2.53

$$x(t) = 3t - 4t^2 + t^3$$

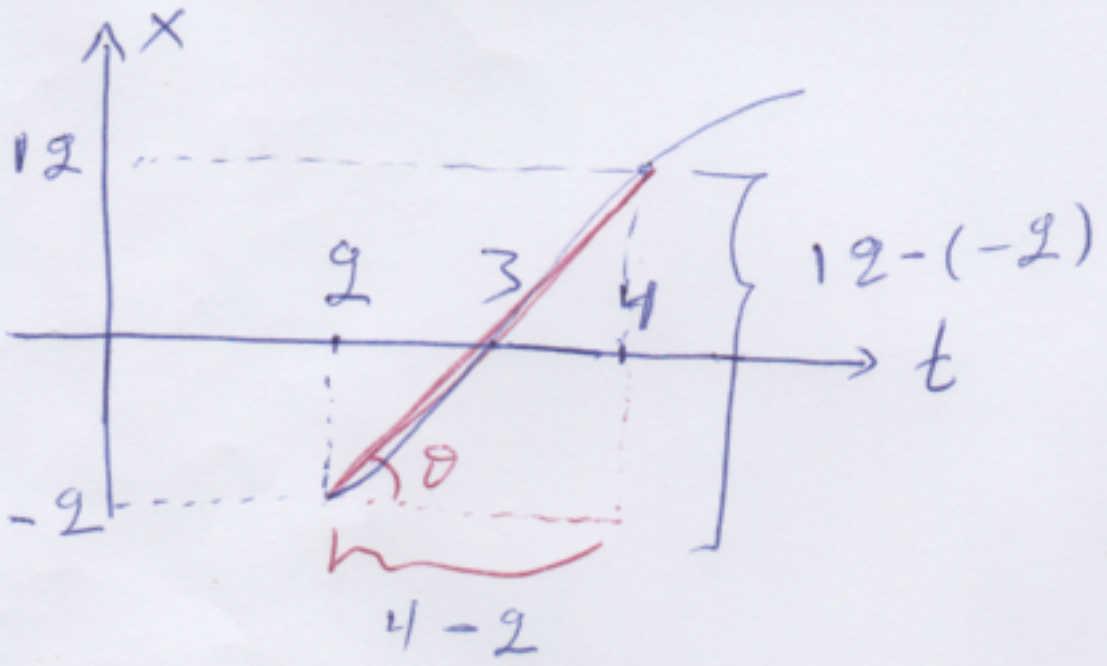
a) $x(1) = 3 - 4 + 1 = 0$
$x(2) = 6 - 4 \cdot 4 + 8 = -2$
$x(3) = 9 - 4 \cdot 9 + 3 \cdot 9 = 0$
$x(4) = 12 - 4 \cdot 16 + 4 \cdot 16 = 12$

β) Μετατόπιση
$t=0 \rightarrow t=4s$
$\Delta x = x(4) - x(0) = 12\ m$

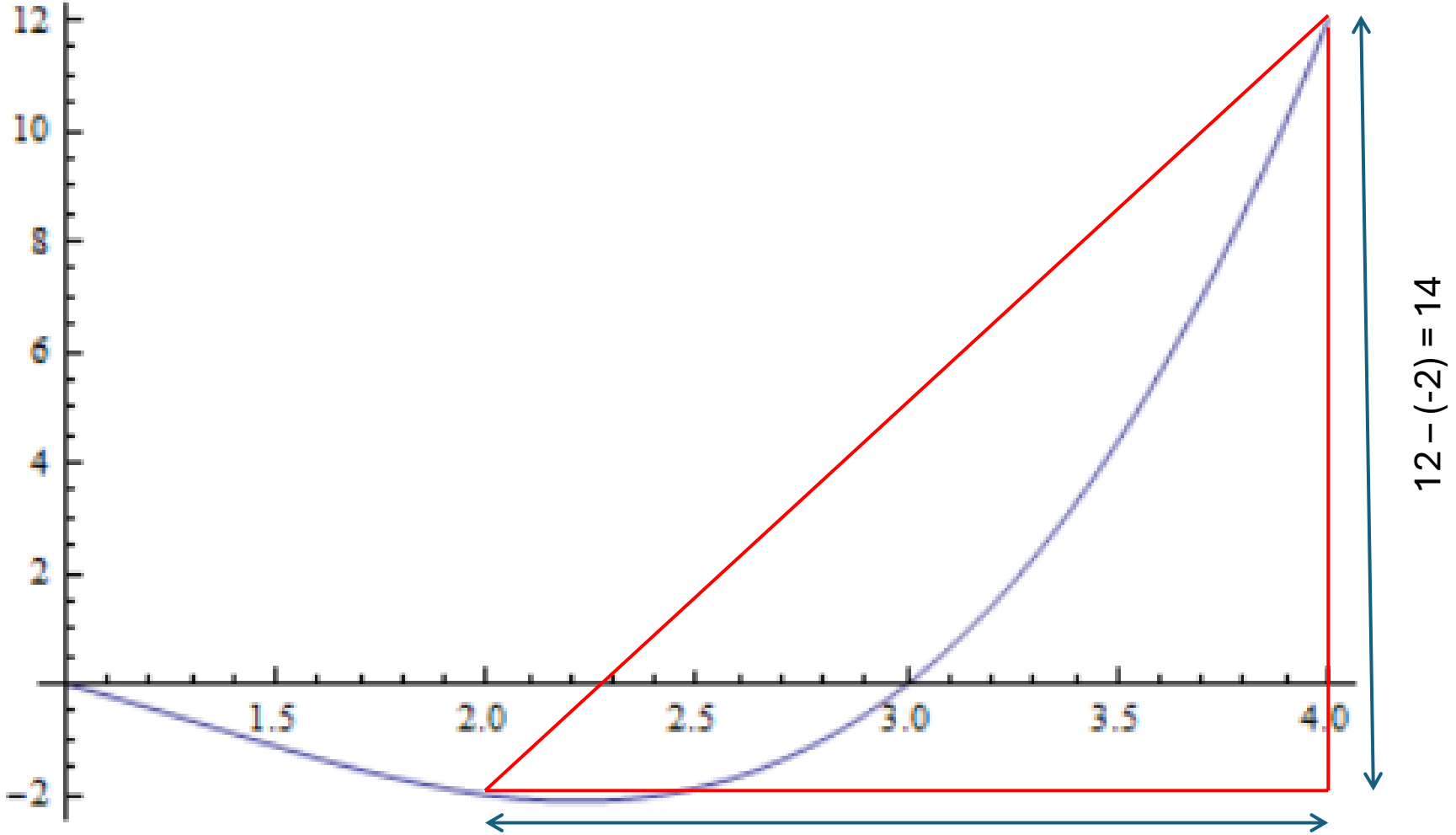
γ) Μέση ταχύτητα
$t=2s \rightarrow t=4s$

$$u_{avg} = \frac{\Delta x}{\Delta t} = \frac{x(4) - x(2)}{4 - 2} = \frac{14}{2} = 7$$

δ)



$$\tan\theta = \frac{14}{2} = 7$$



$\lambda = 14/2 = 7$

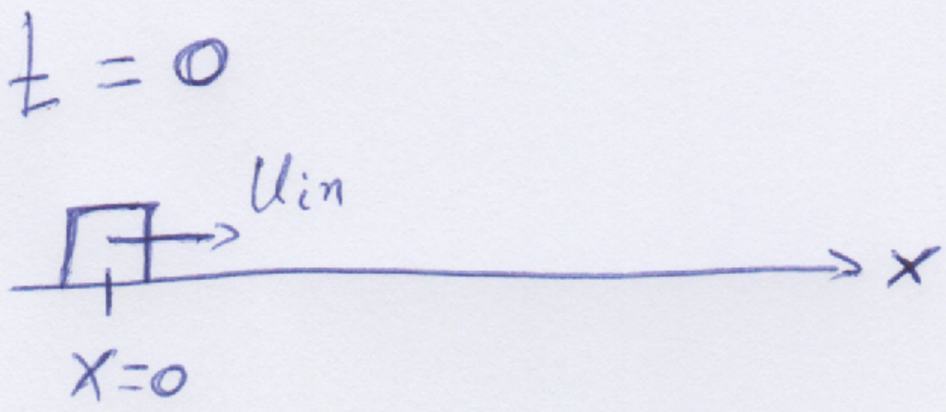
2.54

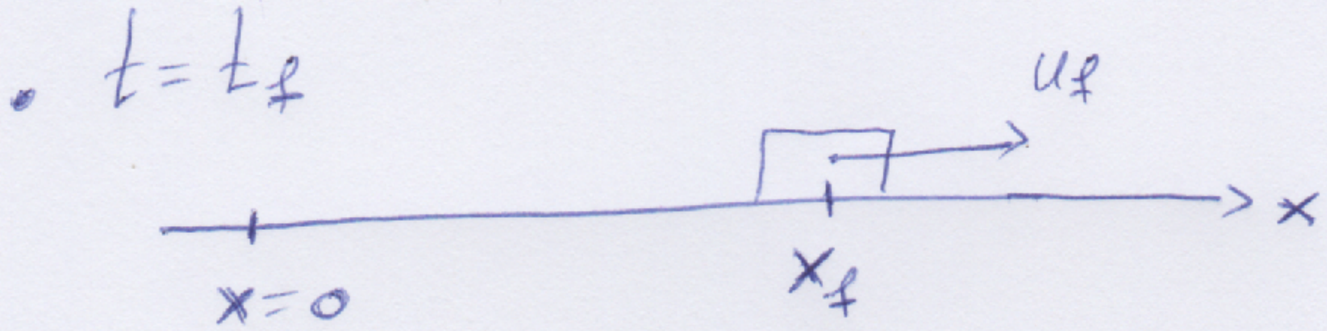
$u_{in} = 2 \times 10^4 \, m/s \longrightarrow u_f = 6 \times 10^6 \, m/s$

$\Delta x = 1.5 \, cm$

a) $\Delta t = ?$

b) $a = ?$





Ε.Ο.Ε.Κ :

$$x_f = x_{in} + u_{in} t + \frac{1}{2} a t^2 \quad , \quad (1)$$

$$u_f = u_{in} + a t \quad , \quad (2)$$

Γνωρίζω : u_{in}, u_f και $x_f - x_{in} = \Delta x$

Άρα: $1.5 \times 10^{-2} = 2 \times 10^4 t + \frac{1}{2} a t^2$, (1)

$6 \times 10^6 = 2 \times 10^4 + a t$, (2)

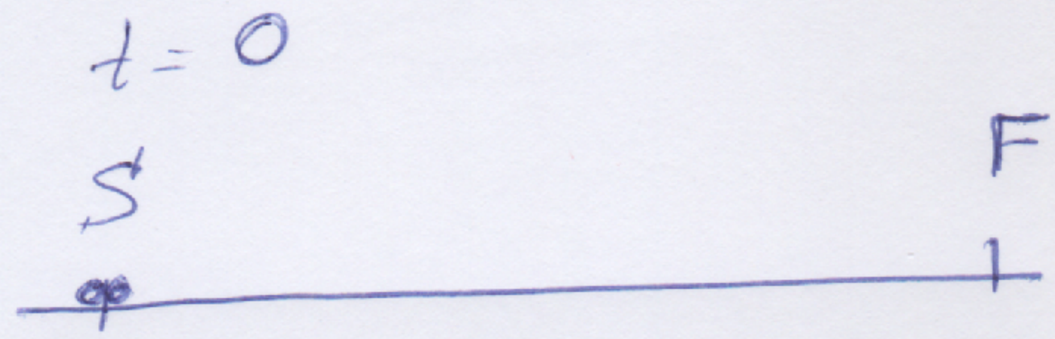
2.51

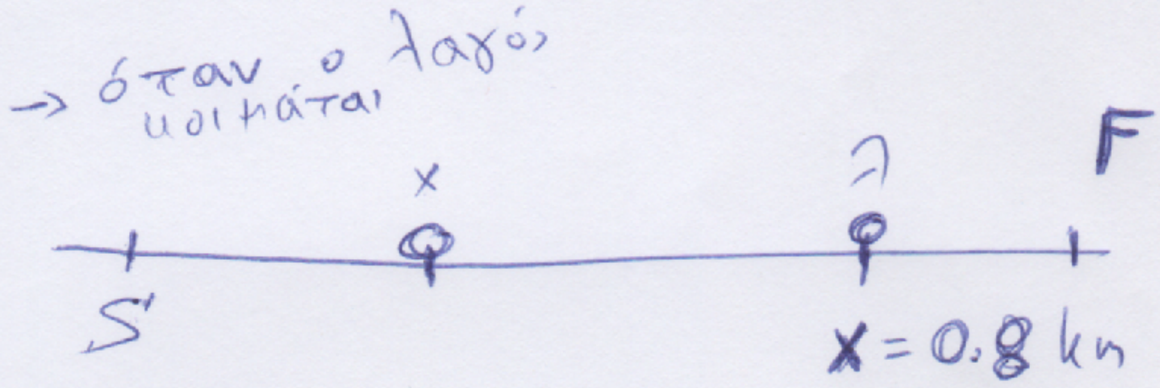
$S = 1\,km$

$u_x = 0.2\ m/s$

$u_\lambda = 8\ m/s$

$x_{t_\lambda} = 0.8\ km$
(ύπνος)

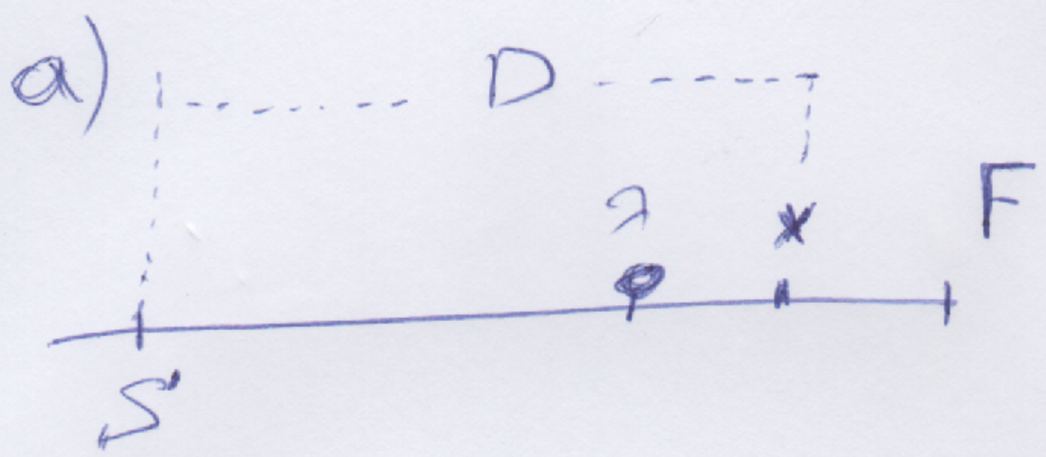




Ζητούμενα

α) $x_{t_x} = ?$ όταν ξυπνάει ο λαγός

β) $t_{ύπνου} = ?$



$$u_{x-\lambda} = \frac{1000 - D}{t}$$

$$u_\lambda = \frac{1000 - 800}{t}$$

$\div$ =>

$$\Rightarrow \frac{0.2}{8} = \frac{1000 - D}{200} \Rightarrow \underline{D = 995\ m}$$

β) $u_\lambda = \frac{800}{t_\lambda} \Rightarrow t_\lambda = 100\ s$

$$u_x = \frac{995}{t_x} \Rightarrow t_x = 4975\ sec$$

$$t_{ύπνου} = t_x - t_\lambda = \underline{4875\ sec}$$

Παρατηρώ ότι ο παράγοντας
at υπάρχει και στις δύο εξισώσεις.

Θέτω $\xi = at$

Άρα $(2) \xrightarrow{\xi} 6\times10^{6} = 2\times10^{4} + \xi \Rightarrow$

$\Rightarrow \xi = 5.98\times10^{6}$

$\Rightarrow$ Άρα $(1) \xrightarrow{\xi} 1.5\times10^{-2} = 2\times10^{4}t + \frac{5.98\times10^{6}}{2}t \Rightarrow$

$\Rightarrow \boxed{t \approx 4.98\times10^{-9}\ s}$

άρα $\xi = at \Rightarrow a = \frac{5.98\times10^{6}}{4.98\times10^{-9}} \approx 1.2\times10^{15}\ \frac{m}{s^2}$

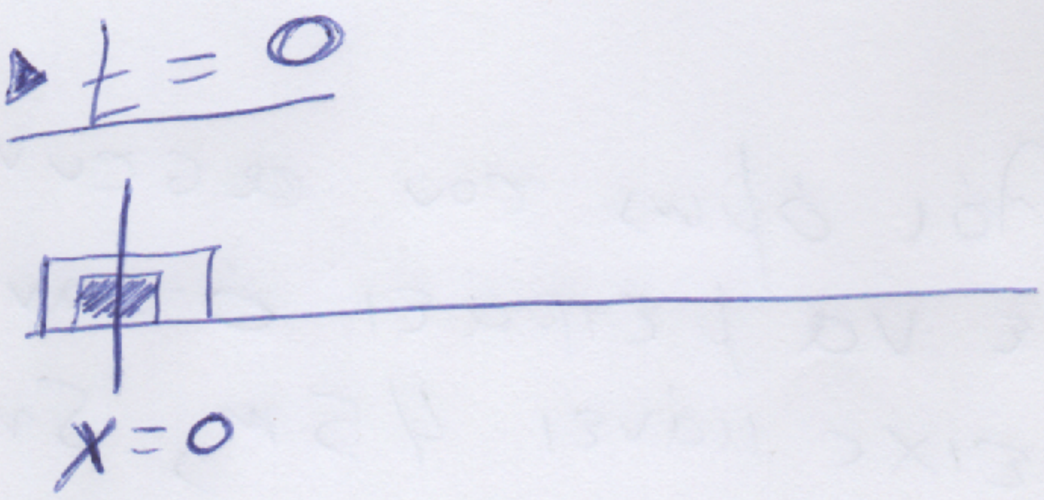
2.50

$u_{in} = 45\ m/s$

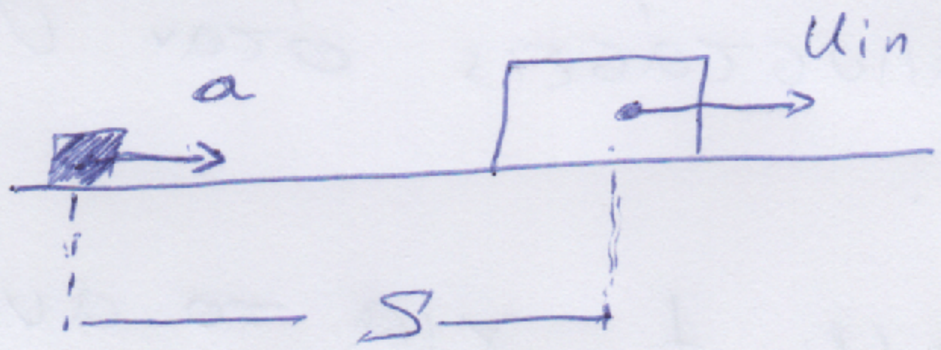
$t_{\varepsilon\kappa} = 1\ s$

$a = 3\ m/s$

$t_f = ?$



$t = t_{\varepsilon\kappa} = 1\ sec$



Το αυτοκίνητο εκτελεί ΕΟΚ.

άρα $u_{in} = \frac{\Delta x}{\Delta t}$. Σε χρόνο

1 s έκανε απόσταση $S = u_{in} \cdot 1\ s = 4{,}5\ m$

Ο αστυνομικός κάνει Ε.Ο.Ε.Κ.

$x_{f_A} = x_{o_A} + u_{in_A} t + \frac{1}{2} a t^2$

$u_{f_A} = u_{in_A} + a t$

όμως $u_{in_A} = 0$ και $x_{in_A} = 0$

Άρα:

$$x_{f_A} = \frac{1}{2} a t^2$$

Το ρολόι όμως του αστυνομικού ξεκίνησε να μετράει όταν το αμάξι είχε κάνει 45m, δηλαδή μετά από 1 sec.

Άρα οι αποστάσεις όταν θα συναντηθούν:

$x_f = x_0 + u_{in} t$ για το αυτοκίνητο που εκτελεί ΕΟΚ

$x_{f_A} = \frac{1}{2} a t^2$ για το περιπολικό που εκτελεί ΕΟΚΑ

Θέλουμε: $x_f = x_{f_A} \Leftrightarrow$

$\Leftrightarrow 45 + 45t = \frac{3}{2} t^2 \Rightarrow$

$\Rightarrow t = \begin{cases} \approx 31 \text{ s} \\ -0.91 \text{ s} \end{cases}$

Όπου φυσικά $t > 0$ άρα $t \approx 31$ s

2.55

$limit = 90$ km/h

$u = 137$ km/h

$a = -5.2$ m/s²

a) $t_{137 \to 90} = ?$

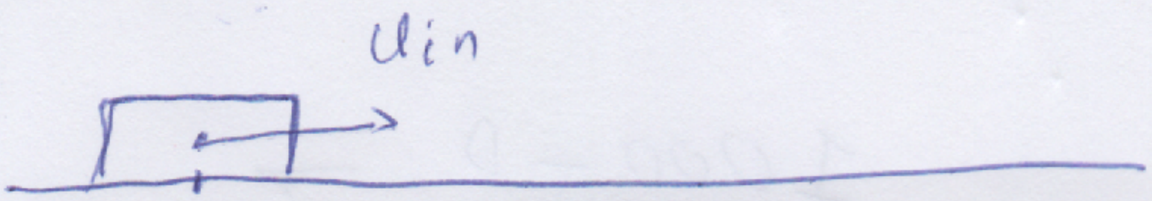
b) $u(t), x(t)$

Μετατροπή μονάδων:

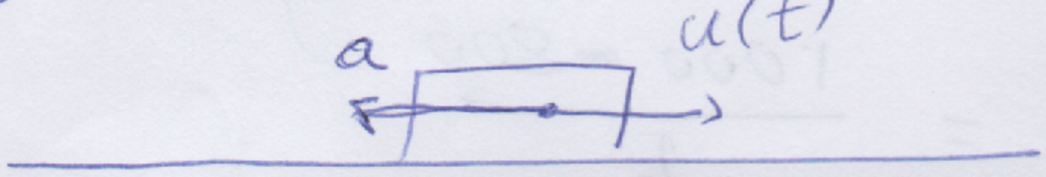
$limit = 90 \frac{1000}{3600} \frac{m}{s} \simeq 25 \frac{m}{s}$

$u = 137 \frac{1000}{3600} \frac{m}{s} \simeq 38.1 \frac{m}{s}$

• $t = 0$



• $0 < t < t_{137 \to 90}$



• $t = t_{137 \to 90}$



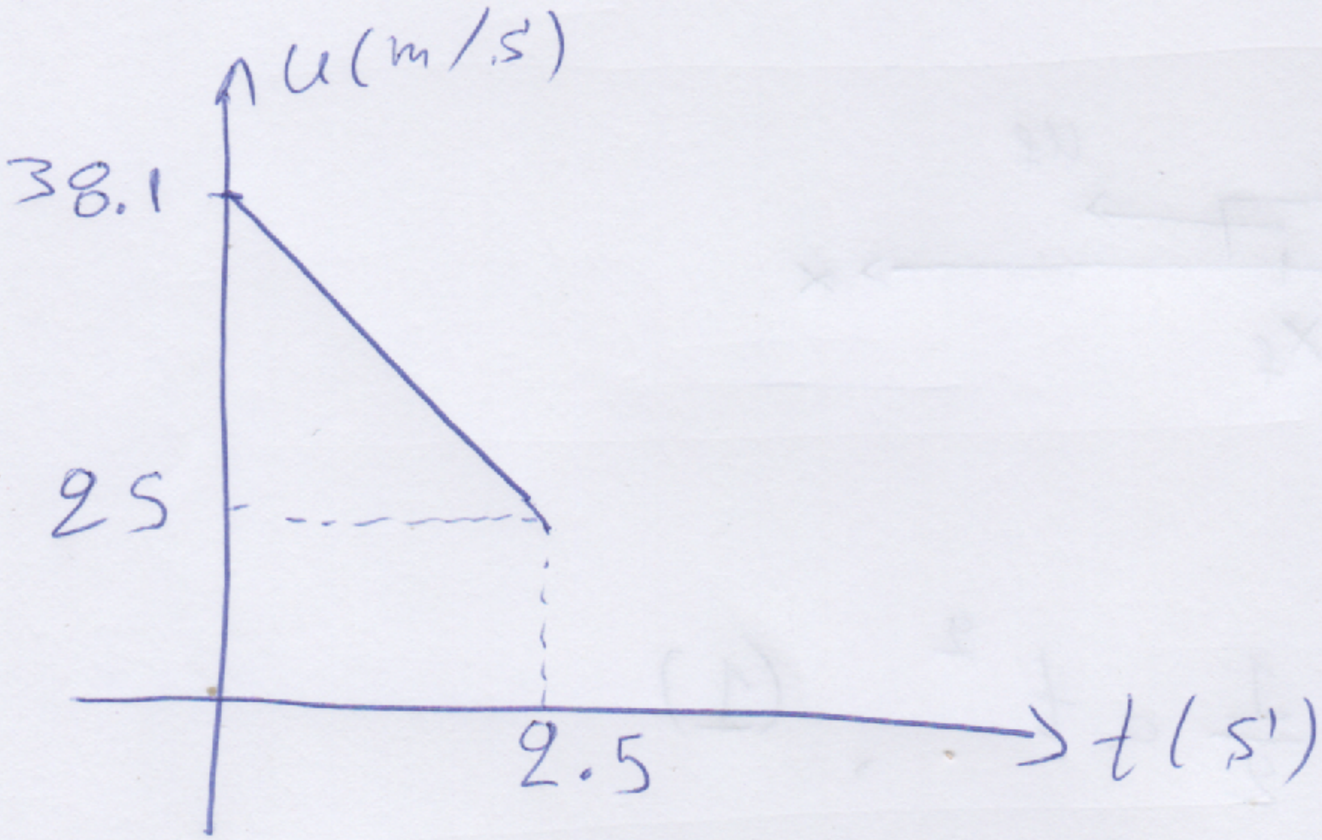
ΕΟΕ ειδ. κ.

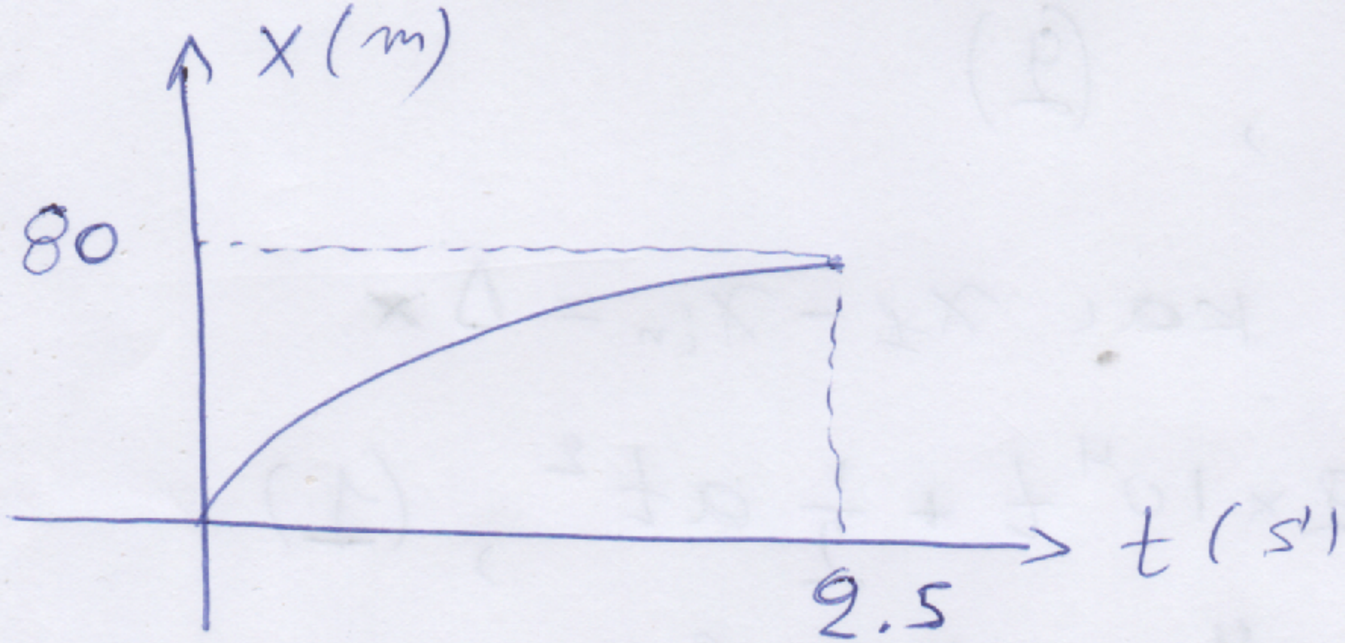
$u_f = u_{in} - at \Rightarrow$

$\Rightarrow 25 = 38.1 - 5.2t \Rightarrow t \simeq 2.5$ s

$$x_f = x_{in} + u_{in} t - \frac{1}{2} a t^2 \Leftrightarrow$$

$$\Leftrightarrow \Delta x = 38.1 \times 2.5 - \frac{5.2}{2} (2.5)^2 \approx 80 \text{ m}$$


u(m/s)
38.1
25
2.5
t(s)


x(m)
80
2.5
t(s)