value of $y = \cos x$ is at $x = 180°$

$x = 180 - 45 = 135°$

$y = -3$

$A(135°, -3)$

14. Solve the equation $\frac{x}{2} - 1 = \frac{3-x}{5}$. **3**

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

$$5x - 10 = 6 - 2x$$

$$7x = 16$$

$$x = \frac{16}{7}$$

$$x = 2\frac{2}{7}$$

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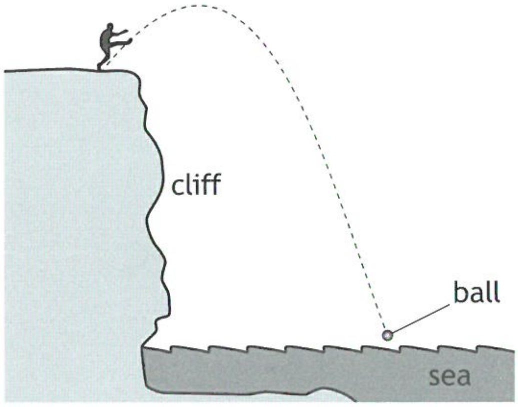
15. A ball is kicked from a clifftop.



The height, h metres, of the ball relative to the clifftop after t seconds is given by $h = 12t - 5t^2$.

(a) Calculate the height of the ball above the clifftop after 2 seconds. **1**

At $t = 2$,

$h = 12(2) - 5(2)^2$

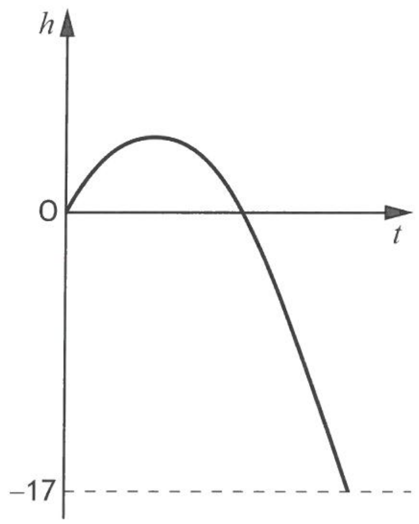
$= 24 - 5(4)$

$= 24 - 20$

$h = 4$ metres after 2 seconds.

15. (continued)

The graph below represents the height, h metres, of the ball relative to the clifftop after t seconds.



The sea is 17 metres below the clifftop.

(b) After how many seconds will the ball hit the sea? 4

Find t when $h = -17$ m

$12t - 5t^2 = -17$

$5t^2 - 12t - 17 = 0$

$(5t - 17)(t + 1) = 0$

$5t - 17 = 0$ $\quad\quad$ $t + 1 = 0$

$5t = 17$ $\quad\quad$ $\cancel{t = -1}$

$t = \frac{17}{5}$ $\quad\quad$ no solution, $t > 0$.

$t = 3.4$ seconds

[END OF QUESTION PAPER]

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ADDITIONAL SPACE FOR ANSWERS