Question Number	Scheme	Marks
9(a)	$(f(x)=)-4\sin x$ or equivalent such as $(f(x)=)4\cos\left(x+\frac{\pi}{2}\right)$	M1 A1
		(2)
(b)(i)	$\left(\frac{5\pi}{3}, 4\right)$	B1, B1
		(2)
(ii)	$\left(\frac{3\pi}{2}, -2\right)$	B1, B1
		(2)
		(6 marks)

Notes

Do <u>not</u> allow the use of degrees in this question.

If there is more than one answer for any part, score the final attempt.

Remember to check for answers written in the question.

(a)

M1: For any sine or cosine curve with an amplitude of 4 and a period of 2π and which passes through the origin. E.g. $(f(x)=)\pm 4\sin(\pm x)$, $(f(x)=)\pm 4\cos\left(x\pm\frac{\pi}{2}\right)$

Condone the use of θ for this mark and "f(x) =" (or "$f(\theta)=$") is not required.

Do not allow ambiguous expressions e.g. $(f(x)=)-4f(\sin x)$

A1: Completely correct expression in terms of x e.g. $(f(x)=)-4\sin x$ or equivalent such as $(f(x)=)4\cos\left(x+\frac{\pi}{2}\right)$, $(f(x)=)4\sin(x+\pi)$, $4\sin(-x)$

"f(x) =" is not required.

(b)

Allow answers to be written as coordinates or as $x = \ldots$, $y = \ldots$

If more than one answer is given, mark their final answer.

Condone missing brackets e.g. $\frac{5\pi}{3}, 4$ and condone punctuation other than a comma e.g. $\left(\frac{5\pi}{3}; 4\right)$

The x coordinates must be written as single fractions but allow equivalents e.g. $\frac{10\pi}{6}$ for $\frac{5\pi}{3}$

The y coordinate must be written as single number so do not allow 0 – 2 for –2

Do **not** allow coordinates the wrong way round e.g. $\left(4, \frac{5\pi}{3}\right)$ or $\left(-2, \frac{3\pi}{2}\right)$

(b) (i)

B1: One correct coordinate from $x=\frac{5\pi}{3}$ or $y=4$

B1: $\left(\frac{5\pi}{3}, 4\right)$ or $x=\frac{5\pi}{3}$ and $y=4$

(b) (ii)

B1: One correct coordinate from $x = \frac{3\pi}{2}$ or $y = -2$

B1: $\left(\frac{3\pi}{2}, -2\right)$ or $x = \frac{3\pi}{2}$ and $y = -2$

Question Number	Scheme	Marks
10(a)	$y=2x^3+\frac{1}{2}x^2-2x+5 \Rightarrow \frac{dy}{dx}=6x^2+x-2$ so at $x=0$, $\frac{dy}{dx}=-2$	M1
	Equation of normal at P is $y=\frac{1}{2}x+5$	A1
	Q is where $y=2x^3+\frac{1}{2}x^2-2x+5$ meets $y=\frac{1}{2}x+5$ $2x^3+\frac{1}{2}x^2-2x+5=\frac{1}{2}x+5 \Rightarrow 4x^3+x^2-5x=0$	**d**M1 A1
	$\Rightarrow x\left(4x^2+x-5\right)=0 \Rightarrow x(4x+5)(x-1)=0 \Rightarrow x=-\frac{5}{4}$	**dd**M1 A1
		(6)

Notes

(a)

M1: Attempts to find the gradient of the curve at P.

It is for attempting to find the value of $\frac{dy}{dx}$ when $x=0$

There must be some evidence of differentiating e.g. $2x^3 \to ...x^2$ or $\frac{1}{2}x^2 \to ...x$

or $-2x \to -2$ or $5 \to 0$ followed by the substitution of $x=0$ which may be implied.

Alternatively deduces that the gradient of the curve at P is -2

A1: Equation of normal at P is $y=\frac{1}{2}x+5$ oe e.g. $y-5=\frac{1}{2}(x-0)$

dM1: Sets $2x^3+\frac{1}{2}x^2-2x+5=kx+5$ where k is not their gradient of the tangent at P and collects terms to one side. Must be $kx+5$ but condone a miscopy of the equation of C.

A1: Correct cubic equation with terms collected and all on one side e.g. $4x^3+x^2-5x=0$ or equivalent e.g. $2x^3+\frac{1}{2}x^2-\frac{5}{2}x=0$. The "= 0" may be implied by their attempt to solve.

ddM1: Cancels or factorises out an x term from an equation of the form $ax^3+bx^2+cx=0$, $a,b,c \neq 0$ and solves resulting 3TQ by any means including a calculator.

Condone factors that are inconsistent with their 3TQ so just look for the correct or correct ft roots.

Allow e.g. $4x^3+x^2-5x=0 \Rightarrow x(4x+5)(x-1)=0 \Rightarrow x=...$

Do **not** allow e.g. $4x^3+x^2-5x=0 \Rightarrow x=\frac{-1\pm\sqrt{1^2-4(4)(-5)}}{2\times 4}=...$

If roots of the 3TQ are just written down you may need to check.

They cannot just write down the roots of the cubic equation. Decimals should be correct to 2 sf or truncated to 2sf.

Depends on the previous method mark.

A1: $x=-\frac{5}{4}$ oe only. Ignore any attempts to find the y coordinate and ignore any incorrect attempts at finding the other x coordinate provided $x=-\frac{5}{4}$ is selected.

Question Number	Scheme	Marks
Note: full marks are available for those with an incorrect $\frac{\mathrm{d}y}{\mathrm{d}x}$ that still leads to a gradient at P of -2		

Beware in part (a) that it is possible to reach the correct answer fortuitously as follows:

$$y = 2x^3 + \tfrac{1}{2}x^2 - 2x + 5 \Rightarrow \frac{\mathrm{d}y}{\mathrm{d}x} = 6x^2 + x - 2$$

$$\frac{\mathrm{d}y}{\mathrm{d}x} = 0 \Rightarrow 6x^2 + x - 2 = 0 \Rightarrow x = \frac{1}{2}, -\frac{2}{3}$$

And then incorrectly assuming the gradient of the normal to C at P is $\frac{1}{2}$ and that l has the equation $y = \tfrac{1}{2}x + 5$

This will generally score no marks in (a) it is entirely fortuitous.

If you are unsure if a particular response deserves credit then use Review.

(b)	Sets $\frac{dy}{dx} = 6x^2 + x - 2 = \frac{1}{2}$	M1
	$12x^2 + 2x - 5 = 0$	A1
	$x = \frac{-2 \pm \sqrt{4 + 240}}{24}$	dM1
	$x = \frac{-1 + \sqrt{61}}{12}$	A1
		(4)
		(10 marks)

Notes

(b)

M1: Sets their $\frac{dy}{dx}$ of the form $ax^2 + bx - 2,\ a, b \neq 0$ equal to $\frac{1}{2}$

A1: Correct 3 term equation $12x^2 + 2x - 5 = 0$ or equivalent e.g. $6x^2 + x - \frac{5}{2} = 0$

The constant terms must be collected but the terms do not need to be all on one side so allow e.g. $12x^2 + 2x = 5$

dM1: Correct attempt to solve a 3TQ resulting from $ax^2 + bx - 2 = \frac{1}{2}$.

Allow calculator solutions for solving their 3TQ and condone factors that are inconsistent with their equation so just look for the correct or correct ft roots.
Note that only the positive solution may be seen which is acceptable.
If values are just written down you may need to check. Decimals should be correct to 2 sf or truncated to 2sf.

A1: $x = \frac{-1 + \sqrt{61}}{12}$ only.