# Section 1: Graphs from parametric equations

## Section test

1. The parametric equations of the circle $(x-2)^2+(y+1)^2=16$ are:

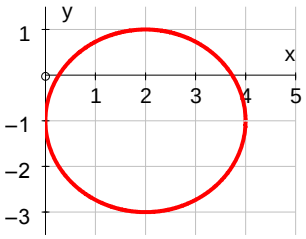
(a) $x=16\cos\theta-2, y=1+16\sin\theta$
(b) $x=4\cos\theta-2, y=1+4\sin\theta$
(c) $x=2+16\cos\theta, y=16\sin\theta-1$
(d) $x=2+4\cos\theta, y=4\sin\theta-1$

2. A curve is defined by the parametric equations $x=\frac{1}{2}\cos\theta, y=\sin 2\theta$.
Find the coordinates of the point with parameter $\theta=\pi$.

3. The cartesian equation of the curve defined by the parametric equations $x=3\cos\theta-1, y=3\sin\theta+4$ is:

(a) $(x+1)^2+(y-4)^2=9$
(b) $(x-1)^2+(y+4)^2=9$
(c) $(x+1)^2+(y-4)^2=3$
(d) $(x-1)^2+(y+4)^2=3$

4. The parametric equations of this circle are




(a) $x=2+2\cos\theta, y=2\sin\theta-1$
(b) $x=2\cos\theta-2, y=1+2\sin\theta$
(c) $x=2+4\cos\theta, y=4\sin\theta-1$
(d) $x=4\cos\theta-2, y=1+4\sin\theta$

5. The equation of the trajectory of a rocket fired on level ground is given by the parametric equations $x=25t, y=10t-5t^2$.
How far does the rocket travel horizontally before it hits the ground?
Find the cartesian equation of the trajectory.

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6. A curve has parametric equations $x = 5\cos\theta, y = 3\sin\theta$.
What is the cartesian equation of the curve?

(a) $\frac{x^2}{25} + \frac{y^2}{9} = 1$
(b) $\frac{x^2}{5} + \frac{y^2}{3} = 1$
(c) $(x-5)^2 + (y-3)^2 = 1$
(d) $(x+5)^2 + (y+3)^2 = 1$

7. A curve has parametric equations $x = 5t^2, y = 10t$.
What is the cartesian equation of the curve?

(a) $y^2 = 5x$
(b) $y = 20x^2$
(c) $y^2 = 20x$
(d) $y = 5x^2$

8. A curve is given by the parametric equations $x = \frac{1}{1-t}, y = \frac{1}{t}$.
What is the value of the parameter at the point $\left(-1, \frac{1}{2}\right)$ ?

9. What is the cartesian equation of the curve from question 8?

(a) $y = \frac{x}{x+1}$
(b) $y = \frac{x}{x-1}$
(c) $y = x^2 + x$
(d) $y = x^2 - x$

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## Section test solutions

1. This is a circle with radius 4, and centre $(2,-1)$
   So the parametric equations are: $x = 2 + 4\cos\theta$
   $y = 4\sin\theta - 1$

2. Replacing $\theta$ with the value $\pi$: $x = \frac{1}{2}\cos\pi = -\frac{1}{2}$
   $y = \sin 2\pi = 0$
   so the coordinates of the point with this parameter are $(-\frac{1}{2}, 0)$

3. $x = 3\cos\theta - 1 \Rightarrow \cos\theta = \dfrac{x+1}{3}$
   $y = 3\sin\theta + 4 \Rightarrow \sin\theta = \dfrac{y-4}{3}$
   Substituting into $\sin^2\theta + \cos^2\theta = 1$: $\left(\dfrac{x+1}{3}\right)^2 + \left(\dfrac{y-4}{3}\right)^2 = 1$
   $\dfrac{(x+1)^2}{9} + \dfrac{(y-4)^2}{9} = 1$
   $(x+1)^2 + (y-4)^2 = 9$

4. The circle has radius 2 and centre $(2,-1)$
   So the parametric equations are: $x = 2 + 2\cos\theta$
   $y = 2\sin\theta - 1$

5. $y = 10t - 5t^2$
   When the rocket hits the ground $y = 0$: $10t - 5t^2 = 0$
   $5t(2-t) = 0$
   $t = 0$ or $t = 2$
   When $t = 2$: $x = 25t = 25 \times 2 = 50\text{m}$

$x = 25t$

$t = \frac{x}{25}$

Substituting into $y = 10t - 5t^2$: $y = 10\left(\frac{x}{25}\right) - 5\left(\frac{x}{25}\right)^2$

$= \frac{2x}{5} - \frac{x^2}{125}$

6. $x = 5\cos\theta \Rightarrow \cos\theta = \frac{x}{5}$

$y = 3\sin\theta \Rightarrow \sin\theta = \frac{y}{3}$

Substituting into $\sin^2\theta + \cos^2\theta = 1$: $\left(\frac{x}{5}\right)^2 + \left(\frac{y}{3}\right)^2 = 1$

$\frac{x^2}{25} + \frac{y^2}{9} = 1$

7. $y = 10t \Rightarrow t = \frac{y}{10}$

Substituting into $x = 5t^2$: $x = 5\left(\frac{y}{10}\right)^2 = \frac{y^2}{20}$

$y^2 = 20x$

8. $x = \frac{1}{1-t}$

At the point where $x = -1$: $-1 = \frac{1}{1-t}$

$-1(1-t) = 1$

$-1 + t = 1$

$t = 2$

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9. $y = \frac{1}{t} \Rightarrow t = \frac{1}{y}$

Substituting into $x = \frac{1}{1-t}$: $x = \frac{1}{\left(1-\frac{1}{y}\right)} = \frac{y}{y-1}$

$$x(y-1) = y$$
$$xy - x = y$$
$$xy - y = x$$
$$y(x-1) = x$$
$$y = \frac{x}{x-1}$$