Name	Date started	Target end date

GCE A LEVEL — PURE MATHEMATICS B QUESTION PACK

0975-01 (Legacy C3) · New spec Unit 3 Topic 10 · A2 unit, 35% of A-level, 120 marks, 2h 30min paper

REVISE
.wales

MATHEMATICS — PURE B · DIFFERENTIATION - CHAIN, PRODUCT, QUOTIENT

Differentiation (Chain, Product, Quotient)

Every differentiation rules question (chain, product, quotient, trig, log, exp inverses) 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: ~2 hours 2 minutes

*Derived from the legacy C3/C4 paper's pace of **~1.25 min/mark** (98 marks over 10 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 10 (2.3.8).

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.

For Examiner's use only

Q	Source	Max	Mark
1	Jun 11 Q5	11	
2	Jan 12 Q5	10	
3	Jun 12 Q5	7	
4	Jan 13 Q5	10	
5	Jun 13 Q5	10	

Q	Source	Max	Mark
6	Jan 14 Q6	11	
7	Jun 14 Q6	11	
8	Jun 15 Q6	10	
9	Jun 16 Q6	10	
10	Jun 17 Q5	8	
Total		**98**	

Differentiation (Chain, Product, Quotient) — what the new spec asks

WJEC GCE A Level Mathematics (from 2017) · Unit 3: Pure Mathematics B · Topic 2.3.8.

Chain rule 2.3.8

- $\frac{d}{dx}[f(g(x))] = f'(g(x)) \cdot g'(x)$.
- Outer function first, then multiply by derivative of inner.
- Watch out for awkward inner functions like $\tan^{-1}$, $\sin^{-1}$, $\sqrt{\cdot}$.

Product & quotient rules 2.3.8

- Product: $(uv)' = u'v + uv'$.
- Quotient: $\left(\frac{u}{v}\right)' = \frac{u'v - uv'}{v^2}$.
- Inverse trig: $\frac{d}{dx}(\sin^{-1} x) = \frac{1}{\sqrt{1-x^2}}$, etc.

Crib sheet »

Differentiation - Chain, Product, Quotient in one page

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

Chain rule

If $y = f(g(x))$, then $\frac{dy}{dx} = f'(g(x)) \cdot g'(x)$.
Identify outer and inner functions before differentiating.

Product rule

$(uv)' = u'v + uv'$.
Useful for products like $x^3 \ln x$, $e^x \sin x$.

Quotient rule

$\left(\frac{u}{v}\right)' = \frac{u'v - uv'}{v^2}$.
Alternative: rewrite as uv^{-1} and apply product rule.

Derivatives of trig

$(\sin x)' = \cos x$, $(\cos x)' = -\sin x$,
$(\tan x)' = \sec^2 x$.
$(\sec x)' = \sec x \tan x$, $(\csc x)' = -\csc x \cot x$, $(\cot x)' = -\csc^2 x$.

Inverse trig derivatives

$(\sin^{-1} x)' = \frac{1}{\sqrt{1-x^2}}$.
$(\cos^{-1} x)' = -\frac{1}{\sqrt{1-x^2}}$.
$(\tan^{-1} x)' = \frac{1}{1+x^2}$.

e^x and $\ln x$ chain rule

$(e^{f(x)})' = f'(x)e^{f(x)}$.
$(\ln f(x))' = f'(x)/f(x)$.

SECTION T10

Differentiation (Chain, Product, Quotient)

Questions 1–10 · 98 marks

5. Differentiate each of the following with respect to x, simplifying your answer wherever possible.

(a) $(9-2x)^{\frac{1}{3}}$ *(b)* $\ln(\cos x)$ *(c)* $x^3 \tan 4x$ *(d)* $\dfrac{e^{6x}}{(3x+2)^4}$

[2], [3], [3], [3]

5. Differentiate each of the following with respect to x, simplifying your answer wherever possible.

(a) $\tan^{-1}4x$ *(b)* e^{x^3} [2], [2]

(c) $x^5 \ln x$ *(d)* $\dfrac{3-2x^2}{5-4x^2}$ [3], [3]

5. Differentiate each of the following with respect to x.

(a) $\ln(7 + 2x - 3x^2)$ *(b)* $e^{\tan x}$ *(c)* $5x^2\sin^{-1}x$ [2], [2], [3]

5. *(a)* Differentiate each of the following with respect to x.

(i) $\sqrt{5x^2 - 3x}$ (ii) $\sin^{-1} 7x$ (iii) $e^{3x} \ln x$ [7]

(b) By first writing $\cot x = \frac{\cos x}{\sin x}$, show that $\frac{d}{dx}(\cot x) = -\text{cosec}^2 x$. [3]

5. Differentiate each of the following with respect to x, simplifying your answer wherever possible.

(a) $(7 - 9x^2)^5$ *(b)* $\tan^{-1} 6x$ [2], [2]

(c) $e^{4x}\tan 2x$ *(d)* $\dfrac{3 + \sin x}{2 + \cos x}$ [3], [3]

6. Differentiate each of the following with respect to x, simplifying your answer wherever possible.

(a) $(5x^3 - x)^{10}$ *(b)* $\sin^{-1}(x^3)$ [2], [2]

(c) $x^4 \ln(2x)$ *(d)* $\dfrac{e^{4x}}{(2x+3)^6}$ [3], [4]

6. *(a)* Differentiate each of the following with respect to x, simplifying your answer wherever possible.

(i) $\dfrac{1}{\sqrt[4]{9-4x^5}}$ (ii) $\dfrac{3+2x^3}{7-x^3}$ [5]

(b) (i) Sketch the graph of $y = \sin^{-1}x$ for values of x satisfying $-1 \leqslant x \leqslant 1$.

(ii) By first rewriting $y = \sin^{-1}x$ as $x = \sin y$, find an expression for $\dfrac{\mathrm{d}y}{\mathrm{d}x}$ in terms of x. You should justify any choice of sign that you make. [6]

6. *(a)* Differentiate each of the following with respect to x, simplifying your answer wherever possible.

(i) $\ln(4x^2 - 3x - 5)$

(ii) $e^{\sqrt{x}}$

(iii) $\dfrac{a + b\sin x}{a - b\sin x}$, where a, b are constants. [7]

(b) By first writing $\cot x = (\tan x)^{-1}$ and assuming the derivative of $\tan x$, find an expression for $\dfrac{d}{dx}(\cot x)$. Simplify your answer. [3]

6. Differentiate each of the following with respect to x, simplifying your answer wherever possible.

(a) $\ln(\cos x)$ [3]

(b) $\tan^{-1}(\frac{x}{3})$ [3]

(c) $e^{6x}(3x-2)^4$ [4]

5. *(a)* Differentiate each of the following with respect to x, simplifying your answer wherever possible.

(i) $\sqrt{3x^2 + 5x}$ (ii) $\sin^{-1} 3x$ [4]

(b) By first writing $y = \cot^{-1} x$ as $x = \cot y$ and then assuming the derivative of cot y, find $\frac{dy}{dx}$ in terms of x. [4]

END OF DIFFERENTIATION - CHAIN, PRODUCT, QUOTIENT PACK

Source: WJEC C3 + C4 (2008 modular spec) · 2011–2017
Curated for WJEC Maths 2017 spec A2 Unit 3 — Topic 10 (2.3.8)