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Functions from Differential Equations 2ii

A Level



The gradient of a curve is given by $\frac{dy}{dx} = 6x - 4$. The curve passes through the distinct points $(2, 5)$ and $(p, 5)$.

Part A Equation of curve

Find the equation of the curve.

The following symbols may be useful: x , y

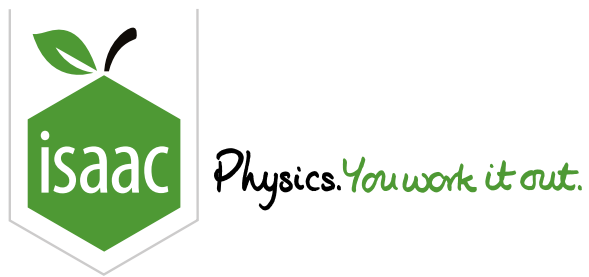
Part B Find p

Find the value of p .

The following symbols may be useful: p

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Functions from Differential Equations 1ii



The gradient of a curve is given by $\frac{dy}{dx} = 12\sqrt{x}$. The curve passes through the point (4, 50). Find the equation of the curve.

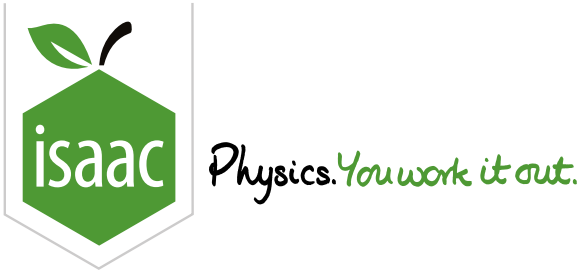
The following symbols may be useful: c , x , y

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Equation of Curve

Pre-Uni Maths for Sciences K1.7

A Level

P

P

P

Find the function $v(u)$ such that $\frac{dv}{du} = \frac{1}{3}u^{\frac{1}{3}} \left(1 - \frac{1}{u}\right)$ and $v(8) = -1$.

The following symbols may be useful: u , v

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Physics. *You work it out.*

Functions from Differential Equations 1i

A Level
P P P

A curve has an equation which satisfies $\frac{dy}{dx} = kx(2x - 1)$ for all values of x . The point $P(2, 7)$ lies on the curve and the gradient of the curve at P is 9.

Part A Find k

Find the value of the constant k . Give your answer as an improper fraction.

The following symbols may be useful: k

Part B Equation of curve

Find the equation of the curve.

The following symbols may be useful: x , y

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Integrating to Find An Area 1

A Level



This question is about the use of integration to find the area of one or more regions between a curve and the x -axis.

Part A Calculating the area under $y = x^2 + 1$

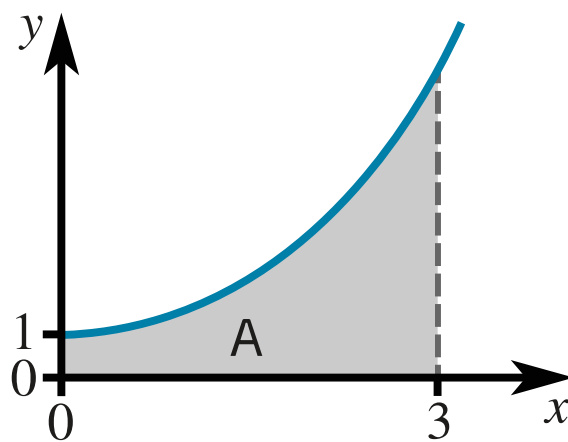


Figure 1: The graph of $y = x^2 + 1$

Figure 1 shows the curve $y = x^2 + 1$. The region between the curve and the x -axis, bounded by the lines $x = 0$ and $x = 3$, is labelled A . Calculate the area of A .

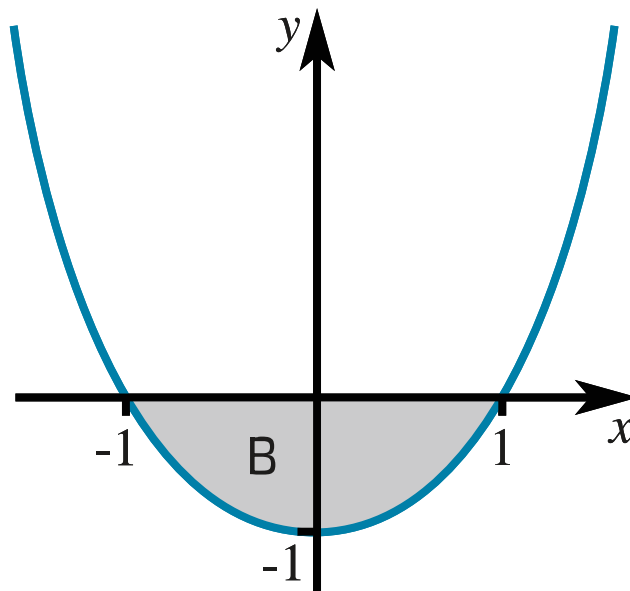
Part B Calculating the area above $y = x^2 - 1$ 

Figure 2: The graph of $y = x^2 - 1$

Figure 2 shows the curve $y = x^2 - 1$. The region between the curve and the x -axis, bounded by the lines $x = -1$ and $x = 1$, is labelled B . Calculate the area of B .

Part C Integrating $5x(x^2 - 1)$

Calculate the value of the integral $\int_{-1}^1 5x(x^2 - 1)dx$.

Part D The region enclosed between $y = 5x(x^2 - 1)$ and the x -axis

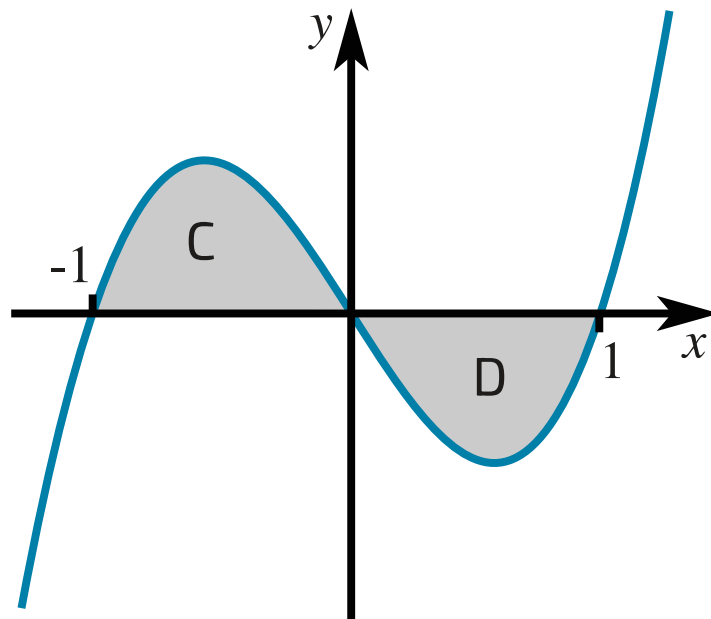


Figure 3: The graph of $y = 5x(x^2 - 1)$

Use **Figure 3** to explain why $\int_{-1}^1 5x(x^2 - 1)dx$ does not give the total area of the regions enclosed by the curve $y = 5x(x^2 - 1)$ and the x -axis between $x = -1$ and $x = 1$. Drag and drop options into the spaces provided to complete your answer.

The curve $y = 5x(x^2 - 1)$ intercepts the x -axis at $x = -1$, $x = 0$ and $x = 1$. For $-1 < x < 0$ the curve is the x -axis. Hence, the value of $\int_{-1}^0 5x(x^2 - 1)dx$ is and equal to the area of region . However, for $0 < x < 1$ the curve is the x -axis. Hence, the value of the integral $\int_0^1 5x(x^2 - 1)dx$ is . The area of the region labelled is given by $-\int_0^1 5x(x^2 - 1)dx$.

The total area of the shaded regions is $\int_{-1}^0 5x(x^2 - 1)dx - \int_0^1 5x(x^2 - 1)dx$. This is not the same as $\int_{-1}^1 5x(x^2 - 1)dx$, which has a value of 0 as the curve has symmetry and the contributions from the parts above and below the x -axis cancel out exactly.

Items:

positive

rotational

reflective

below

above

C

negative

D

Part E Calculating an area for $y = 5x(x^2 - 1)$

Calculate the area of the region enclosed between the curve $y = 5x(x^2 - 1)$ and the x -axis for x between -1 and 1 .

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Integration and Area 1ii

A Level
P P P

Figure 1 shows part of the curve $y = x^2 - 3x$ and the line $x = 5$.

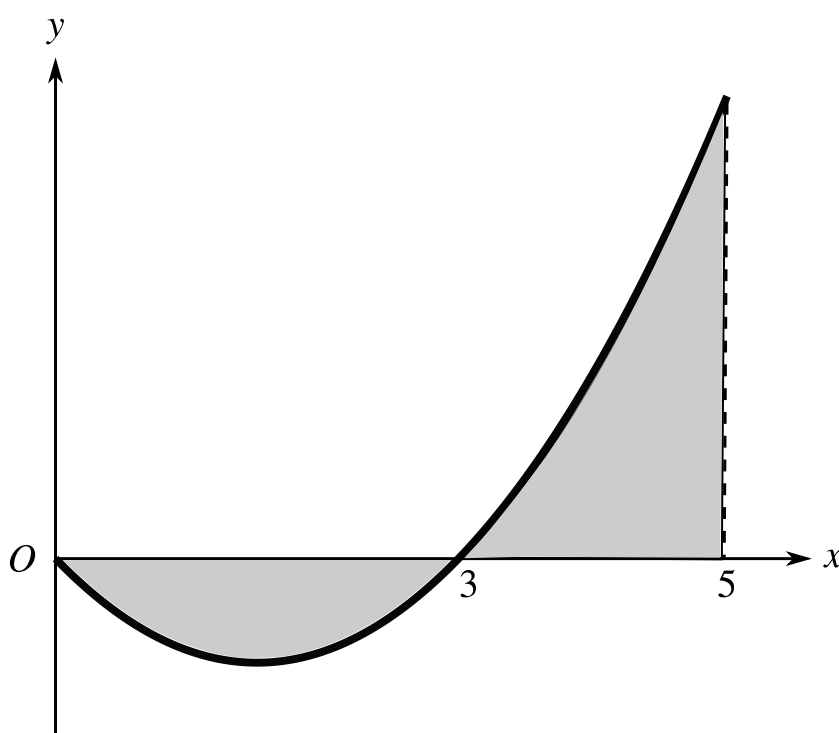


Figure 1: A graph of $y = x^2 - 3x$ and the line $x = 5$

Part A Area of shaded regions

Which of the following expressions gives the total area of the regions shaded in **Figure 1**? Explain your choice.

- ☐ $\int_3^5 (x^2 - 3x) \, dx - \int_0^3 (x^2 - 3x) \, dx$
- ☐ $\int_0^3 (x^2 - 3x) \, dx + \int_3^5 (x^2 - 3x) \, dx$
- ☐ $\int_0^5 (x^2 - 3x) \, dx$

Part B Find area

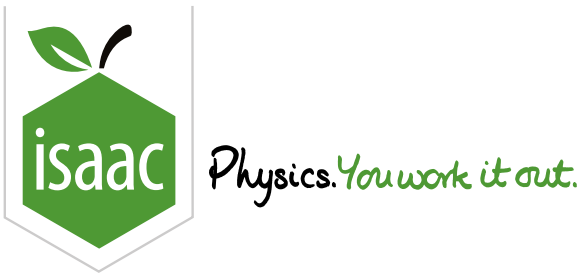
Use integration to find the total area of the shaded regions. Give your answer to 3 significant figures.

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Area Under a Curve 1

Pre-Uni Maths for Sciences K2.7

A Level
P P P

A graph of the functions $y = (x - 2)(x + 1)$ and $y = x + 1$ is shown in **Figure 1**. Find the areas of the shaded regions labelled A and B. A is the region between P and Q enclosed by the curve $y = (x - 2)(x + 1)$ and the x -axis; B is the region between Q and R below the curve $y = (x - 2)(x + 1)$ and above the x -axis.

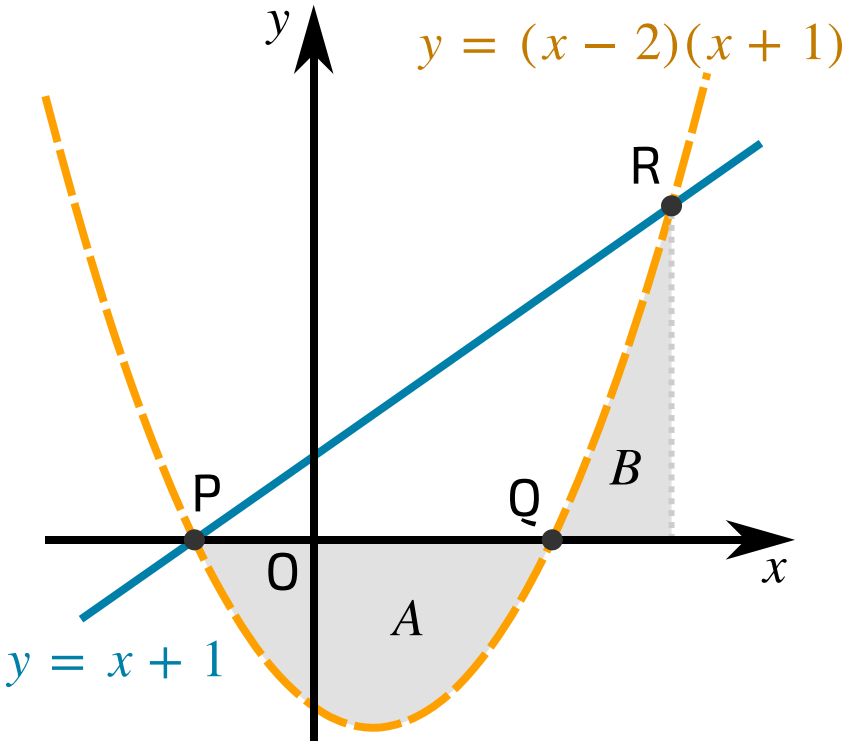


Figure 1: A graph of the functions $y = (x - 2)(x + 1)$ and $y = x + 1$. A is the region between P and Q enclosed by the curve $y = (x - 2)(x + 1)$ and the x -axis; B is the region between Q and R below the curve $y = (x - 2)(x + 1)$ and above the x -axis.

Part A Region A

Find the area of the region A. Give your answer in the form of an improper fraction.

Part B Region B

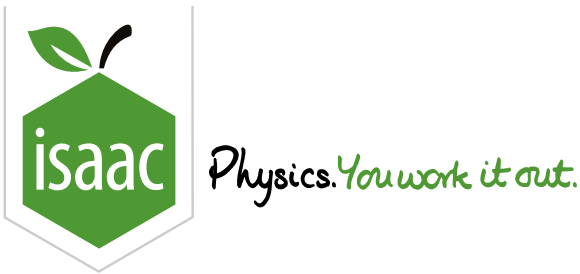
Find the area of the region B. Give your answer in the form of an improper fraction.

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Integration and Area 3i

A Level
P P P

Figure 1 shows the graph of $y = 1 - 3x^{-\frac{1}{2}}$.

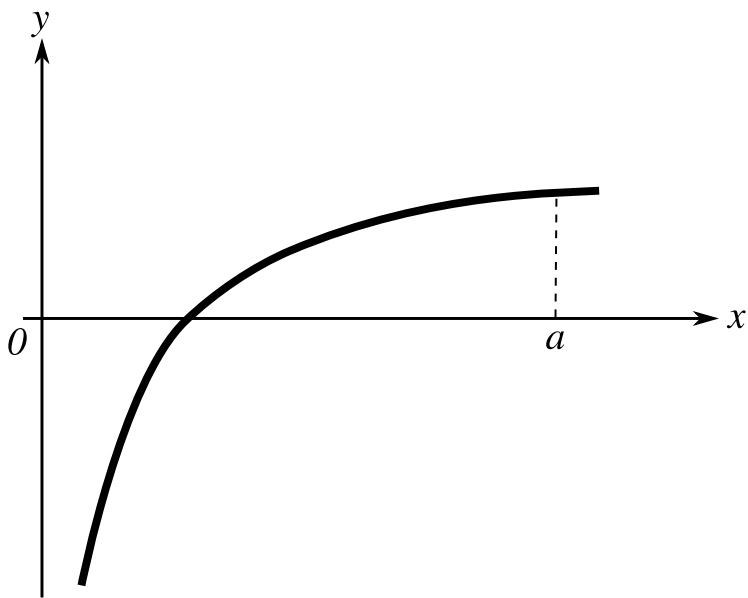


Figure 1: Graph of $y = 1 - 3x^{-\frac{1}{2}}$.

Part A Find intersection with x -axis

Find the x -coordinate of the intersection of that curve with the x -axis.

The following symbols may be useful: x

Part B Find a

The region enclosed by the curve, the x -axis and the line $x = a$ (where $a > 9$) has an area equal to 4 square units, find the value of a .

The following symbols may be useful: a

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Area Under a Curve 3

Pre-Uni Maths for Sciences K2.9

A Level



A graph of the functions $y = \frac{1}{2\sqrt{x}}$ and $y = 2x\sqrt{x}$ for $x \geq 0$ is shown in **Figure 1**. Find the area of the shaded region OPQR.

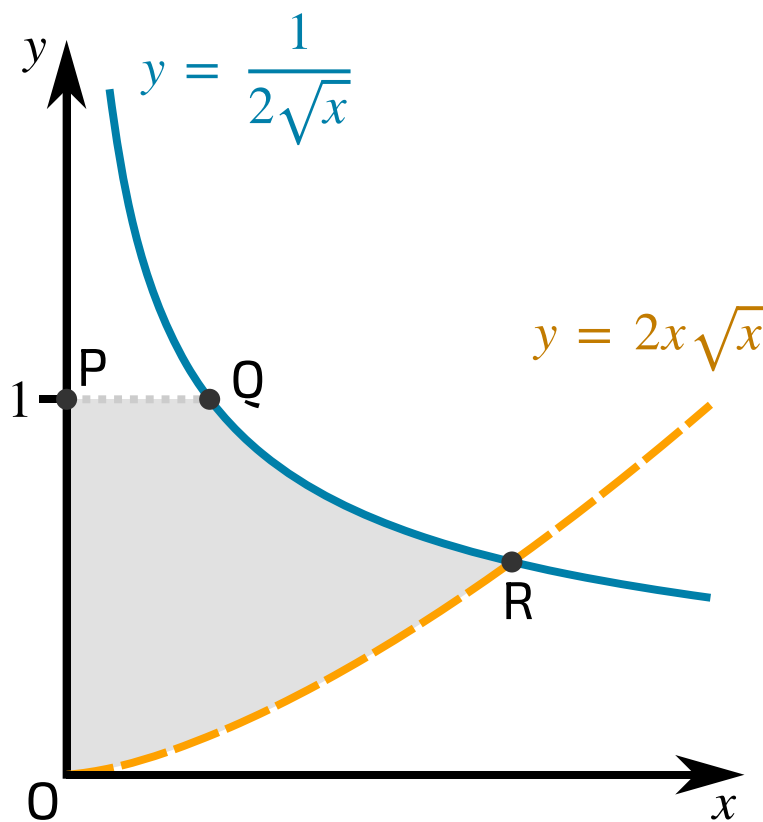


Figure 1: A graph of the functions $y = \frac{1}{2\sqrt{x}}$ and $y = 2x\sqrt{x}$ for $x \geq 0$. The shaded region OPQR is bounded by the line $x = 0$, the line $y = 1$, the curve $y = \frac{1}{2\sqrt{x}}$ and the curve $y = 2x\sqrt{x}$.

Part A The x coordinate of Q

Deduce the x coordinate of the point Q.

Part B The x coordinate of R

Find the x coordinate of the point R.

Part C The area of OPQR

Find the area of the shaded region OPQR, giving your answer in an exact form.

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