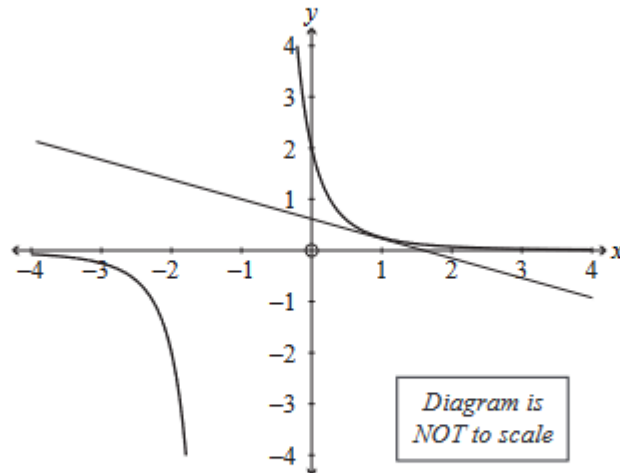# Differentiation Collated Past Papers - Tangents

2023 Question 1c.

(c)   The graph shows the curve $y = \dfrac{2}{(x+1)^3}$, along with the tangent to the curve drawn at $x = 1$.

Diagram is NOT to scale

A second tangent to this curve is drawn which is parallel to the first tangent shown in the diagram.
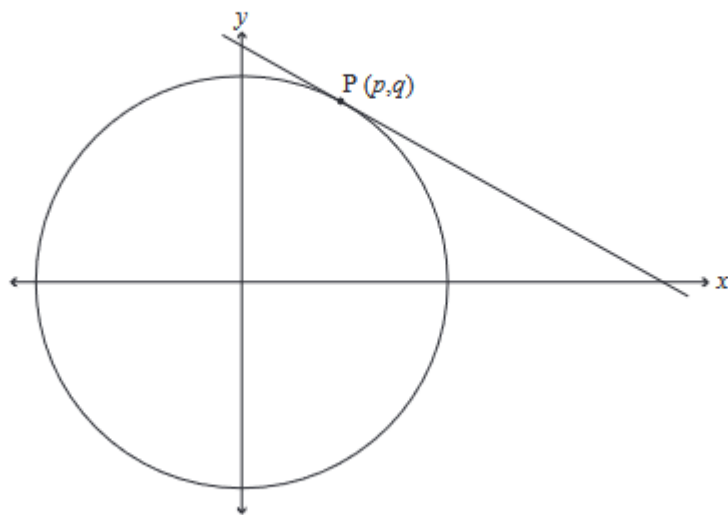
Find the x-coordinate of the point where this second tangent touches the curve.

You must use calculus and show any derivatives that you need to find when solving this problem.

2023 Question 1d.

d) The diagram below shows a tangent passing through the point P (p, q) which lies on the circle with parametric equations $x = 4\cos\theta$ and $y = 4\sin\theta$.

Show that the equation of the tangent line is $px + qy = p^2 + q^2$.

2023 Question 2c.

(c) A curve is defined by the equation $f(x) = \dfrac{e^x}{x^2 + 2x}$.

Find the x-value(s) of any point(s) on the curve where the tangent to the curve is parallel to the x-axis.

You must use calculus and show any derivatives that you need to find when solving this problem.

2023 Question 3c.

(c) Char goes for a ride on a Ferris wheel. As she rotates around, her position can be described by the pair of parametric equations :

$$x = 5\sqrt{2}\sin\left(\frac{\pi t}{5}\right) \text{ and } y = 10 - 5\sqrt{2}\cos\left(\frac{\pi t}{5}\right)$$

where t is time, in seconds, from the start of the ride.

Find the gradient of the normal to this curve at the point when $t = 6.25$ seconds, after the start of the ride.

You must use calculus and show any derivatives that you need to find when solving this problem.

2022 Question 1c.

c) The graph below shows the function $y = \sqrt{x+2}$, and the normal to the function at the point where the function intersects the y-axis.
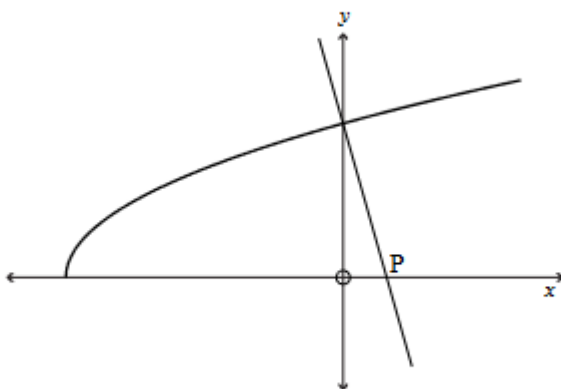
Find the coordinates of point P, the x-intercept of the normal.

You must use calculus and show any derivatives that you need to find when solving this problem.
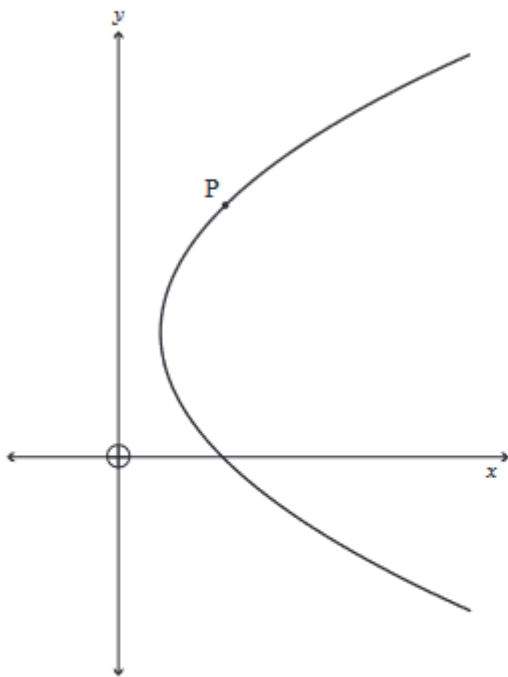
2022 Question 2b.

b) Find the gradient of the tangent to the curve $y = (3x^2 - 2)^3$ when $x = 2$.

You must use calculus and show any derivatives that you need to find when solving this problem.

2022 Question 2e.

e) The curve with the equation $(y-5)^2 = 16(x-2)$ has a tangent of gradient 1 at point P.

This tangent intersects the x and y axes at points R and S respectively.

Prove that the length RS is $7\sqrt{2}$.

You must use calculus and show any derivatives that you need to find when solving this problem.

2021 Question 2c.

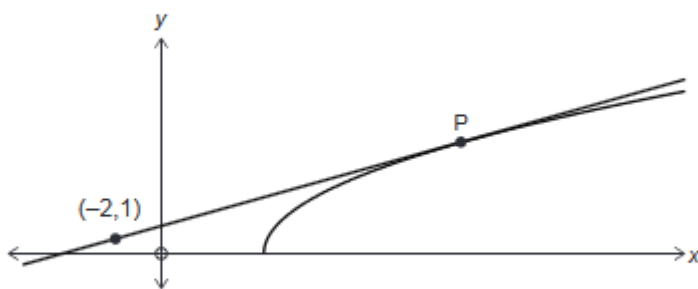c) A curve has the equation $y = (x^2 + 3x + 2)\cos 3x$.

Find the equation of the normal to the curve at the point where the curve crosses the y-axis.

You must use calculus and show any derivatives that you need to find when solving this problem.

2021 Question 2e.

e) The graph below shows the curve $y = \sqrt{2x-4}$, and the tangent to the curve at point P.

The tangent passes through the point $(-2,1)$.

Find the coordinates of point P.

You must use calculus and show any derivatives that you need to find when solving this problem.

2021 Question 3b.

b) The graph of the function $y = 4\sqrt{x} - x + 2$, where $x > 0$, has a stationary point at point Q.

Find the coordinates of point Q.

You must use calculus and show any derivatives that you need to find when solving this problem.

2021 Question 3d.

d) A curve has the equation $y = \dfrac{4x+k}{4x-k}$, where k is a constant and $x \neq \dfrac{k}{4}$.

The point P lies on the curve and has an x-coordinate of 3.

The gradient of the tangent to the curve at P is $\dfrac{-8}{27}$.

Find the possible value(s) of k.

You must use calculus and show any derivatives that you need to find when solving this problem.

2020 Question 1b.

b) Find the gradient of the tangent to the curve $y = 3\sin 2x + \cos 2x$ at the point where $x = \dfrac{\pi}{4}$.

You must use calculus and show any derivatives that you need to find when solving this problem.

2020 Question 1d.

d) A curve has the equation $y = x^2 \cos x$.

Show that the equation of the tangent to the curve at the point $\left(\pi, -\pi^2\right)$ is

$$y + 2\pi x = \pi^2$$

You must use calculus and show any derivatives that you need to find when solving this problem.

2020 Question 3b.
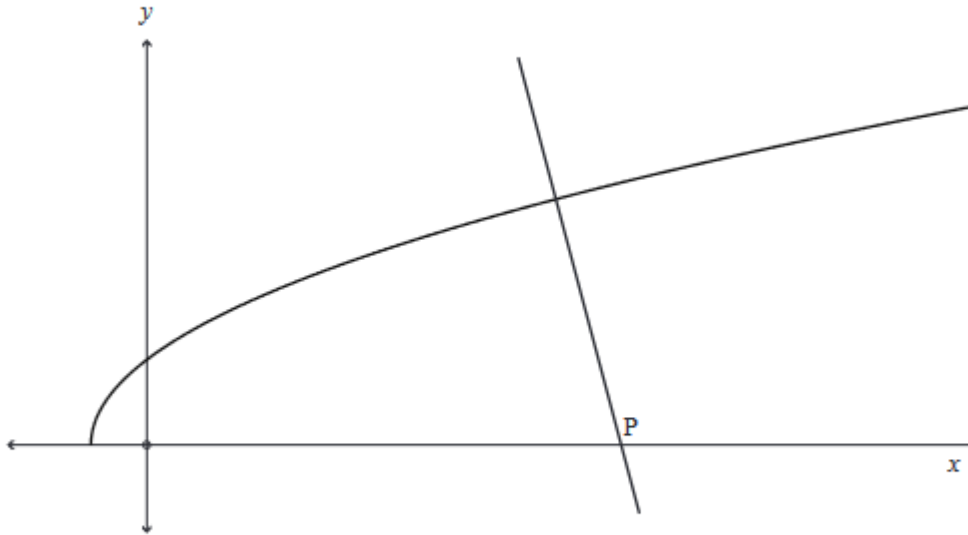
(b)   For what value(s) of x does the tangent to the graph of the function

$f(x) = 2x - 2\sqrt{x}$, $x > 0$, have a gradient of 1?

You must use calculus and show any derivatives that you need to find when solving this problem.

2020 Question 3c.

c)   The normal to the graph of the function $y = \sqrt{2x+1}$ at the point $(4,3)$ intersects the x-axis at point P.

Find the x-coordinate of point P.

You must use calculus and show any derivatives that you need to find when solving this problem.
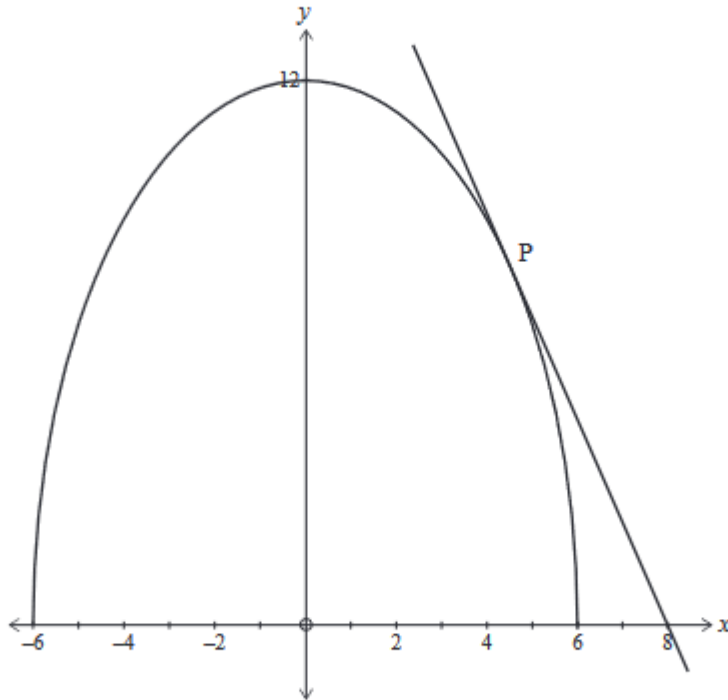
2019 Question 1c.

c)   Find the gradient of the tangent to the curve $y = \dfrac{e^{2x}}{1+x^2}$ at the point where $x = 2$.

You must use calculus and show any derivatives that you need to find when solving this problem.

2019 Question 3e.

e)   The graph below shows the function $y = 2\sqrt{36-x^2}$, and the tangent to that function at point P.

The tangent intersects the x-axis at the point $(8,0)$.

Find the x-coordinate of point P.

You must use calculus and show any derivatives that you need to find when solving this problem.

2018 Question 3d.

d)   Find the equation of the tangent to the curve $y = x^2 \ln x$ at the point where $x = e$.

You must use calculus and show any derivatives that you need to find when solving this problem.
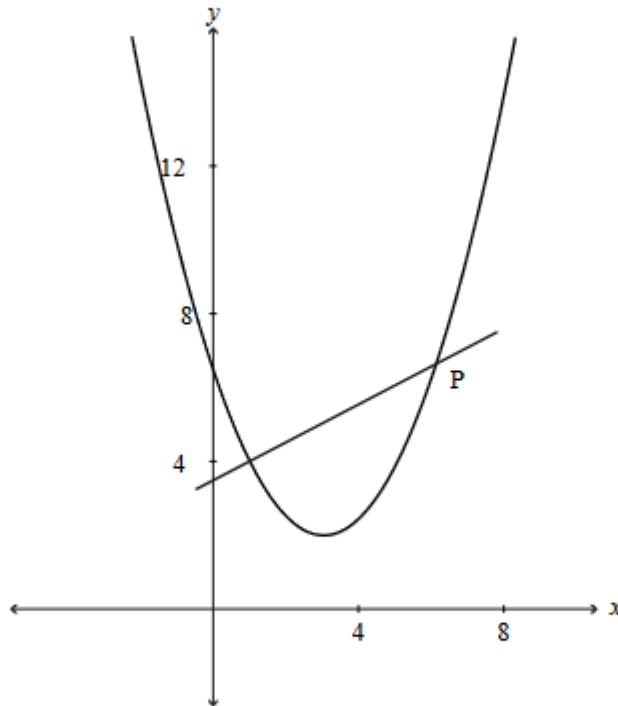
2017 Question 1b.

b)   Find the gradient of the tangent to the curve $y = \dfrac{e^{2x}}{x+2}$ at the point where $x = 0$.

You must use calculus and show any derivatives that you need to find when solving this problem.

2017 Question 1c.

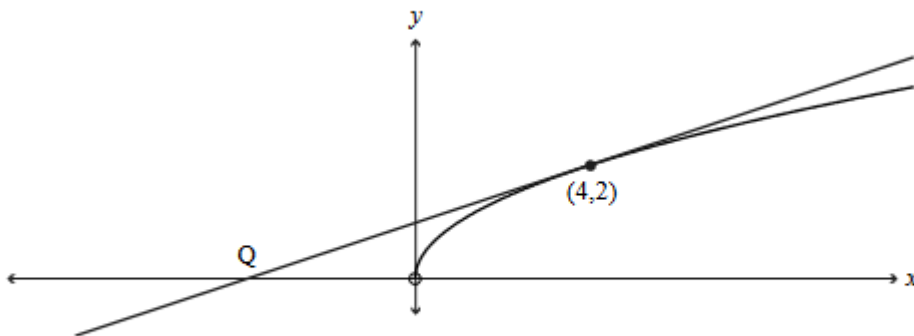c) The normal to the parabola $y = 0.5(x-3)^2 + 2$ at the point $(1,4)$ intersects the parabola again at the point P.

Find the x-coordinate of point P.

You must use calculus and show any derivatives that you need to find when solving this problem.

2017 Question 2c.

c) The tangent to the curve $y = \sqrt{x}$ is drawn at the point $(4,2)$.
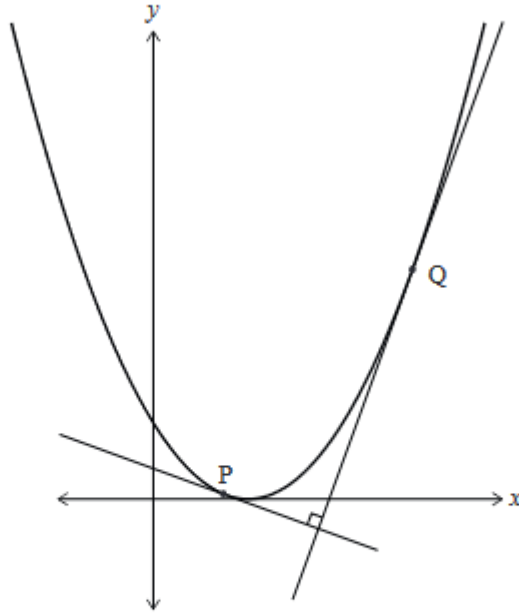

Find the co-ordinates of the point Q where the tangent intersects the x-axis.

You must use calculus and show any derivatives that you need to find when solving this problem.

2016 Question 1d.

d) The tangents to the curve $y = \frac{1}{4}(x-2)^2$ at points P and Q are perpendicular.

Q is the point $(6, 4)$.

What is the x-coordinate of point P?

You must use calculus and show any derivatives that you need to find when solving this problem.

2016 Question 2b.

(b) Find the gradient of the tangent to the function $y = \sqrt{2x - 1}$ at the point $(5, 3)$.

You must use calculus and show any derivatives that you need to find when solving this problem.

2016 Question 3b.

(b) Find the x-value at which a tangent to the curve $y = 6x - e^{3x}$ is parallel to the x-axis.

You must use calculus and show any derivatives that you need to find when solving this problem.

2015 Question 1b.

(b) Find the gradient of the tangent to the function $y = (4x - 3x^2)^3$ at the point $(1, 1)$.

You must use calculus and show any derivatives that you need to find when solving this problem.

2015 Question 1d.

d) For what value(s) of x is the tangent to the graph of the function $f(x) = \dfrac{x+4}{x(x-5)}$ parallel to the x-axis?

You must use calculus and show any derivatives that you need to find when solving this problem.

2015 Question 2b.

b) Find the gradient of the normal to the curve $y = x - \dfrac{16}{x}$ at the point where $x = 4$.

You must use calculus and show any derivatives that you need to find when solving this problem.

2015 Question 3a.

a) For what value(s) of x does the tangent to the graph of the function $f(x) = 5\ln(2x - 3)$ have a gradient of 4?

You must use calculus and show any derivatives that you need to find when solving this problem.

2014 Question 1b.

b) Find the gradient of the normal to the function $y = (3x^2 - 5x)^2$ at the point $(1,4)$.

Show any derivatives that you need to find when solving this problem.

2014 Question 1d.

d) Find the x-value at which the tangent to the function $y = \dfrac{4}{e^{2x-2}} + 8x$ is parallel to the x-axis.

Show any derivatives that you need to find when solving this problem.

2013 Question 2b.

b) A curve has the equation $y = (x^3 - 2x)^3$.

Find the equation of the tangent to the curve at the point where $x = 1$.

Show any derivatives that you need to find when solving this problem.