

FOR OFFICIAL USE

N5

National
Qualifications

Mark

50

X847/75/01

**Mathematics
Paper 1 (Non-calculator)**

Duration — 1 hour 15 minutes



* X 8 4 7 7 5 0 1 *

2021 Paper 1 Worked Solutions

H Wallace

Total marks — 50
Attempt ALL questions

1. Calculate $|\mathbf{d}|$, the magnitude of vector $\mathbf{d} = \begin{pmatrix} 1 \\ -4 \\ 8 \end{pmatrix}$.

2

$$|\mathbf{d}| = \sqrt{(1)^2 + (-4)^2 + (8)^2}$$

$$= \sqrt{81}$$

$$\underline{\underline{|\mathbf{d}| = 9 \text{ units.}}}$$

2. Evaluate $5\frac{1}{2} - 1\frac{2}{7}$.

2

$$= 5\frac{1}{2} - 1 - \frac{2}{7}$$

$$= 4\frac{1}{2} - \frac{2}{7}$$

$$= 4\frac{7}{14} - \frac{4}{14}$$

$$\underline{\underline{= 4\frac{3}{14}}}$$



* X 8 4 7 7 5 0 1 0 3 *

3. Expand and simplify $(6x-5)(x+3)+2x(4-x)$.

$$6x^2 + 18x - 5x - 15 + 8x - 2x^2$$

$$\underline{\underline{4x^2 + 21x - 15}}$$

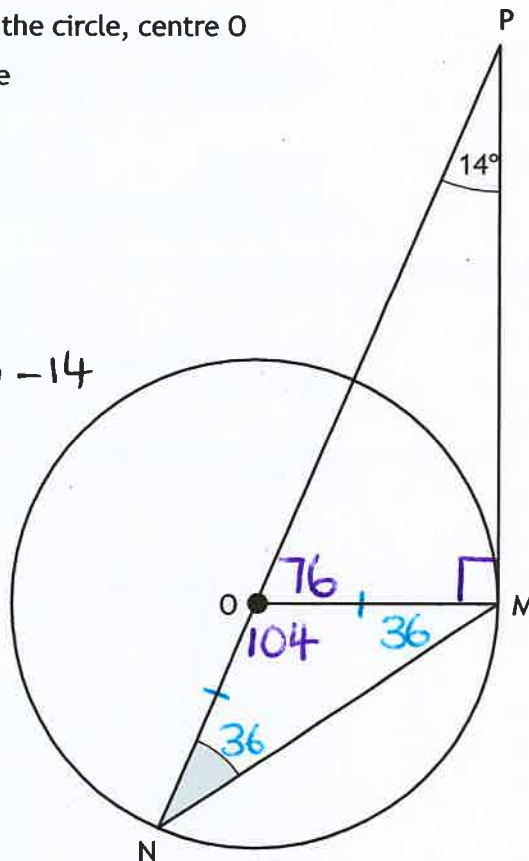
4. In the diagram shown below

- PM is a tangent to the circle, centre O
- PN is a straight line
- angle OPM is 14° .

$$\angle PMO = 90^\circ$$

$$\begin{aligned} \angle POM &= 180 - 90 - 14 \\ &= 76^\circ \end{aligned}$$

$$\begin{aligned} \angle MON &= 180 - 76 \\ &= 104 \end{aligned}$$



Lengths
 $ON = OM$

Calculate the size of shaded angle ONM.

2

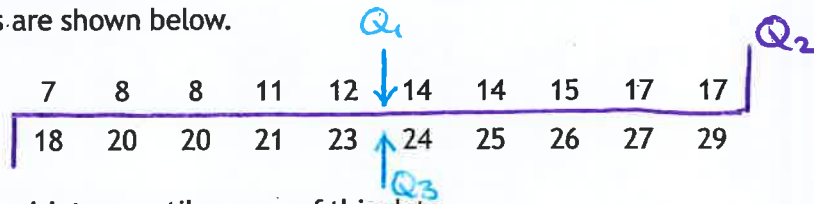
$$\angle ONM = \frac{1}{2} \text{ of } 76$$

$$\underline{\underline{\angle ONM = 38^\circ}}$$



5. The number of absentees at Applegrove High School was recorded each day over a four-week period.

The results are shown below.



Find the semi-interquartile range of this data.

2

$$Q_2 = 17.5$$

$$IQR = Q_3 - Q_1$$

$$Q_1 = 13$$

$$= 23.5 - 13$$

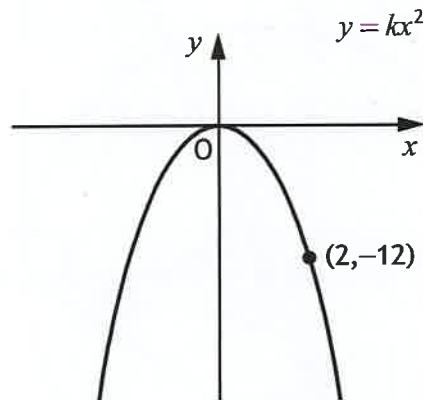
$$Q_3 = 23.5$$

$$IQR = 10.5$$

$$SIQR = \frac{1}{2} \text{ of } 10.5$$

$$SIQR = 5.25$$

6. The diagram below shows part of the graph of $y = kx^2$.



Find the value of k .

2

$$y = kx^2$$

$$-12 = k(2)^2$$

$$-12 = 4k$$

$$k = -3$$



7. Solve, algebraically, the system of equations

$$5c + 2d = 4 \quad \times 3$$

$$4c - 3d = 17 \quad \times 2$$

$$15c + 6d = 12$$

$$\oplus \quad 8c - 6d = 34$$

$$23c = 46$$

$$\underline{c = 2}$$

$$\hookrightarrow 5(2) + 2d = 4$$

$$10 + 2d = 4$$

$$2d = -6$$

$$\underline{d = -3}$$

Solutions: $c = 2$ and $d = -3$



8. Determine the nature of the roots of the function $f(x) = x^2 + 4x - 7$.

2

$$\text{let } ax^2 + bx + c = 0$$

$$a = 1$$

$$b = 4$$

$$c = -7$$

$$\Delta = b^2 - 4ac$$

$$= (4)^2 - 4(1)(-7)$$

$$= 16 + 28$$

$$\Delta = 44$$

Since $b^2 - 4ac > 0$, there are real and distinct roots.

9. Express $\sqrt{50} + \sqrt{45} - \sqrt{2}$ in its simplest form.

3

$$\sqrt{25}\sqrt{2} + \sqrt{9}\sqrt{5} - \sqrt{2}$$

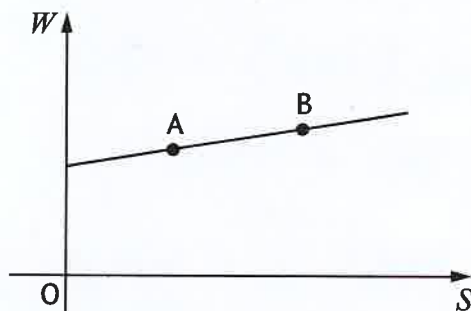
$$5\sqrt{2} + 3\sqrt{5} - \sqrt{2}$$

$$\underline{\underline{4\sqrt{2} + 3\sqrt{5}}}$$



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

10. David works in a shop, and is paid weekly.
 His wage is made up of a basic wage plus commission on his sales.
 The graph shows his wage, W pounds, against his sales, S pounds.



Point A represents sales of £6000 and a wage of £450.

Point B represents sales of £7200 and a wage of £510.

- (a) Find the equation of the line in terms of W and S .
 Give the equation in its simplest form.

3

Gradient: $A(6000, 450)$ $B(7200, 510)$

$$m_{AB} = \frac{510 - 450}{7200 - 6000} = \frac{60}{1200} = \frac{1}{20}$$

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

$$y - 450 = \frac{1}{20}(x - 6000)$$

$$y - 450 = \frac{1}{20}x - 300$$

$$y = \frac{1}{20}x + 150$$

$$\underline{\underline{W = \frac{1}{20}S + 150}}$$



10. (continued)

(b) Calculate David's wage in a week when his sales are £1000.

1

$$S = 1000$$

$$W = \frac{1}{20}(1000) + 150$$

$$W = 50 + 150$$

$$W = 200 \quad \underline{\underline{\text{Wages } \pounds 200.}}$$

11. Solve, algebraically, the inequation $1 - (x + 4) > 2x$.

3

$$1 - x - 4 > 2x$$

$$-3 - x > 2x$$

$$-3 > 3x$$

$$-1 > x$$

$$\hookrightarrow \underline{\underline{x < -1}}$$



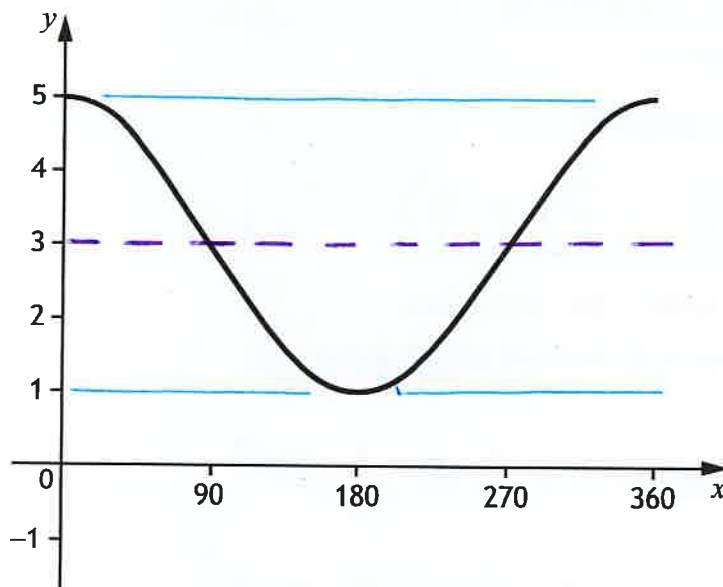
12. A band sold 2400 tickets for their gig in Edinburgh.
 This was 75% of the number of tickets sold for their gig in Glasgow.
 Calculate the number of tickets sold for their gig in Glasgow.

3

$$\begin{aligned} 75\% \text{ of tickets} &= 2400 \\ 25\% &= 800 \\ 100\% &= 3200 \end{aligned}$$

3200 tickets were sold in Glasgow.

13. The graph of $y = a \cos x^\circ + b$, $0 \leq x \leq 360$, is shown.



State the values of a and b .

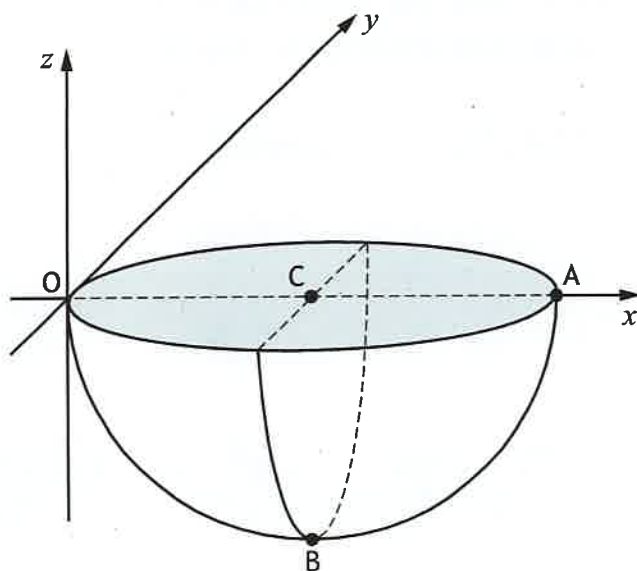
2

$$y = 2 \cos x + 3$$

$$\underline{a = 2 \text{ and } b = 3}$$



14. The diagram shows a hemisphere relative to the coordinate axes.



- A is the point (6, 0, 0)
- C is the midpoint of diameter OA
- B is vertically below C

diameter = 6
 \therefore radius = 3

(a) State the coordinates of B.

1

$B(3, 0, -3)$

(b) Calculate the volume of the hemisphere.

Give your answer in its simplest form in terms of π .

2

$$\begin{aligned} V_{\text{hemisphere}} &= \frac{1}{2} \times \frac{4}{3} \pi r^3 \\ &= \frac{2}{3} \times \pi \times 3^3 \\ &= \frac{2}{3} \times \pi \times 27 \end{aligned}$$

Volume = 18π cubic units.



15. Evaluate $16^{\frac{3}{2}}$.

2

$$= \sqrt{16^3}$$

$$= 4^3$$

$$= \underline{\underline{64}}$$

16. The function $f(x)$ is defined by $f(x) = 4 \sin 3x^\circ$.

Evaluate $f(90)$.

2

$$f(90) = 4 \sin 3(90)^\circ$$

$$= 4 \sin 270^\circ$$

$$= 4(-1)$$

$$\underline{\underline{f(90) = -4}}$$



$$\sin 270^\circ = -1$$



17. Sketch the graph of $y = 2(x-1)^2 + 4$.

On your sketch, show clearly the coordinates of the turning point and the point of intersection with the y -axis.

3

$$y = 2(x-1)^2 + 4$$

Minimum Turning Point at (1, 4)

y -intercept at $x=0$

$$y = 2(0-1)^2 + 4$$

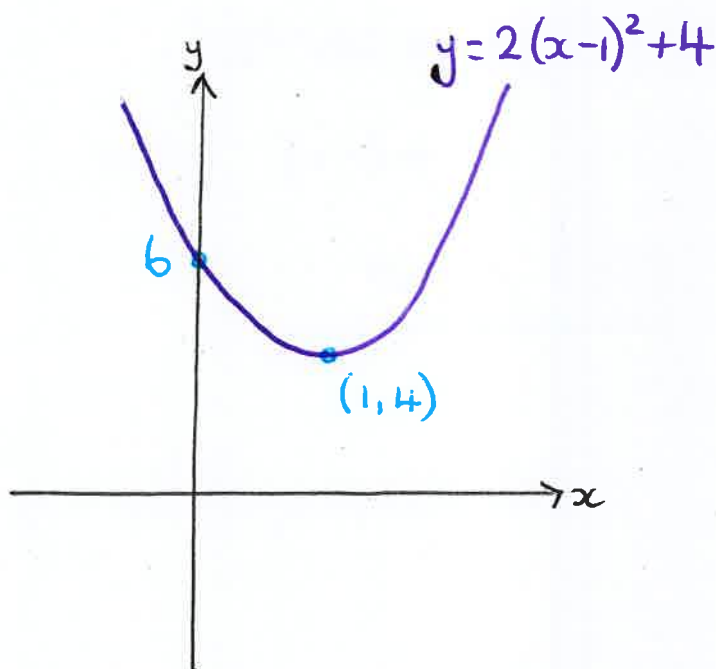
$$y = 2(-1)^2 + 4$$

$$y = 2 + 4$$

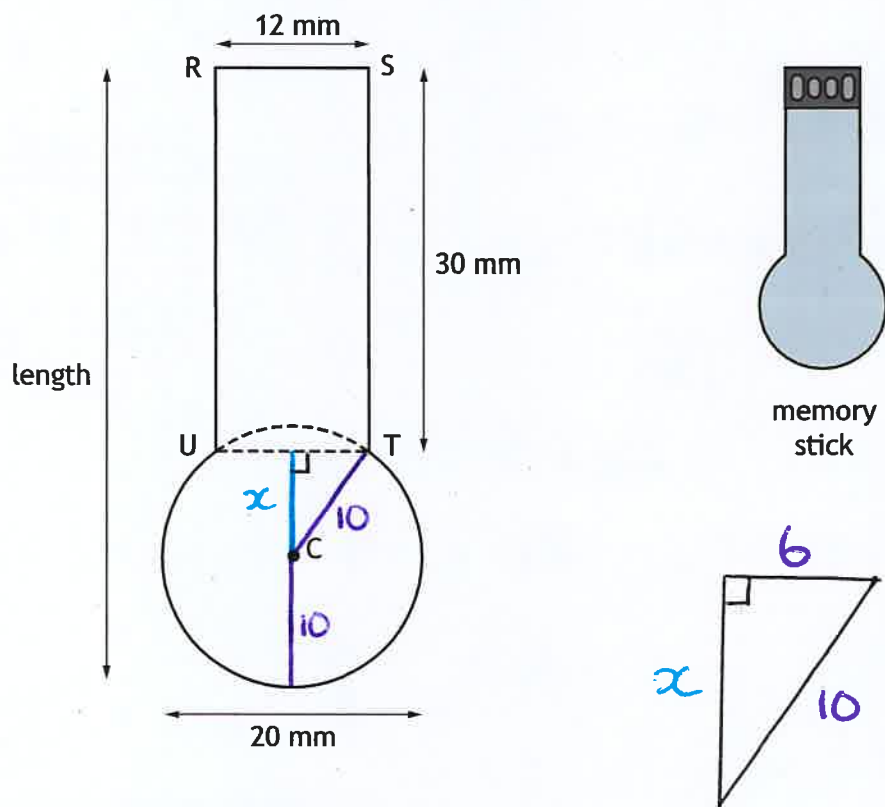
$$y = 6$$

Point (0, 6)

Sketch:



18. The diagram below shows a design for a memory stick.
The design consists of a rectangle, RSTU and part of a circle, centre C.



- $RS = UT = 12$ millimetres
- $RU = ST = 30$ millimetres
- The diameter of the circle is 20 millimetres
- UT is a chord of the circle

Calculate the length of the memory stick.

4

$$x^2 = 10^2 - 6^2$$

$$x^2 = 100 - 36$$

$$x^2 = 64$$

$$x = 8$$

$$\text{Length} = 30 + x + 10$$

$$= 30 + 8 + 10$$

$$\underline{\underline{\text{Length} = 48 \text{ mm}}}$$



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

19. Solve the equation by factorising

$$6x^2 + 13x - 5 = 0$$

3

$$6x^2 + 13x - 5 = 0$$

$$(3x - 1)(2x + 5) = 0$$

↓

$$3x - 1 = 0$$

$$3x = 1$$

$$x = \frac{1}{3}$$

↓

$$2x + 5 = 0$$

$$2x = -5$$

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

	$2x + 5$
$3x$	$6x^2 + 15x$
-1	$-2x - 5$

Solutions:

$$\underline{\underline{x = -\frac{5}{2}, \frac{1}{3}}}$$

[END OF QUESTION PAPER]



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