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

$\dot{x} = 2\sin 2t + C$

at $t = 0$, $\dot{x} = 1$

$1 = C$

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

ii at rest $v = 0$

$0 = 2\sin 2t + 1$ ↑+

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

$2t = \frac{7\pi}{6}$

$t = \frac{7\pi}{12}$ s

iii. $x = -\frac{1}{2}\cos 2t + t + C$

at $t = 0$

$x = 0$

$0 = C$

$\therefore x = -\frac{1}{2}\cos 2t + t$

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

$\therefore$ at $x = -1$

$m = -2$

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

$y - 1 = -2x - 2$

$2x + y + 1 = 0$

ii. $m(AB) = \frac{4-1}{2+1}$

$= 1$

at $m = 1$

$x = \frac{1}{2}$

at $x = \frac{1}{2}$

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

$\therefore$ C

$(\frac{1}{2}, \frac{1}{4})$

M: $(\frac{2-1}{2}, \frac{4+1}{2})$

M $(\frac{1}{2}, \frac{5}{2})$

$\therefore$ M and C have same x values MC is vertical.

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iii. $MC: x = \frac{1}{2}$

$2x + y + 1$

$y = 0$

$T\left(\frac{1}{2}, 0\right)$

$m_{BT} = \frac{4}{2 - \frac{1}{2}}$

$= \frac{8}{3}$

$y - 4 = \frac{8}{3}(x - 2)$

$3y - 12 = 8x - 16$

BT: $8x - 3y - 4 = 0$

If tangent

$8x - 3x^2 - 4 = 0$ has one solution.

one solution if $\Delta = 0$

~~$\Delta = 64 - 4(-3)(-4)$~~

$3x^2 - 8x + 4 = 0$

$0 = 64 - 4(3)(4)$

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