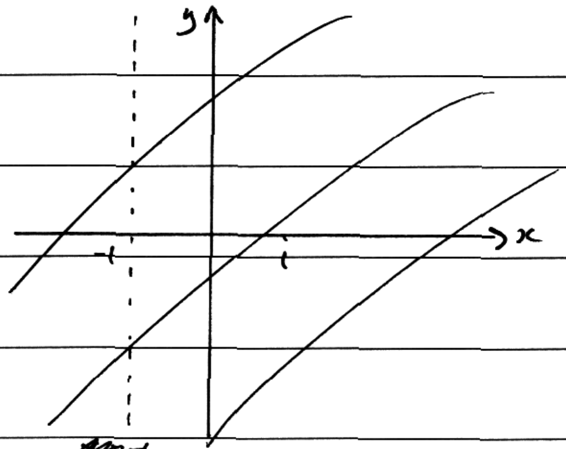
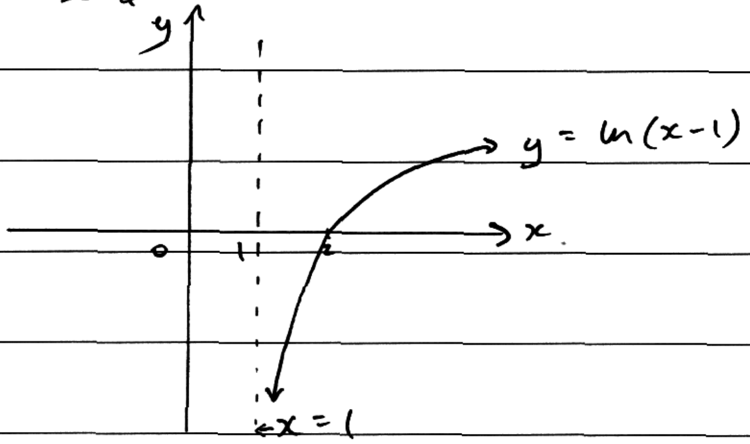
Question 9

(a)



(i)



(ii) $\int_2^4 \ln(x-1)\,dx \doteqdot \frac{h}{3}\left[(y_2+y_4)+2(y_3)+4(0)\right]$

$\doteqdot \frac{1}{3}\left[(0+\ln 3)+2(\ln 2)\right]$

$\doteqdot 0.82830226$ ~~units~~ (by cal.)

(b) $P = 5000$ $r = 1.0875$ $n = 20$

First year $5000(1.0875)^{20}$

Second year $5000(1.0875)^{19}$

Third year $5000(1.0875)^{18}$

⋮

20^{th} year $5000(1.0875)^{1}$

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(b) $\therefore \quad S_{20} = 5000(1.0875)^{20} + 5000(1.0875)^{19} + \ldots + 5000(1.0875)^{1}$

$= 5000\left[(1.0875)^{1} + (1.0875)^{2} + \ldots + (1.0875)^{20}\right]$

Geometric Progression. $a = 1.0875,\ r = 1.0875,\ n = 20$

$\therefore \quad S_{20} = \dfrac{a(r^n - 1)}{r - 1}$

$= \dfrac{1.0875(1.0875^{20} - 1)}{1.0875 - 1}$

$= \dfrac{1.0875(1.0875^{20} - 1)}{0.0875}$

$= \$54.00$

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(c) (i) $v_1 = \frac{v}{t}$

$v_1 = \frac{50}{5}$

$v_1 = 10t$

(ii) $v_1 = 10t$

$x_1 = \int 10t \, dt.$

$= 5t^2 + c.$

at $t=0$, $x_1 = 0$.

$0 = 5(0)^2 + c.$

$\therefore x_1 = 5t^2$

$v_2 = 2t^2$

$x_2 = \int 2t^2 \, dt.$

$= \frac{2}{3}t^3 + c.$

when $t=0$, $x_2 = 0$.

$0 = \frac{2}{3}(0)^3 + c$

$\therefore x_2 = \frac{2}{3}t^3$

at $t=5$: $x_1 = 5(5)^2$

$= 125.$

$x_2 = \frac{2}{3}(5)^3$

$= 83\frac{1}{3}.$

$\therefore$ The jet is $41\frac{2}{3}$ m behind the car.

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(c) (iii) $x_2 = \frac{2}{3}t^3$

$x_1 = 5t^2$

Sub in each other.

$\frac{2}{3}t^3 = 5t^2$

$\frac{2}{3}t^3 - 5t^2 = 0.$

$2t^3 - 15t^2 = 0.$

$t^2(2t - 15) = 0.$

$\therefore\ t = 0$ or $\frac{15}{2}.$

$\therefore$ The jet ~~eathe~~ catches up with the car at $t = \frac{15}{2}$ seconds.