

# Learning Enhancement Team

## Worksheet: The Differential Operator

This worksheet has questions on the differentiation of a function using the differential operator. Before attempting the questions below, you could read the study guide: [The Differential Operator](#).

The Differential  
Operator Study  
Guide



Model Answers  
to this sheet



1. Apply the differential operator to the following expressions of  $x$ :

a.  $2x$

b.  $-\frac{1}{4}x^6$

c.  $-\frac{x^3}{3}$

d.  $-e^x$

e.  $\cos(x)$

f.  $\ln(3x)$

2. Now look at the following equations and apply the differential operator to them.

a.  $y = 2x$

b.  $y = -\frac{1}{4}x^6$

c.  $y = -\frac{x^3}{3}$

d.  $y = -e^x$

e.  $y = \cos(x)$

f.  $y = \ln(3x)$

Looking at your answers in question 1 and question 2 what do you notice?

3. Apply the differential operator **twice** to the following equations:

a.  $y = -2x^3$

b.  $y = \frac{2x^7}{7}$

c.  $y = e^{2x}$

d.  $y = \sin(2x)$

4. Apply the differential operator to the following equations, using term-by-term differentiation:

a.  $y + x = 2x^2 + 3x^3$

b.  $y - 2x^{-3} + \frac{x^{-8}}{4} = 2x^3 + x^4$

5. The following expressions are products or quotients of functions. Apply the differential operator using the product rule or the quotient rule form of the differential operator where appropriate.

a.  $x^2y$

b.  $\frac{x}{y}$

c.  $x^3(x^2 + y^2)$

d.  $\frac{x + y^3}{x^2 + y^2}$

6. Apply the differential operator to the expressions below, keeping in mind that in these expressions  $y$  is a function of  $x$  so you will need to use the chain rule form of the differential operator.

a.  $y^3$

b.  $y^{\frac{3}{4}}$

c.  $\sin(3y)$

d.  $\cos(2y)$

e.  $-\ln(4y)$

f.  $2e^{-4y}$

7.

a. Apply the differential operator to the expression  $y^2 - 2e^{-x} + x^2 \ln(-3y) + \cos(2y)$  using the appropriate form for each of the terms.

b. Use your answer to a. and apply the differential operator to the **equation**:

$$y^2 - 2e^{-x} + x^2 \ln(-3y) + \cos(2y) = 1.$$

What does this enable you to find that you couldn't in a.?

c. How can your answers to parts a. and b. help you to apply the differential operator to the equation  $-2e^{-x} + \cos(2y) = -y^2 + 1 - x^2 \ln(-3y)$ ?



This worksheet is one of a series on mathematics produced by the Learning Enhancement Team with funding from the UEA Alumni Fund. Scan the QR-code with a smartphone app for [more resources](#).



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