Instructions

• Use black ink or ball-point pen.
• Answer all questions.
• Answer the questions in the spaces provided
  – there may be more space than you need.
• Diagrams are NOT accurately drawn, unless otherwise indicated.
• You must show all your working out.

Information

• The marks for each question are shown in brackets
  – use this as a guide as to how much time to spend on each question.

Advice

• Read each question carefully before you start to answer it.
• Keep an eye on the time.
• Try to answer every question.
• Check your answers if you have time at the end
1. A is the point (0, 1)
   B is the point (10, 6)

The equation of the straight line through A and B is \( y = \frac{1}{2} x + 1 \)

a) Write down the equation of another straight line parallel to \( y = \frac{1}{2} x + 1 \)

\[ y = \frac{1}{2} x \ldots \ldots (1) \]

b) Write down the equation of another straight line that passes through the point (0, 1)

\[ y = 5x + 1 \ldots \ldots (1) \]

c) Find the equation of the line perpendicular to AB passing through B.

\[ AB \text{ gradient } = \frac{y_2 - y_1}{x_2 - x_1} \]
\[ \text{Perpendicular gradient } = -2 \]

\[ (10, 6) \quad y = -2x + c \]
\[ 6 = -2(10) + c \]
\[ 6 = -20 + c \]
\[ c = 26 \]

\[ y = -2x + 26 \ldots \ldots (3) \]
2.

A straight line, L, passes through the point with coordinates (4, 7) and is perpendicular to the line with equation \( y = 2x + 3 \).

Find an equation of the straight line L.

\[
\text{perp. gradient } = -\frac{1}{2}
\]

\[
\begin{align*}
(4, 7) & \quad y = -\frac{1}{2}x + c \\
x & \quad 7 = -\frac{1}{2}(4) + c \\
y & \quad 7 = -2 + c \\
c & \quad c = 9
\end{align*}
\]

\[
y = -\frac{1}{2}x + 9 \quad (3)
\]

3.

A straight line passes through the points (0, 5) and (3, 17). Find the equation of the straight line.

\[
m = \frac{y_2 - y_1}{x_2 - x_1}
\]

\[
= \frac{17 - 5}{3 - 0}
\]

\[
= \frac{12}{3}
\]

\[
= 4
\]

\[
\begin{align*}
(0, 5) & \quad y = 4x + c \\
5 & \quad y = 4(0) + c \\
c & \quad c = 5
\end{align*}
\]

\[
y = 4x + 5 \quad (3)
\]
4. Show that line $3y = 4x - 14$ is perpendicular to line $4y = -3x + 48$.

\[
\begin{align*}
3y &= 4x - 14 \quad (\div 3) \\
y &= \frac{4}{3}x - \frac{14}{3} \\
\mu &= \frac{4}{3}
\end{align*}
\]

\[
\begin{align*}
4y &= -3x + 48 \quad (\div 4) \\
y &= -\frac{3}{4}x + 12 \\
\lambda &= -\frac{3}{4}
\end{align*}
\]

\[
\frac{4}{3} \times \left(-\frac{3}{4}\right) = -1
\]

\[\text{................................................. (4)}\]

5. Here are the equations of 5 straight lines.

\[
\begin{align*}
P: \quad y &= 2x + 5 \\
Q: \quad y &= -2x + 5 \\
R: \quad y &= x + 5 \\
S: \quad y &= -\frac{1}{2}x + 6 \\
T: \quad y &= \frac{1}{2}x + 1
\end{align*}
\]

a) Write down the letter of the line that is parallel to $y = x + 6$

\[\text{................... (1)}\]

b) Write down the letter of the line that is perpendicular to $y = 2x - 1$

\[\text{................... (1)}\]
6. The point A has the coordinates (2,5)  
The point B has the coordinates (6,7)

a) Find the mid point of AB

\[
\left( \frac{4+7}{2}, \frac{6+6}{2} \right) \quad \text{(2)}
\]

b) Find the gradient of the line that passes through AB

\[
m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{6 - 5}{6 - 2} = \frac{1}{2} \quad \text{(2)}
\]

c) Find the equation of the perpendicular bisector to AB

\[
\text{perpendicular gradient} = -2
\]

\[
y = -2x + c
\]

\[
6 = -2(4) + c \\
6 = -8 + c \\
c = 14
\]

\[
y = -2x + 14 \quad \text{(3)}
\]
7. A circle C has centre (2,5)
   The point A (11, 8) lies on the circumference of the circle
   \( x_2, y_2 \)

   Find the equation of the tangent to the circle at A

   **Gradient & radius:** \( \frac{y_2 - y_1}{x_2 - x_1} \)

   \[ \frac{8 - 5}{11 - 2} \]
   \[ = \frac{3}{9} \]
   \[ = \frac{1}{3} \]

   *perpendicular gradient = \(-3\)*

   \[ y = -3x + c \]

   \[ 8 = -3(11) + c \]
   \[ 8 = -33 + c \]
   \[ c = 41 \]

   \[ y = -3x + 41 \] \( \text{.................. (5)} \)
8. A circle has the equation \( x^2 + y^2 = 5 \)

a) Write down the centre of the circle

\((0, 0)\) .... (1)

b) Write down the exact length of the radius of the circle

\( \sqrt{5} \) .... (1)

P is the point \((1, 2)\) on the circle \(x^2 + y^2 = 5\)

c) Work out the equation of the tangent to the circle at P

\[
\begin{align*}
(0, 0) & \quad (1, 2) \\
(x_1, y_1) & \quad (x_2, y_2) \\
m & = \frac{y_2 - y_1}{x_2 - x_1} \\
& = \frac{2 - 0}{1 - 0} \\
& = 2
\end{align*}
\]

Perpendicular gradient = \(-\frac{1}{2}\)

\[
\begin{align*}
y &= -\frac{1}{2} x + c \\
2 &= -\frac{1}{2} (1) + c \\
2 &= -\frac{1}{2} + c \\
2\cdot\frac{1}{2} &= c
\end{align*}
\]

\[
y = -\frac{1}{2} x + \frac{5}{2} \quad (4)
\]
9. The diagram shows a circle of radius 5 cm, centre the origin.

Find the equation of the tangent to the circle at (3,4)

\[ m = \frac{y_2 - y_1}{x_2 - x_1} \]
\[ = \frac{4 - 0}{3 - 0} \]
\[ = \frac{4}{3} \]

Perpendicular gradient \( = -\frac{3}{4} \)

\[ y = -\frac{3}{4} x + c \]

\[ 4 = -\frac{3}{4} (3) + c \]
\[ 4 = -\frac{9}{4} + c \]
\[ c = \frac{25}{4} \]

\[ y = -\frac{3}{4} x + \frac{25}{4} \]