1. The straight line L1 passes through the points (-1, 3) and (11, 12).
a. Find an equation for L1 in the form $ax + by + c = 0$, where a, b and c are integers. **(4)**

The line L2 has equation $3y + 4x - 30 = 0$.
b. Find the coordinates of the point of intersection of L1 and L2. **(3)**

1a.

Gradient $= \frac{12-3}{11--1} = \frac{9}{12} = \frac{3}{4}$	**M1**
Equation of L1: $y - 3 = \frac{3}{4}(x-1)$	**M1**
$4y - 12 = 3x + 3$	**M1**
$3x - 4y + 15 = 0$	**M1**

1b.

L1: $3x - 4y + 15 = 0$ ($\times 3$) L2: $3y + 4x - 30 = 0$ ($\times 4$) L1: $9x - 12y + 45 = 0$ L2: $12y + 16x - 120 = 0$	**M1**
$25x - 75 = 0$ $x = 3$	**M1**
When $x = 3$, $3(3) - 4y + 15 = 0$ $4y = 24$ $y = 6$	**M1**

Joshua Maths

1. The point A has coordinates (-1, 6) and the point B has coordinates (7, 2)

a. Find the equation of the perpendicular bisector of AB, giving your answer in the form $y = mx + c$. **(4)**

b. A point C on the perpendicular bisector has coordinates (p, q). The distance OC is 2 units, where O is the origin. Write down two equations involving p and q and hence find the coordinates of the possible positions of C. **(5)**

<u>Solutions</u>

1a.

Gradient $AB = \frac{6-2}{-1-7} = \frac{4}{-8} = -\frac{1}{2}$	**M1**
Gradient of bisector $= 2$	**M1**
Midpoint M: $(\frac{-1+7}{2}, \frac{6+2}{2}) = (3, 4)$	**M1**
Equation of perpendicular bisector is: $y - 4 = 2(x - 3)$ $y - 4 = 2x - 6$ $y = 2x - 2$	**M1**

1b.

$x = p, y = q$ $q = 2p - 2$	**M1**
$OC = 2,$ $OC^2 = 4$ $p^2 + q^2 = 4$	**M1**
$p^2 + (2p - 2)^2 = 4$ $p^2 + 4p^2 - 8p + 4 = 4$ $5p^2 - 8p = 0$ $p(5p - 8) = 0$	**M1**
$p = 0$ $q = -2$	**M1**
$5p - 8 = 0$ $p = \frac{8}{5}$ $q = \frac{6}{5}$	**M1**
$(0, -2)$ and $(\frac{8}{5}, \frac{6}{5})$	

1. A curve has equation $y = x^2 - 4x + 4$ and a line has equation $y = mx$, where m is a constant.

a. For the case where $m = 1$, the curve and the line intersect at the points A and B. Find the coordinates of the mid-point of AB. **(4)**

b. Find the non-zero value of m for which the line is a tangent to the curve, and find the coordinates of the point where the tangent touches the curve. **(5)**

Solutions

1a.

$y = x^2 - 4x + 4$ $y = x$ $x = x^2 - 4x + 4$	**M1**
$x^2 - 5x + 4 = 0$ $(x - 4)(x - 1) = 0$	**M1**
$x = 4, x = 1$ $y = 4, y = 1$	**M1**
Therefore, midpoint AB: $(\frac{1+4}{2}, \frac{1+4}{2})$ $= (\frac{5}{2}, \frac{5}{2})$	**M1**

1b.

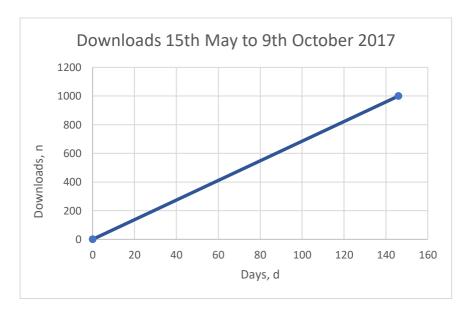|	
$y = x^2 - 4x + 4$ $y = mx$ $mx = x^2 - 4x + 4$	**M1**
$x^2 - (4 + m)x + 4 = 0$	**M1**
As $b^2 - 4ac = 0$ $[-(4 + m)]^2 - (4)(1)(4) = 0$	**M1**
$(4 + m)^2 = 16$ $4 + m = \pm 4$ $m = -4 \pm 4$ Therefore, $m = 0, m = -8$	**M1**
When $m = -8$ $x^2 + 4x + 4 = 0$ $x = -\frac{4}{2} = -2$ Therefore $y = 16$	**M1**

1.Below shows a graph of the number of downloads against time in days. At 146 days, downloads are at 1000.

a. Find equations in the form $n = kd$ (give k to the nearest whole number). **(1)**

b. Interpret the meaning of k. **(1)**

c. Based on the model, how long will it be until there are 10,000 downloads. **(1)**

Use the exact value of k and assume there are 365 days per year.

Downloads 15th May to 9th October 2017

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Solutions

1a.

$n = 7d$	**M1**

1b.

7 downloads per day	**M1**

1c.

1460 days, 4 years, 15th May 2021.	**M1**