

Name	Date started	Target end date
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GCE A LEVEL – PURE MATHEMATICS B QUESTION PACK

0975-01 (Legacy C3) · New spec Unit 3 Topic 9 · A2 unit, 35% of A-level, 120 marks, 2h 30min paper

REVISE

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MATHEMATICS – PURE B · EXPONENTIALS, LOGS & GRAPH TRANSFORMATIONS

Exponentials, Logarithms & Graph Transformations

Every exponential, log and $y = af(x+b)$ transformation question from the legacy WJEC C3 papers (June 2011 – June 2017) for new-spec A2 Unit 3

LEGACY 2008 SPECIFICATION

Estimated time for entire question pack: ~0 hours 32 minutes

Derived from the legacy C3/C4 paper's pace of ~1.25 min/mark (26 marks over 6 questions).

*You are advised to **not** attempt to complete all of this in one sitting.*

ABOUT THIS QUESTION PACK

This is a **comprehensive practice question pack**, not a single mock paper. It contains questions from the legacy WJEC C3 and C4 papers (2008 modular spec) that maps onto new-spec A2 Unit 3 Topic 9 (2.3.7).

Questions are ordered chronologically.

INSTRUCTIONS

Use black ink or black ball-point pen. Show all working – method marks are awarded for clear setup.

A calculator is allowed (except where specified by individual questions). The WJEC Formula Booklet may be referred to.

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Q	Source	Max	Mark
1	Jun 11 Q8	5	
2	Jan 12 Q8	6	
3	Jun 12 Q8	3	
Total		26	

Q	Source	Max	Mark
4	Jun 13 Q9	3	
5	Jun 15 Q9	5	
6	Jun 17 Q7	4	
Total		26	

Exponentials, Logarithms & Graph Transformations – what the new spec asks

WJEC GCE A Level Mathematics (from 2017) · Unit 3: Pure Mathematics B · Topic 2.3.7.

Exponential function e^x 2.3.7

- $\frac{d}{dx}(e^x) = e^x$, $\frac{d}{dx}(e^{f(x)}) = f'(x)e^{f(x)}$.
- $\int e^x dx = e^x + c$, $\int e^{ax+b} dx = \frac{1}{a}e^{ax+b} + c$.
- Use to model growth/decay: $N = Ae^{kt}$.

Natural logarithm $\ln x$ 2.3.7

- $\frac{d}{dx}(\ln x) = \frac{1}{x}$, $\frac{d}{dx}(\ln f(x)) = \frac{f'(x)}{f(x)}$.
- Log laws: $\ln(ab) = \ln a + \ln b$, $\ln(a^n) = n \ln a$.
- Use \ln to linearise exponential models.

Exponentials, Logs & Graph Transformations in one page

Quick-reference notes – revisit before each section. Don't use during questions.

e^x basics

$e \approx 2.71828 \dots$

e^x is its own derivative.

$\ln(e^x) = x$ for all real x .

Log laws

$\ln(ab) = \ln a + \ln b$.

$\ln(a/b) = \ln a - \ln b$.

$\ln(a^n) = n \ln a$.

Solving exponential equations

$e^{f(x)} = c \Rightarrow f(x) = \ln c$.

$a^x = b \Rightarrow x = \frac{\ln b}{\ln a}$.

Graph transformations

$y = f(x) + a$: vertical shift by a .

$y = f(x + a)$: horizontal shift by $-a$.

$y = af(x)$: vertical stretch by factor a .

$y = f(ax)$: horizontal stretch by factor $1/a$.

$y = -f(x)$ & $y = f(-x)$

$y = -f(x)$: reflect in x -axis.

$y = f(-x)$: reflect in y -axis.

Sketch checklist

Mark all axes intersections.

Indicate asymptotic behaviour.

Show key stationary points.

SECTION T9

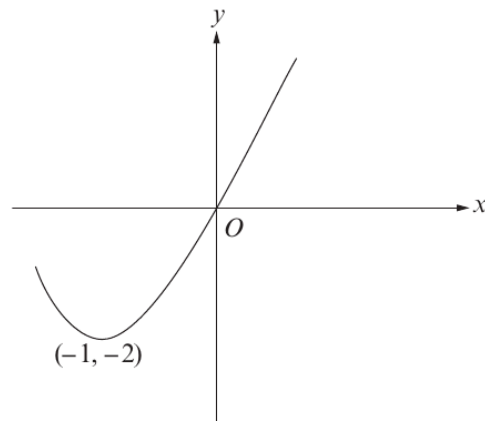
Exponentials, Logarithms & Graph Transformations

Questions 1-6 · 26 marks

8. Given that $f(x) = \ln x$, sketch, on the same diagram, the graphs of $y = f(x)$ and $y = \frac{1}{2}f(x+3)$.
Label the coordinates of the point of intersection of each of the graphs with the x -axis.
Indicate the behaviour of each of the graphs for large positive and negative values of y . [5]

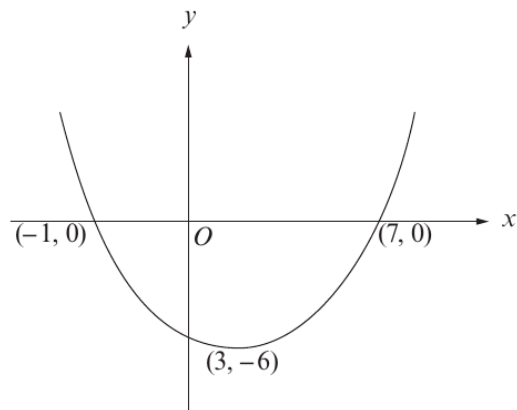
8. The function f is defined by $f(x) = e^x$.
- (a) Sketch the graph of $y = f(x)$. Write down the coordinates of the point of intersection of the graph with the y -axis. [2]
- (b) Using a separate set of axes,
- sketch the graph of $y = f(3x) - 4$, indicating the behaviour of your graph for large negative values of x ,
 - write down the coordinates of the point of intersection of the graph with the y -axis,
 - find the x -coordinate of the point of intersection of the graph with the x -axis. Give your answer correct to three decimal places. [4]

8. The diagram shows a sketch of the graph of $y = f(x)$. The graph passes through the origin and has a minimum point at $(-1, -2)$.



Sketch the graph of $y = -4f(2x)$, indicating the coordinates of the stationary point. [3]

9. The diagram shows a sketch of the graph of $y = f(x)$. The graph passes through the points $(-1, 0)$ and $(7, 0)$ and has a minimum point at $(3, -6)$.



Sketch the graph of $y = -\frac{2}{3}f(x + 4)$, indicating the coordinates of the stationary point and the coordinates of the points of intersection of the graph with the x -axis. [3]

9. Given that $f(x) = \ln x$, sketch, on the same diagram, the graphs of $y = f(x)$ and $y = \frac{2}{3}f(x + 4)$.

Label the coordinates of the point of intersection of **each** of the graphs with the x -axis.
Indicate the behaviour of **each** of the graphs for large positive and negative values of y . [5]

7. (a) Show, by counter-example, that the following statement is false.

$$\text{'If } \frac{7x-200}{x} > 5, \text{ then } x > 100.\text{'}$$
 [2]

- (b) The graph of $y = f(x)$ has a single maximum which is situated at the point $(-2, 4)$. The graph of $y = af(x + b)$ has a single minimum which is situated at the point $(4, -2)$. Find the values of the constants a and b . [2]

END OF EXPONENTIALS, LOGS & GRAPH TRANSFORMATIONS PACK

Source: WJEC C3 + C4 (2008 modular spec) · 2011–2017
Curated for WJEC Maths 2017 spec A2 Unit 3 – Topic 9 (2.3.7)

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