Start here for Question Number: 7

(a) (i) velocity = $\dot{x}$

acceleration = $\ddot{x}$

∴ acceleration is the derivative of velocity

∴ integrate acceleration to get velocity.

$$\int 4\cos 2t \, dx = \left[\frac{4}{2}\sin 2t + C \right]$$

$$= 2\sin 2t + C.$$

v at $t=0$ is 1.

$$1 = 2\sin 2t + C$$

$$v = 2\sin 2t + 1$$

(ii) when particle is at rest $v = 0$, $\dot{x} = 0$.

$$0 = 2\sin 2t + 1$$

$$-1 = 2\sin 2t$$

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

$$t = 15$$

(ii) displacement = x.

$$\int 2\sin 2t + 1 = -\tfrac{2}{2}\cos 2t + t$$

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

(b) (i) $y = x^2$

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

$y' = -2$.

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

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

$y - 1 = -2x - 2$

~~$y = -2x$~~ $y = -2x - 1$

(ii) grad of $AB = \frac{\Delta y}{\Delta x}$.

$m = \frac{3}{3}$ $m = 1$. sub into $y' = 2x$.

$y = 2x$

$1 = 2x$

$x = 1/2$. C is $(1/2, 1/4)$

midpoint of AB is $\left(\frac{3}{2}, \frac{3}{2}\right)$. $M = (3/2, 3/2)$

Line is vertical if $|m| > 1$.

grad MC $= -5/4 / 2/2$, $m = -5/4$

$|-5/4| > 1$, so MC is vertical

(iii) next page

Additional writing space on back page.

(iii) Find T. where MC and target at A intersect.

A target: $y = -2x - 1$

MC:

grad $= -5/4$.

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

$y - 1/4 = -5/4(x - 1/2)$

$= -5/4x + 5/8$

$y = -5/4x + 7/8$

Simultaneous equation.

$-5/4x + 7/8 = -2x - 1$

$-5/4x + 15/8 = -2x$

$15/8 = -13/4x$

$x = -15/26$. sub into original

$y = -2(-15/26) - 1$

$y = 2/13$.

$T(-15/26, 2/13)$

grad of BT $= \frac{\Delta y}{\Delta x} = \frac{50/13}{119/26} = \frac{100}{119}$

$y' = 2x$

$\frac{100}{119} = 2x$

$x = \frac{50}{119}$.

At $x = \frac{50}{119}$, the target to the curve is line BT

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