1.

The points $A(1, 7)$, $B(20, 7)$ and $C(p, q)$ form the vertices of a triangle $ABC$, as shown in Figure 2. The point $D(8, 2)$ is the mid-point of $AC$.

(a) Find the value of $p$ and the value of $q$.  

(b) Find an equation for $l$, in the form $ax + by + c = 0$, where $a$, $b$ and $c$ are integers.

(c) Find the exact $x$-coordinate of $E$. 

Jan 05 Q8
2. Given that 
\[ f(x) = x^2 - 6x + 18, \quad x \geq 0, \]

(a) express \( f(x) \) in the form \( (x - a)^2 + b \), where \( a \) and \( b \) are integers. 

The curve \( C \) with equation \( y = f(x) \), \( x \geq 0 \), meets the \( y \)-axis at \( P \) and has a minimum point at \( Q \).

(b) Sketch the graph of \( C \), showing the coordinates of \( P \) and \( Q \).

The line \( y = 41 \) meets \( C \) at the point \( R \).

(c) Find the \( x \)-coordinate of \( R \), giving your answer in the form \( p + q\sqrt{2} \), where \( p \) and \( q \) are integers.

3. The line \( l_1 \) passes through the point \((9, -4)\) and has gradient \( \frac{1}{3} \).

(a) Find an equation for \( l_1 \) in the form \( ax + by + c = 0 \), where \( a \), \( b \) and \( c \) are integers.

The line \( l_2 \) passes through the origin \( O \) and has gradient \(-2\). The lines \( l_1 \) and \( l_2 \) intersect at the point \( P \).

(b) Calculate the coordinates of \( P \).

Given that \( l_1 \) crosses the \( y \)-axis at the point \( C \),

(c) calculate the exact area of \( \triangle OCP \).

4. The line \( L \) has equation \( y = 5 - 2x \).

(a) Show that the point \( P \) \((3, -1)\) lies on \( L \).

(b) Find an equation of the line perpendicular to \( L \), which passes through \( P \). Give your answer in the form \( ax + by + c = 0 \), where \( a \), \( b \) and \( c \) are integers.
5. The line \( l_1 \) passes through the points \( P(-1, 2) \) and \( Q(11, 8) \).

(a) Find an equation for \( l_1 \) in the form \( y = mx + c \), where \( m \) and \( c \) are constants. \( \text{ (4) } \)

The line \( l_2 \) passes through the point \( R(10, 0) \) and is perpendicular to \( l_1 \). The lines \( l_1 \) and \( l_2 \) intersect at the point \( S \).

(b) Calculate the coordinates of \( S \). \( \text{ (5) } \)

(c) Show that the length of \( RS \) is \( 3\sqrt{5} \). \( \text{ (2) } \)

(d) Hence, or otherwise, find the exact area of triangle \( PQR \). \( \text{ (4) } \)

June 06 Q11

6. The curve \( C \) has equation \( y = x^2(x - 6) + \frac{4}{x}, \ x > 0 \).

The points \( P \) and \( Q \) lie on \( C \) and have \( x \)-coordinates 1 and 2 respectively.

(a) Show that the length of \( PQ \) is \( \sqrt{170} \). \( \text{ (4) } \)

June 07 Q10

7. The line \( l_1 \) has equation \( y = 3x + 2 \) and the line \( l_2 \) has equation \( 3x + 2y - 8 = 0 \).

(a) Find the gradient of the line \( l_2 \). \( \text{ (2) } \)

The point of intersection of \( l_1 \) and \( l_2 \) is \( P \).

(b) Find the coordinates of \( P \). \( \text{ (3) } \)

The lines \( l_1 \) and \( l_2 \) cross the line \( y = 1 \) at the points \( A \) and \( B \) respectively.

(c) Find the area of triangle \( ABP \). \( \text{ (4) } \)

June 07 Q11
8. The point $A(-6, 4)$ and the point $B(8, -3)$ lie on the line $L$.

(a) Find an equation for $L$ in the form $ax + by + c = 0$, where $a$, $b$ and $c$ are integers.  

(b) Find the distance $AB$, giving your answer in the form $k\sqrt{5}$, where $k$ is an integer.

Jan 08 Q4

9. The points $Q (1, 3)$ and $R (7, 0)$ lie on the line $l_1$, as shown in Figure 2.

The length of $QR$ is $a\sqrt{5}$.

(a) Find the value of $a$.

The line $l_2$ is perpendicular to $l_1$, passes through $Q$ and crosses the $y$-axis at the point $P$, as shown in Figure 2. Find

(b) an equation for $l_2$,

(c) the coordinates of $P$,

(d) the area of $\triangle PQR$.

June 08 Q10

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10. The line \(l_1\) passes through the point \(A(2, 5)\) and has gradient \(-\frac{1}{2}\).

(a) Find an equation of \(l_1\), giving your answer in the form \(y = mx + c\).

(3)

The point \(B\) has coordinates \((-2, 7)\).

(b) Show that \(B\) lies on \(l_1\).

(1)

(c) Find the length of \(AB\), giving your answer in the form \(k\sqrt{5}\), where \(k\) is an integer.

(3)

The point \(C\) lies on \(l_1\) and has \(x\)-coordinate equal to \(p\).

The length of \(AC\) is 5 units.

(d) Show that \(p\) satisfies

\[p^2 - 4p - 16 = 0.\]

(4)

Jan 09 Q10
The points $A$ and $B$ have coordinates $(6, 7)$ and $(8, 2)$ respectively.

The line $l$ passes through the point $A$ and is perpendicular to the line $AB$, as shown in Figure 1.

(a) Find an equation for $l$ in the form $ax + by + c = 0$, where $a$, $b$ and $c$ are integers. \(4\) 

Given that $l$ intersects the $y$-axis at the point $C$, find

(b) the coordinates of $C$. \(2\)

(c) the area of $\Delta OCB$, where $O$ is the origin. \(2\)

June 09 Q8
12. The line \( l_1 \) has equation \( 3x + 5y - 2 = 0 \).

(a) Find the gradient of \( l_1 \).  \hspace{1cm} \text{(2)}

The line \( l_2 \) is perpendicular to \( l_1 \) and passes through the point \((3, 1)\).

(b) Find the equation of \( l_2 \) in the form \( y = mx + c \), where \( m \) and \( c \) are constants. \hspace{1cm} \text{(3)}

Jan 10 Q3

13. (a) Factorise completely \( x^3 - 4x \). \hspace{1cm} \text{(3)}

(b) Sketch the curve \( C \) with equation
\[ y = x^3 - 4x, \]
showing the coordinates of the points at which the curve meets the axis. \hspace{1cm} \text{(3)}

The point \( A \) with \( x \)-coordinate \(-1\) and the point \( B \) with \( x \)-coordinate \(3\) lie on the curve \( C \).

(c) Find an equation of the line which passes through \( A \) and \( B \), giving your answer in the form \( y = mx + c \), where \( m \) and \( c \) are constants. \hspace{1cm} \text{(5)}

(d) Show that the length of \( AB \) is \( k\sqrt{10} \), where \( k \) is a constant to be found. \hspace{1cm} \text{(2)}

Jan 10 Q9

14. (a) Find an equation of the line joining \( A(7, 4) \) and \( B(2, 0) \), giving your answer in the form \( ax + by + c = 0 \), where \( a, b \) and \( c \) are integers. \hspace{1cm} \text{(3)}

(b) Find the length of \( AB \), leaving your answer in surd form. \hspace{1cm} \text{(2)}

The point \( C \) has coordinates \((2, t)\), where \( t > 0 \), and \( AC = AB \).

(c) Find the value of \( t \). \hspace{1cm} \text{(1)}

(d) Find the area of triangle \( ABC \). \hspace{1cm} \text{(2)}

June 10 Q8
15. The line $L_1$ has equation $2y - 3x - k = 0$, where $k$ is a constant.

Given that the point $A(1, 4)$ lies on $L_1$, find

(a) the value of $k$, \hspace{1cm} (1)

(b) the gradient of $L_1$. \hspace{1cm} (2)

The line $L_2$ passes through $A$ and is perpendicular to $L_1$.

(c) Find an equation of $L_2$ giving your answer in the form $ax + by + c = 0$, where $a$, $b$ and $c$ are integers. \hspace{1cm} (4)

The line $L_2$ crosses the $x$-axis at the point $B$.

(d) Find the coordinates of $B$. \hspace{1cm} (2)

(e) Find the exact length of $AB$. \hspace{1cm} (2)

Jan 11 Q9

16. The points $P$ and $Q$ have coordinates $(-1, 6)$ and $(9, 0)$ respectively.

The line $l$ is perpendicular to $PQ$ and passes through the mid-point of $PQ$.

Find an equation for $l$, giving your answer in the form $ax + by + c = 0$, where $a$, $b$ and $c$ are integers. \hspace{1cm} (5)

June 11 Q3