

part	marks	Syllabus Code	Calc. Code (CN,CR,NC)	Grade (C, B, A)	Source
a)	2	1.1.7, 1.1.6	NC	C	2002W q1
b)	2	1.1.3	NC	C	

(a)	Find the equation of the straight line through the points A(-1, 5) and B(3, 1).	2
(b)	Find the size of the angle which AB makes with the positive direction of the x -axis.	2

Give 1 mark for each •

Illustrations for awarding each •

a ans: $y + x = 4$ 2 marks

- ¹ ss : know how to and find gradient
- ² ic : state equation of st line

- ¹ $m = -1$
- ² $y - 5 = -1(x + 1)$ **or** $y - 1 = -1(x - 3)$

b ans: 135° 2 marks

- ³ ss : know that $\tan(\text{angle}) = \text{gradient}$
- ⁴ pd : calculate angle

- ³ $\tan(\text{angle}) = -1$
- ⁴ angle = 135°

Notes

- 1 •³ and •⁴ are only available for candidates who use their gradient from part (a).
- 2 If part (a) yields a positive gradient, maximum award for (b) is 1.
- 3 For •³ and •⁴, accept a diagram correctly showing 45° and 135° .
- 4 For •³ treat as bad form $\tan(-1) = \text{angle}$

part	marks	Syllabus Code	Calc. Code (CN,CR,NC)	Grade (C, B, A)	Source
a)	2	3.1.2	CN	C	2002W q2
b)	2	3.1.10	CN	C	

- (a) If $u = \begin{pmatrix} 1 \\ 7 \\ -2 \end{pmatrix}$ and $v = \begin{pmatrix} 1 \\ -2 \\ 1 \end{pmatrix}$, write down the components of $u + 3v$ and $u - 3v$. 2
- (b) Hence, or otherwise, show that $u + 3v$ and $u - 3v$ are perpendicular. 2

Give 1 mark for each •

Illustrations for awarding each •

a ans: as shown 2 marks

- ¹ ic : interpret vector components
- ² ic : interpret vector components

$$\bullet^1 \quad u + 3v = \begin{pmatrix} 4 \\ 1 \\ 1 \end{pmatrix}$$

$$\bullet^2 \quad u - 3v = \begin{pmatrix} -2 \\ 13 \\ -5 \end{pmatrix}$$

b ans: proof 2 marks

- ³ ss : know to use scalar product
- ⁴ pd : process s.p. to get zero

$$\bullet^3 \quad \begin{pmatrix} 4 \\ 1 \\ 1 \end{pmatrix} \cdot \begin{pmatrix} -2 \\ 13 \\ -5 \end{pmatrix}$$

$$\bullet^4 \quad = -8 + 13 - 5 = 0$$

Alternative

$$\bullet^3 \quad (u + 3v) \cdot (u - 3v)$$

$$= |u|^2 - 9|v|^2$$

$$\bullet^4 \quad = 54 - 9 \times 6 = 0$$

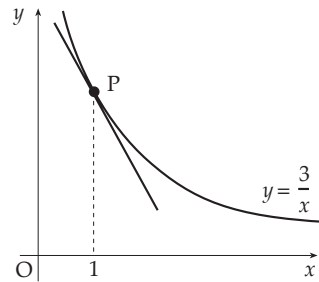
Notes

1 Treat $\begin{pmatrix} 4 \\ 1 \\ 1 \end{pmatrix} \cdot \begin{pmatrix} -2 \\ 13 \\ -5 \end{pmatrix} = \begin{pmatrix} -8 \\ 13 \\ -5 \end{pmatrix} = -8 + 13 - 5 = 0$ as bad form.

2 Treat $\begin{pmatrix} 1 \\ 7 \\ 2 \end{pmatrix}$ as a casual error - max 3/4

part	marks	Syllabus Code	Calc. Code (CN,CR,NC)	Grade (C, B, A)	Source
	5	1.3.4, 1.3.7, 1.1.6	CN	C	2002W q3

Find the equation of the tangent to the curve with equation $y = \frac{3}{x}$ at the point P where $x = 1$.



5

Give 1 mark for each •

Illustrations for awarding each •

ans: $y + 3x = 6$

5 marks

- ¹ ic : express in standard form
- ² pd : differentiate negative power
- ³ ss : know how to and find gradient
- ⁴ ss : know how to and find y-coord.
- ⁵ ic : write down equ of tangent

- ¹ $y = 3x^{-1}$
- ² $\frac{dy}{dx} = -3x^{-2}$
- ³ $m_{x=1} = -3$
- ⁴ $y_{x=1} = 3$
- ⁵ $y - 3 = -3(x - 1)$

Notes

- 1 For •⁵, gradient must be obtained from derivative.
- 2 •⁵ is not available to candidates who find and use the gradient perpendicular to -3.

part	marks	Syllabus Code	Calc. Code (CN,CR,NC)	Grade (C, B, A)	Source
a)	1	1.2.11	NC	C	2002W q4
b)	2	2.3.1	NC	C	

- (a) Write down the exact values of $\sin\left(\frac{\pi}{3}\right)$ and $\cos\left(\frac{\pi}{3}\right)$. 1
- (b) If $\tan x = 4 \sin\left(\frac{\pi}{3}\right) \cos\left(\frac{\pi}{3}\right)$, find the exact values of x for $0 \leq x \leq 2\pi$. 2

Give 1 mark for each •

Illustrations for awarding each •

a ans: $\frac{\sqrt{3}}{2}, \frac{1}{2}$ 1 mark

•¹ ic : know exact values

•¹ $\sin \frac{\pi}{3} = \frac{\sqrt{3}}{2}$ **and** $\cos \frac{\pi}{3} = \frac{1}{2}$

b ans : $\frac{\pi}{3}, \frac{4\pi}{3}$ 2 marks

•² pd : start to solve - simplify fractions

•² $\tan x = \sqrt{3}$

•³ pd : complete solving process

•³ $x = \frac{\pi}{3}, \frac{4\pi}{3}$

Notes

1 •² is only available for an expression for $\tan x$ involving at least 1 surd and tidied up.

2 •³ is only available for answers in radians.

part	marks	Syllabus Code	Calc. Code (CN,CR,NC)	Grade (C, B, A)	Source
	5	2.1.1	CN	C	2002W q5

Given that $(x - 2)$ and $(x + 3)$ are factors of $f(x)$ where $f(x) = 3x^3 + 2x^2 + cx + d$, find the values of c and d .

5

Give 1 mark for each •

Illustrations for awarding each •

ans: $c = -19, d = 6$

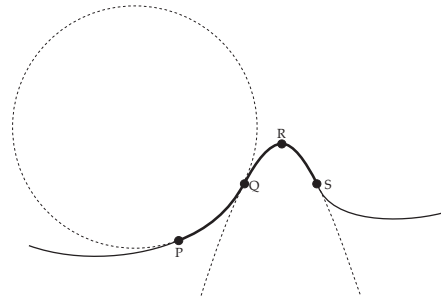
5 marks

- | | |
|---|--|
| • ¹ ss : know to use $f(a)$ or synth. division | • ¹ use $f(2)$ or $f(-3)$ or start appr.synth. division |
| • ² pd : determine an exp. in c & d | • ² $2c + d + 32$ |
| • ³ pd : determine another equ. in c & d | • ³ $-3c + d - 63$ |
| • ⁴ ss : know to form and solve sim. equ. | • ⁴ $2c + d = -32$ and $-3c + d = 63$ or equiv |
| • ⁵ pd : process solutions of sim. equations | • ⁵ $(c, d) = (-19, 6)$ |

part	marks	Syllabus Code	Calc. Code (CN,CR,NC)	Grade (C, B, A)	Source
a)	4	2.4.4	CN	C	2002W q6
b)	2	1.3.9	CN	B	

The side view of part of a roller coaster ride is shown by the path PQRS. The curve PQ is an arc of the circle with equation $x^2 + y^2 + 4x - 10y + 9 = 0$. The curve QRS is part of the parabola with equation $y = -x^2 + 6x - 5$. The point Q has coordinates (2, 3).

- (a) Find the equation of the tangent to the circle at Q.
 (b) Show that this tangent to the circle at Q is also the tangent to the parabola at Q.



4
2

Give 1 mark for each •

Illustrations for awarding each •

a ans: $y - 2x = -1$ 4 marks

- ¹ ic : state coord of centre of circle
- ² ss : know how to and find m_{radius}
- ³ ss : know how to and find m_{tangent}
- ⁴ ic : write down equ of tangent

- ¹ centre = $(-2, 5)$
- ² $m_{\text{rad}} = \frac{2}{-4}$
- ³ $m_{\text{tgt}} = 2$
- ⁴ $y - 3 = 2(x - 2)$

Notes

- 1 •⁴ only available if perp. gradient used
- 2 Attempting to solve the circle and the parabola cannot earn any credit.

b ans: proof 2 marks

- ⁵ ss : know to diff and differentiate
- ⁶ ic : complete proof

- ⁵ $\frac{dy}{dx} = -2x + 6$
- ⁶ $m = 2$ and complete

OR

OR

- ⁵ ss : know to solve two curves
- ⁶ ic : complete proof of equal roots

- ⁵ $-x^2 + 6x - 5 = 2x - 1$
 $(x - 2)^2 = 0$
- ⁶ \Rightarrow equal roots so tgt at $x = 2$

part	marks	Syllabus Code	Calc. Code (CN,CR,NC)	Grade (C, B, A)	Source
	4	2.2.4	CN	C	2002W q7

Find $\int \left(\sqrt[3]{x} - \frac{1}{\sqrt{x}} \right) dx$.

4

Give 1 mark for each •

Illustrations for awarding each •

ans: $\frac{3}{4}x^{\frac{4}{3}} - 2x^{\frac{1}{2}} + c$

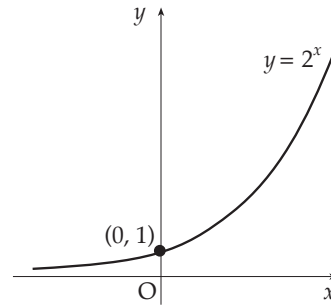
4 marks

- | | |
|---|---|
| <ul style="list-style-type: none"> •¹ ic : express in standard form •² ic : express in standard form •³ pd : integrate fractional power •⁴ pd : integrate neg. fractional power
plus constant of int. | <ul style="list-style-type: none"> •¹ $x^{\frac{1}{3}}$ •² $x^{-\frac{1}{2}}$ •³ $\frac{3}{4}x^{\frac{4}{3}}$ or $-2x^{\frac{1}{2}}$ •⁴ $\frac{3}{4}x^{\frac{4}{3}} - 2x^{\frac{1}{2}} + c$ |
|---|---|

part	marks	Syllabus Code	Calc. Code (CN,CR,NC)	Grade (C, B, A)	Source
a)	2	1.2.4	NC	B	2002W q8
b)	2	1.2.5	NC	A	

The diagram shows part of the graph of $y = 2^x$.

- (a) Sketch the graph of $y = 2^{-x} - 8$.
 (b) Find the coordinates of the points where it crosses the x and y axes.



2
2

Give 1 mark for each •

Illustrations for awarding each •

a ans: sketch 2 marks

- ¹ ic : interpret negative index
- ² ic : interpret vertical displacement

- ¹ sketch with y – axis reflection
- ² sketch with translation $| \cdot |^1$ to y – axis

b ans: sketch 2 marks

- ³ ic : interpret new y -intercept
- ⁴ pd : calculate the new ' x '-intercept

- ³ $(0, -7)$
- ⁴ $(-3, 0)$

Notes

- 1 •² and •³ are connected!. Stating they are “going down 8” will earn •². Doing it to get $(0, -7)$ will earn •³. A wrong translation downwards on its own will earn neither mark.
- 2 Horizontal translations earn no marks.
- 3 •² is still available after first reflecting in the line $y = x$.

part	marks	Syllabus Code	Calc. Code (CN,CR,NC)	Grade (C, B, A)	Source
a)	3	1.2.6	CN	C	2002W q9
b)	1	1.2.2	CN	B	

The function f , defined on a suitable domain, is given by $f(x) = \frac{3}{x+1}$.

- (a) Find an expression for $h(x)$ where $h(x) = f(f(x))$, giving your answer as a fraction in its simplest form. 3
- (b) Describe any restriction on the domain of h . 1

Give 1 mark for each •

Illustrations for awarding each •

a ans: $\frac{3(x+1)}{x+4}$ 3 marks

- ¹ ic : interpret composite functions
- ² ic : interpret composite functions
- ³ pd : simplify algebraic fractions

•¹ $f\left(\frac{3}{x+1}\right)$ stated or implied by •²

•² $\frac{3}{\frac{3}{x+1} + 1}$

b ans: $x \neq -4$ 1 mark

- ⁴ ic : interpret alg. fraction

•³ $\frac{3x+3}{x+4}$

•⁴ $x \neq -4$

Notes

- 1 Do not penalise the inclusion of $x \neq -1$ at •⁴

part	marks	Syllabus Code	Calc. Code (CN,CR,NC)	Grade (C, B, A)	Source
	5	3.2.2, 2.1.9, 1.3.11	CN	A	2002W q10

A function f is defined by $f(x) = 2x + 3 + \frac{18}{x-4}$, $x \neq 4$.

Find the values of x for which the function is strictly increasing.

5

Give 1 mark for each •

Illustrations for awarding each •

ans: proof

5 marks

- ¹ ss : know to diff and begin
- ² pd : complete $f'(x)$
- ³ ss : know to solve $f'(x) = 0$ and begin
- ⁴ pd : complete solution of $f'(x) = 0$
- ⁵ ic : interpret solution to $f'(x) > 0$

- ¹ $f'(x) = 2 \dots\dots$
- ² $\dots\dots -18(x-4)^2$
- ³ $(x-4)^2 - 9 = 0$
- ⁴ $x = 1, x = 7$
- ⁵ $x < 1, x > 7$

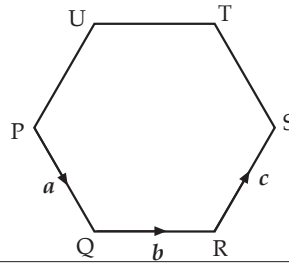
More aesthetic solution

- ¹ ss : know that for incr. f , $f'(x) > 0$
- ² pd : find $f'(x)$
- ³ pd : start to solve inequality
- ⁴ pd : continue to solve inequality
- ⁵ ic : interpret factors

- ¹ $f'(x) > 0$
 - ² $2 - \frac{18}{(x-4)^2}$
 - ³ $(x-4)^2 - 9 > 0$
 - ⁴ $(x-7)(x-1) > 0$
 - ⁵ $x < 1, x > 7$
- Alternative for •³, •⁴, •⁵
- ³ $(x-4)^2 > 9$
 - ⁴ $(x-4) > 3$ **and** $(x-4) < -3$
 - ⁵ $x < 1, x > 7$

part	marks	Syllabus Code	Calc. Code (CN,CR,NC)	Grade (C, B, A)	Source
	3	3.1.9	CN	A	2002W q11

PQRSTU is a regular hexagon of side 2 units.
 \vec{PQ} , \vec{QR} and \vec{RS} represent vectors a , b and c respectively.
 Find the value of $a \cdot (b + c)$.



3

Give 1 mark for each •

Illustrations for awarding each •

ans: 0

3 marks

- ¹ ss : know to use and use dist. law
- ² ic : interpret scalar product
- ³ pd : evaluate scalar products

- ¹ $a \cdot b + a \cdot c$
- ² $|a||b|\cos 60^\circ + |a||c|\cos 120^\circ$
- ³ $2 \times 2 \times \frac{1}{2} + 2 \times 2 \times -\frac{1}{2} = 0$

Alternative sol^u:

- ¹ $\vec{PQ} \cdot \vec{QS}$
- ² $\hat{Q}RS = 120^\circ \Rightarrow \hat{R}QS = 30^\circ \Rightarrow \hat{P}QS = 90^\circ$
- ³ $\vec{PQ} \cdot \vec{QS} = |PQ||QS|\cos 90^\circ = 0$

Note

- 1 The use of a coordinate framework is acceptable.
- 2 •² may be awarded for $|a||b|\cos 60^\circ = 2 \times 2 \times \frac{1}{2}$ or $|a||b|\cos 120^\circ = 2 \times 2 \times -\frac{1}{2}$.

part	marks	Syllabus Code	Calc. Code (CN,CR,NC)	Grade (C, B, A)	Source
	3	3.3.2, 3.3.1	CN	A	2002W q11

If $\log_a p = \cos^2 x$ and $\log_a r = \sin^2 x$, show that $pr=a$.

3

Give 1 mark for each •

Illustrations for awarding each •

ans: a

3 marks

- ¹ ss : choose a starting point
- ² pd : know and use sum/product rule
- ³ ic : interpret log statement and complete proof.

- ¹ $\log_a p + \log_a r = \cos^2 x + \sin^2 x$
- ² $\log_a p + \log_a r = \log_a pr$
- ³ $\log_a pr = 1$ and so $pr = a$

Alternative sol^u:

- ¹ $p = a^{\cos^2 x}$ $r = a^{\sin^2 x}$
- ² $pr = a^{\cos^2 x + \sin^2 x}$
- ³ $pr = a^1 = a$

Note

- 1 To gain all 3 marks there needs to be some indication that the candidate has noticed that $\cos^2 x + \sin^2 x = 1$.