

A Level · Edexcel · Maths





6.1 Exponential & Logarithms

6.1.1 Exponential Functions / 6.1.2 Logarithmic Functions / 6.1.3 "e" / 6.1.4 **Derivatives of Exponential Functions**

Total Marks	/165
Very Hard (11 questions)	/50
Hard (10 questions)	/40
Medium (10 questions)	/42
Easy (12 questions)	/33

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Easy Questions

- 1 Write down the value of:
 - 33 (i)
 - 4-2 (ii)
 - 90.5 (iii)

(3 marks)

2 Sketch the graph with equation $y = a^x$, a > 1, stating the coordinates of the point where the graph intersects the y-axis and the equation of any asymptotes.

Also state whether this equation would represent exponential growth or decay.

(3 marks)

3 The following equations can be used for exponential models.

State whether each one would represent exponential growth or exponential decay.

- (i) $y = 3^{-2x}$
- (ii) $y = 20(2)^x$
- (iii) $y = 30a^{-x}$ where a > 1

(3 marks)

- **4** Write down the value of in the following statements:
 - (i) $3^a = 27$
 - (ii) $a^{\frac{1}{3}} = 5$
 - (iii) $4a^2 = 64$

(3 marks)

- **5** Write down the value of in the following statements:
 - (i) $\log_3 a = 4$
 - (ii) $\log_a 216 = 3$
 - (iii) $\log_2 128 = a$

(3 marks)

6 Solve the equation

$$2^{x} = 16$$



7 (a) Solve the equation $x^2 - 12x + 27 = 0$.

(2 marks)

(b) Hence, or otherwise, solve the equation $(3^x)^2 - 12(3^x) + 27 = 0$.

(3 marks)

8 Solve the equation

$$2\log_3 9 = 5x - 6$$

(2 marks)

9 Sketch the graph of $y = e^x$, clearly showing the coordinates of the point where the graph intercepts the y-axis and stating the equations of any asymptotes.

- **10** Given $y = e^{2x}$:
 - (i) Write down an expression for $\frac{dy}{dx}$.

(ii) Fi	nd the	gradient of	$y = e^{2x}$	at the	point where	x = 0.
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(2 marks)

- **11** Use a calculator to find the value of
 - (i) 5 log₃ 7
 - (ii) $2 \log_2 3 + 3 \log_3 2$

giving your answers to four significant figures.

(2 marks)

12 Solve the equation $e^{2x} - 16 = 0$, giving your answer in the form $a \ln a$ where a is an integer.

Medium Questions

1 On the same axes, sketch the graphs of $y = 2^x$ and $y = 3^x$, labelling any points where the graphs cross the coordinate axes and writing down the equation of any asymptotes.

(4 marks)



2 (a) Sketch the graph of $y = 2^{-x}$, stating whether this graph indicates exponential growth or exponential decay.

(3 marks)

(b) Find the exact value of y when x = 3.

(1 mark)

- **3** Write down the value of a in the following statements.
 - $\log_a 8 = 3$ (i)
 - (ii) $\log a = 2$
 - (iii) $\ln e^3 = a$
 - (iv) $\log_5 a = 1$

(4 marks)

- 4 (a) Using a calculator, find to 3 significant figures
 - (i) $\log_2 5 + \log_5 2$
 - (ii) $\log 25 \ln 2$
 - (iii) $\log 200 + \log_5 50 \log 20 + \ln 10$

(3 marks)

(b) Solve $3 \log_2 4 + 3x = 5 \log_6 216$.

(2 marks)

5 Solve
$$2^{2x} - 24(2^x) + 128 = 0$$
.

6 (a) On the same axes, sketch the graphs of $y = e^x$ and $y = e^{-x}$. Label any points where the graphs intersect the coordinate axes. Write down the equations of any asymptotes.

(4 marks)

(b) Write down the gradient of $y = e^x$ at the point (0,1).

7 (a) Given $y = e^{4x}$ write down an expression for $\frac{dy}{dx}$.

(1 mark)

(b) Given $y = 2e^{2x}$ write down an expression for $\frac{dy}{dx}$.

(1 mark)

(c) Find the gradient $y = 3e^{-2x}$ of at the point where x = 3. Give your answer in the form pe^q , where p and q are integers to be found.

- **8 (a)** (i) Write down the gradient function of $y = e^{-3x}$
 - Find the gradient of $y = e^{-3x}$ at the point where x = 0. (ii)

(2 marks)

- In terms of e, write down the gradient of $y = e^{-3x}$ at the point where x = 2. **(b)** (i)
 - Find the value for x for which the gradient of $y = e^{-3x}$ is $-3e^{-12}$. (ii)

(2 marks)

- **9 (a)** The function f(x) is defined by $f(x) = 2e^{3x}$ for $x \in \mathbb{R}$
 - (i) Find f(-x).
 - On the same axes, sketch the graphs of y = f(x) and y = f(-x). Label any points where the graphs intersect the coordinate axes.

(3 marks)

(b) Describe the transformation from y = f(x) to y = -f(x).

(2 marks)

10 Solve $e^{2x} - 8e^x + 15 = 0$, giving your answers to 3 significant figures.

Hard Questions

1 (a) On the same axes, sketch the graphs of $y = 4^x$ and $y = 5^x$.

Label any points of intersection with the coordinate axes. Write down the equations of any asymptotes.

(4 marks)

(b) Write down an equation for the graph that is a reflection of $y = 4^x$ in the y-axis.

		(3 ma	arks)
	(ii)	State whether this graph indicates exponential growth or exponential decay.	
2 (a)	(1)	Sketch the graph of $y = 0.4^x$.	

(b) Find the value of x when y = 0.064.

3 (a) Find the value of log 1000 + log 10000

(1 mark)

(b) Write down the value of a in the statement $6^{\log_6 a} = 36$.

(1 mark)

(c) Evaluate $\frac{2\log_4 64 + 3^{\log_2 8} - \log_5 5}{\log 100}.$

(2 marks)

4 (a) Solve $2 \log 1000 = x \log_{16} 4$.

(2 marks)

(b) Solve $3 \log_4 x = \log_4 x + 3 \log_5 25$.

(2 marks)

5 Solve $2(2^{2x}) + 4 = 9(2^x)$.

6 (a) Sketch the graph of $y = 12e^{-x}$ for $x \ge 0$. Label any points of intersection with the coordinate axes. Write down the equations of any asymptotes.

(3 marks)

(b) Write down the gradient of $y = 12e^{-x}$ at the point where x = 0.

7 (a) The function f(x) is defined by $f(x) = 3e^{2x}$ for $x \in \mathbb{R}$. Find f(2x).

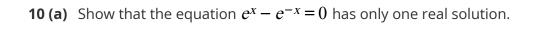
(2 marks)

(b) Find f'(2x).

(2 marks)

8 Solve $2e^{2x} = e^x + 10$, giving your answer to 3 significant figures.

9 (a)	Find the gradient of the curve $y = ae^{bx}$ where and a and b are constants.	
(b)	At the point $(0,a)$ the gradient is 12, find b in terms of a .	(1 mark)
(c)	Hence write down y in terms of a (and x) only.	(2 marks)
		(1 mark)



(3 marks)

(b) Explain why the equation $e^x + e^{-x} = 0$ has no real solutions.

(2 marks)

Very Hard Questions

1 (a) On the same axes, sketch the graphs of $y = 0.3^x$ and $y = 0.5^x$.

Label any points of intersection with the coordinate axes. Write down the equations of any asymptotes.

(4 marks)

(b) Write down an equation for the graph that is a reflection of $y = 0.5^x$ in the y-axis.

2 (a)	Sketch the graph of $y=0.2^{-x}$, stating whether this graph indicates exponential growth or exponential decay.
	(3 marks)
(b)	Find the value of x when $y = 625$.
	(1 mark)

3 (a) Without using a calculator, evaluate $\log_4\,128$. Show each stage of your solution carefully.

(2 marks)

(b) Evaluate $\frac{3\log_6 216 - \ln e^5 + 4^{\log_5 625}}{\log 10000}.$

(2 marks)

4 Solve $3^{2(x+1)} + 3 = 28(3^x)$.

(4 marks)

5 Find two values of *x* for which $\log(x^2) = (\log x)^2$ is true.

(4 marks)

Sketch the graph of $y = 4e^x$ for $x \ge 0$.		
Label any points of intersection with the coordinate axes.		
Write down the equations of any asymptotes.		

(3 marks)

(b) Find the gradient of $y = 4e^x$ at the point where x = 3, giving your answer correct to 3 significant figures.

(1 mark)

(c) The population growth of population, *P*, at time, *t* years, is modelled by the equation $P = 4e^t$

Write down the initial population.

7 (a) The function f(x) is defined by $f(x) = 5e^{3x}$ for $x \in \mathbb{R}$. Find f(4x).

(2 marks)

(b) Find f'(5x).

(2 marks)

8 (a) Find the gradient of the curve $y = \frac{1}{a}e^{-bx}$ where a and b are constants.

(1 mark)

(b) State a condition on b to ensure y represents exponential decay.

(1 mark)

(c) At the point (0,a) the gradient is 10. Find y in terms of a (and x) only.

(2 marks)

9 (a) A particle is travelling with velocity, $v \text{ ms}^{-1}$, at time t seconds. The velocity of the particle is modelled $v = 0.3e^{kt}$, where k is a constant.

Write down the initial velocity of the particle.

(1 mark)

(b) Find an expression (in terms of k and t) for the acceleration of the particle.

(2 marks)

(c) After 12 seconds the velocity of the particle is 0.9 ms⁻¹. Find the value of k, giving your answer to 3 significant figures.

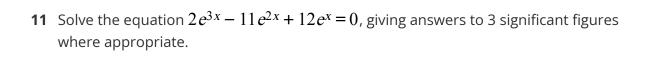
(3 marks)

(d) State a problem with the model for large values of t

(1 mark)

10 Solve $(e^x - e^{-x})^2 = 0$.

(4 marks)



(5 marks)