(a) $N = N_0 e^{kt}$

N_0 = number of koalas when $t=0$

$\therefore$ 18 koalas

$\therefore N_0 = 18$

$\therefore N = 18e^{kt}$

When $t = 70$, $N = 5000$

$\therefore 5000 = 18e^{70k}$

$\frac{5000}{18} = e^{70k}$

$\therefore \log_e\left(\frac{5000}{18}\right) = \log_e e^{70k}$

$= 70k \log_e e$

$= 70k$

$\therefore k = \frac{\log_e\left(\frac{5000}{18}\right)}{70}$

$= 0.0803\ldots$ (by calc)

$= 0.08$ (to 2 decimal places)

In 2001, it will be 78 years from 1923.

$\therefore N = 18e^{0.0803\ldots \times 78}$

$= 9511.515\ldots$

$\therefore$ There will be 9511 koalas in november 2001.

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~~(b) (i) $P(A) = \frac{1}{5}$~~

~~(ii) $P(A, B, C, D, E)$~~

~~$= P(A) \times PC$~~

(b) (i) The probability that any card drawn is $\frac{1}{5}$

$\therefore$ the probability of a particular card, in this case

$$A_1 = P(A\tilde{B}\tilde{C}\tilde{D}\tilde{E})$$

$$= \frac{1}{5} \times \frac{4}{5} \times \frac{4}{5} \times \frac{4}{5} \times \frac{4}{5}$$

$$= \frac{256}{3125}$$

(ii) $P(E) = \left(\frac{1}{5} \times \frac{4}{5} \times \frac{4}{5} \times \frac{4}{5} \times \frac{4}{5}\right) \times \left(\frac{1}{5} \times \frac{4}{5} \times \frac{4}{5} \times \frac{4}{5}\right) \times \left(\frac{1}{5} \times \frac{4}{5} \times \frac{4}{5}\right) \times \left(\frac{1}{5} \times \frac{4}{5}\right) \times 1$

$$= \frac{256}{3125} \times \frac{64}{625} \times \frac{16}{125} \times \frac{4}{25} \times 1$$

$$= \frac{1048576}{6103515625}$$

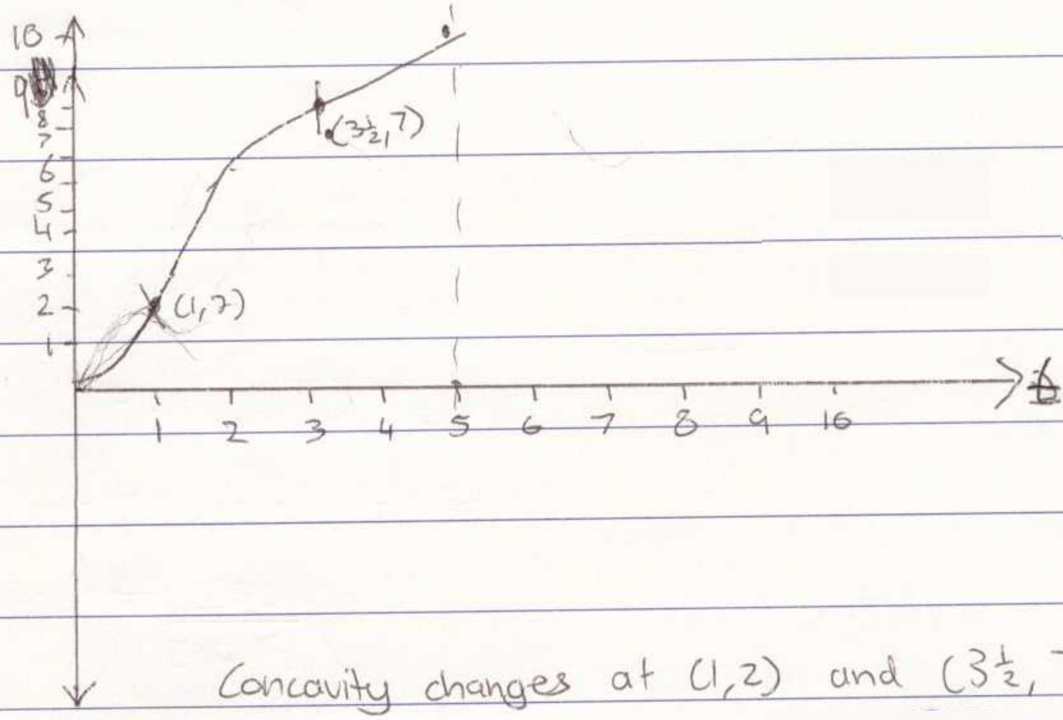
(c) (i) y_1 occurs when $\frac{dy}{dt}$ is a maximum, ie, the velocity is at a maximum.

From the diagram, $y_1 \doteqdot 2$ cm

y_2 occurs when $\frac{dy}{dt}$ is a minimum, ie, the velocity is at a minimum.

From the diagram, $y_2 \doteq 7$ cm

(ii)



Concavity changes at (1, 2) and $(3\frac{1}{2}, 7)$