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(angle) = gradient
- •4 pd : calculate angle

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

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) = 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 $\boldsymbol{u}=\begin{pmatrix}1\\7\\-2\end{pmatrix}$ and $\boldsymbol{v}=\begin{pmatrix}1\\-2\\1\end{pmatrix}$, write down the components of $\boldsymbol{u}+3\boldsymbol{v}$ and $\boldsymbol{u}-3\boldsymbol{v}$. 2

(*b*) Hence, or otherwise, show that $\boldsymbol{u}+3\boldsymbol{v}$ and $\boldsymbol{u}-3\boldsymbol{v}$ are perpendicular. 2

Give 1 mark for each •

a ans: as shown 2 marks

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

b ans: proof 2 marks

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

Illustrations for awarding each •

•1 $u+3v=\begin{pmatrix}4\\1\\1\end{pmatrix}$

•2 $u-3v=\begin{pmatrix}-2\\13\\-5\end{pmatrix}$

•3 $\begin{pmatrix}4\\1\\1\end{pmatrix}.\begin{pmatrix}-2\\13\\-5\end{pmatrix}$

•4 $=-8+13-5=0$

Alternative

•3 $(u+3v).(u-3v)$
$=|u|^2-9|v|^2$

•4 $=54-9\times6=0$

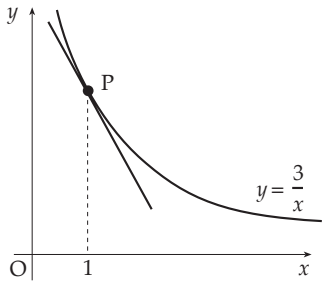
Notes

1 Treat $\begin{pmatrix}4\\1\\1\end{pmatrix}.\begin{pmatrix}-2\\13\\-5\end{pmatrix}=\begin{pmatrix}-8\\13\\-5\end{pmatrix}=-8+13-5=0$ 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 froma 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 $0 \le x \le 2\pi$. 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

•3 pd : complete solving process

•2 $\tan x = \sqrt{3}$

•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
- •2 pd : determine an exp. in c & d
- •3 pd : determine another equ. in c & d
- •4 ss : know to form and solve sim. equ.
- •5 pd : process solutions of sim. equations

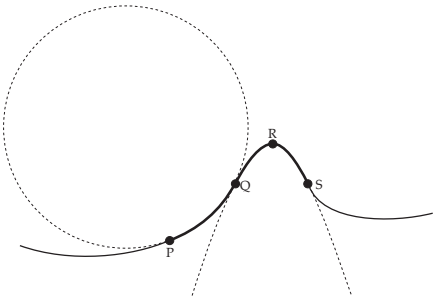
- •1 use $f(2)$ or $f(-3)$ or start appr.synth. division
- •2 $2c+d+32$
- •3 $-3c+d-63$
- •4 $2c+d=-32$ **and** $-3c+d=63$ or equiv
- •5 $(c,d)=(-19,6)$

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. 4

(*b*) Show that this tangent to the circle at Q is also the tangent to the parabola at Q. 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 $m_{rad} = \frac{2}{-4}$
- •3 $m_{tgt} = 2$
- •4 $y - 3 = 2(x - 2)$

Notes
1 •4 only available if perp. gradient used
2 Attempting to solve the circle and the parabola casnnot earn any credit.

b ans: proof 2 marks

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

OR

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

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

OR

- •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

- •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.

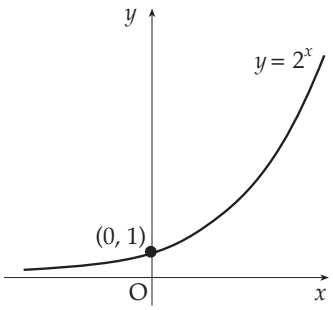
- •1 $x^{\frac{1}{3}}$
- •2 $x^{-\frac{1}{2}}$
- •3 $\frac{3}{4}x^{\frac{4}{3}}$ **or** $-2x^{\frac{1}{2}}$
- •4 $\frac{3}{4}x^{\frac{4}{3}}-2x^{\frac{1}{2}}+c$

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 $y = 2^{-x} - 8$. 2

(*b*) Find the coordinates of the points where it crosses the x and y axes. 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 $|1|^{el}$ 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 $\frac{3}{\frac{3}{x+1}+1}$
- •3 $\frac{3x+3}{x+4}$

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

- •4 ic : interpret alg. fraction

- •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 $f(x) = 2x + 3 + \frac{18}{x-4}, \quad x \neq 4.$

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

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

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

More aesthetic solution

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

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

Alternative for $\bullet^3$, $\bullet^4$, $\bullet^5$

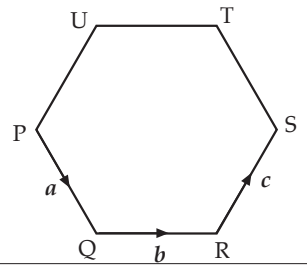
- $\bullet^3$ $(x-4)^2 > 9$
- $\bullet^4$ $(x-4) > 3$ **and** $(x-4) < -3$
- $\bullet^5$ $x < 1, \ x > 7$

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 $\boldsymbol{a}$, $\boldsymbol{b}$ and $\boldsymbol{c}$ respectively.

Find the value of $\boldsymbol{a}.(\boldsymbol{b}+\boldsymbol{c})$. 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 $a.b + a.c$
- •2 $|a||b|\cos 60° + |a||c|\cos 120°$
- •3 $2\times 2\times \frac{1}{2} + 2\times 2\times -\frac{1}{2} = 0$

Alternative sol^{u}:

- •1 $\vec{PQ}.\vec{QS}$
- •2 $Q\hat{R}S = 120° \Rightarrow R\hat{Q}S = 30° \Rightarrow P\hat{Q}S = 90°$
- •3 $\vec{PQ}.\vec{QS} = |PQ||QS|\cos 90° = 0$

Note

1 The use of a coordinate framework is acceptable.

2 •2 may be awarded for $|a||b|\cos 60° = 2\times 2\times \frac{1}{2}$ or $|a||b|\cos 120° = 2\times 2\times -\frac{1}{2}$.

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 $p = a^{\cos^2 x} \quad r = a^{\sin^2 x}$
•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 $\cos^2 x + \sin^2 x = 1$.

