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a $\ddot{x} = 4\cos 2t$

initially $t = 0$

$\dot{x} \int \ddot{x}$

$= \frac{4}{2}\sin 2t + C$

$\dot{x} = 2\sin 2t + 1$.

when $t = 0$ $v = 1$.

$2\sin 2(0) + C = 1$.

$C = 1$.

ii $\therefore \dot{x} = 2\sin 2t + 1$.

$v = 0$.

$\dot{x} = 2\sin 2t + 1 = 0$

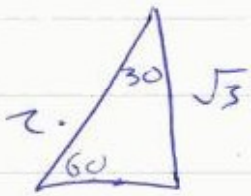
$= 2\sin 2t = -1$

$\sin 2t = -\frac{1}{2}$ $\rightarrow \sin 30 = \frac{1}{2}$

$2 \times 15 = 30$.

$t = 15$ seconds

50 + 1



iii $x = \int 2\sin 2t + 1$.

$x = -\frac{2}{2}\cos 2t + t + C$

$= -\cos 2t + t + C$

at $t = 15$ is at rest $x = 0$.

$\therefore 14.85 + C = 0$.

$C = -14.85$ (2dp).

$x = -\cos 2t + t - 14.85$.

b. $\frac{dy}{dx} = 2x$

at $A(-1, 1)$.

gradient $= -2$.

using point gradient form.

$y - y_1 = m(x - x_1)$.

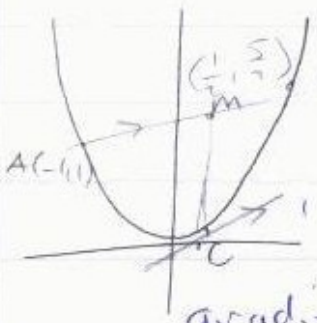
$= y - 1 = -2(x + 1)$

$y - 1 = -2x - 2$.

$2x + y - 1 + 2 = 0$.

$2x + y + 1 = 0$ is equation of tangent.

ii midpoint of AB $= \left(\frac{2-1}{2}, \frac{4+1}{2}\right)$



$M = \left(\frac{1}{2}, 2\frac{1}{2}\right)$

gradient of AB $= \left(\frac{y_2 - y_1}{x_2 - x_1}\right)$

$= \frac{4-1}{2+1}$

$= \frac{3}{3}$

$m = 1$

$\therefore$ m of $\ell = 1$ $m_1 = m_2$ for $\parallel$ lines.

$m\left(\frac{1}{2}, \frac{5}{2}\right)$ $m_\ell = 1$

using point grad. frm $\left(\left(\frac{1}{2}, \right.\right.$

$y - \frac{5}{2} = 1\left(x - \frac{1}{2}\right)$

$= y - \frac{5}{2} = x - \frac{1}{2}$

$= 2y - 5 = 2x - 1$

$= 2x - 1 + 5 - 2y$

$= 2x$

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$m = (\frac{1}{2}, \frac{5}{2})$ $m_c = 1$. $((\frac{1}{2},)$

mc must be $x = \frac{1}{2}$ to be vertical.

$((\frac{1}{2},)$ sub $x = \frac{1}{2}$ into $y = x^2$.

$y = (\frac{1}{2})^2$

$y = \frac{1}{4}$.

$C(\frac{1}{2}, \frac{1}{4})$ $m(\frac{1}{2}, \frac{5}{2})$.

using $\frac{y - y_1}{x - x_1} = \frac{y_2 - y_1}{x_2 - x_1}$

$= \frac{y - \frac{1}{4}}{x - \frac{1}{2}} = \frac{\frac{5}{2} - \frac{1}{4}}{\frac{1}{2} - \frac{1}{2}}$.

$= \frac{y - \frac{1}{4}}{x - \frac{1}{2}} = 2\frac{1}{4}$.

$y - \frac{1}{4} = 2\frac{1}{4}(x - \frac{1}{2})$ 7

$y - \frac{1}{4} = \frac{9x}{4} - \frac{9}{8}$.

$y = \frac{9}{4}x - \frac{9}{8} + \frac{1}{4} - \frac{9}{8}$.

$y = \frac{9}{4}x - \frac{7}{8}$.

$8y = \frac{72}{4}x - 7$.

$32y = 72x - 28$

$8y = 18x - 7$.

$= 18x - 8y - 7$. 7

iii $m = -2$.

You may ask for an extra Writing Booklet if you need more space to answer question 7.