Ex:
A truck starts from rest and moves with cons. acc^{n} of 5 m/s^2. Find its speed and the distance traveled after 4 s has elapsed

Sol:

$v_f = v_0 + at$; $v_0 = 0$, $a = 5\ m/s^2$ $t = 4\ sec$

$= 0 + 5 \times 4$

$= 20\ m/s$

$x = v_0 t + \frac{1}{2} a t^2$

$= 0 + \frac{1}{2} \times 5 \times 4^2$

$= 40\ m$

Ex: A car is accelerating uniformly as it passes two checkpoints that are 30 m apart The time taken between checkpoints is 4.0 sec and the car's speed at the first checkpoint is 5.0 m/sec. Find the car's acc^{n} and its speed at the second checkpoint.

Sol:

Calling the first checkpoint the initial position and the second = the final position, we have, $v_0 = 5$ m/sec, $x = 30$ m, $t = 4$ sec to find a we use: $x = v_0 t + \frac{1}{2} a t^2$

$30 = 5 \times 4 + \frac{1}{2} a \times (4)^2$

$30 - 20 = 8a$

$a = \frac{10}{8} = 1.25\ m/sec^2$

$v_f = v_0 + at = 5 + (1.25)(4) = 10$ m/sec

Ex: A particle is moving on a straight line according to the equ$^{n.}$ $x = \sqrt{2kt + x_0^2}$. at $t = 0$

1) prove that $v = \frac{k}{x_0}$ at $t = 0$

2) prove that acc$^{n.}$ $= \frac{-k^2}{x_0^3}$

Sol.

1) $x = \sqrt{2kt + x_0^2} = (2kt + x_0^2)^{1/2}$

$$v = \frac{dx}{dt} = \frac{1}{2}(2kt + x_0^2)^{-1/2} \cdot 2k$$

$$= k(2kt + x_0^2)^{-1/2} \text{ at } t=0 \quad \boxed{v = \frac{k}{x_0}}$$

2) $a = \frac{dv}{dt} = k\left(-\frac{1}{2}\right)(2kt + x_0^2)^{-3/2} \cdot (2k)$

$$= -\frac{k^2}{(2kt + x_0^2)^{3/2}} \text{ at } t=0 \text{ then}$$

$$\boxed{a = -\frac{k^2}{x_0^3}}$$

Ex. H.W.

A train starts from rest and moved with cons. acc$^{n.}$ At one time it was traveling at 33 m/sec, and 160 m farther on it was traveling at 54 m/sec Calculate a- the acc$^{n.}$,

b- the time required to travel 160 m

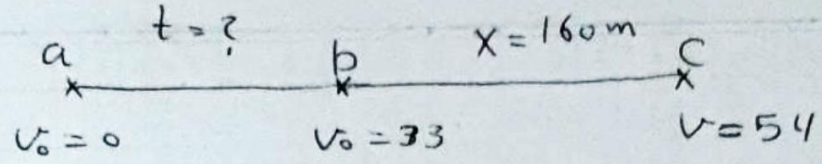
c- the time required to attain the speed of 33 m/sec

d- the distance moved from rest to the time the train had a speed of 33 m/sec

تحرك قطار من السكون وبتعجيل ثابت. في البداية قطع مسافة بسرعة ٢٤/٥ م/ث وبعد ١٦٠ م من سرعته هذه اصبحت سرعته ٥٤ م/ث

Cont.
sec,
54 m/sec

Sol.



from b ⟶ c

a) $v_0 = 33$ m/sec $v = 54$ m/sec $x = 160$m

$v^2 = v_0^2 + 2ax$

$(54)^2 = (33)^2 + 2a(160)$

$a = 5.71$ m/sec^2

b) from b ⟶ c

$v = v_0 + at$

$54 = 33 + 5.71t \Rightarrow t = 3.68$ sec

c) $v = v_0 + at$ from a ⟶ b

$33 = 0 + 5.71t \Rightarrow t = 5.78$ sec

d) $x = v_0 t + \frac{1}{2} a t^2$ from a ⟶ b

$= 0 + \frac{1}{2} \times 5.71 (5.78)^2$

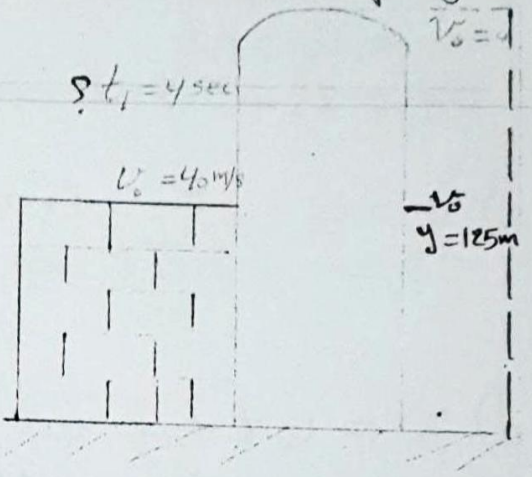
$x = 95.4$ m

* H.w.

Ex: A projectile is fired straight up from the top of building at an initial velocity of 40 m/sec. The top of building is 45 m above the ground.

a) find the maximum height of the projectile
b) find the time for the projectile to reach the max. height.
c) find the velocity of the projectile as it strikes the ground.
d) what is the total time that the project is in air.

Sol.



(a) when the projectile reaches to max. height $v_2 = 0$

$$v_2^2 = v_0^2 + 2gy$$
$$0 = (40)^2 + 2 \times 10 y$$
$$y = \frac{1600}{20} = 80 m$$

$$\boxed{y = 80 + 45 = 125 m}$$

(b) $v_2 = v_0 + gt \Rightarrow 0 = 40 - 10t \Rightarrow \boxed{t = 4 \text{ sec}}$

$v_2 = v_0 + 2gy$ (o)

$v_2^2 = 0 + 2 \times 10 \times 125 = 2500$

$v_2^2 = 2500$

$v_2 = 50$ m/sec

d) $v_2 = v_0 + gt$

$50 = 0 + 10t$

$t = \frac{50}{10} = 5$ sec

total time $= 4 + 5 = 9$ sec

~~Ex 2 Page 49~~

problem

*Ex: The acc$^{n.}$ of a body moving on the x-axis is given by $a = 2 + 6x$ where (a) is in cm/sec^2 and (x) in cm. The velocity of the body is 10 cm/sec at the point $x = 0$.
Find the velocity of the body at any position.

$$a = \frac{dv}{dt} = \frac{dv}{dx} \cdot \frac{dx}{dt} = v \frac{dv}{dx}$$

$$a = 2 + 6x$$

$$v \frac{dv}{dx} = 2 + 6x$$

$$\int v\,dv = 2\int dx + 6\int x\,dx$$

$$\left[\frac{v^2}{2} = 2x + 6x^2/2 + c\right] \times 2$$

$$v^2 = 4x + 6x^2 + 2c$$

where $x = 0$, $v = 10$

$$10^2 = 0 + 0 + 2c \Rightarrow c = 50$$

$$v^2 = 4x + 6x^2 + 100$$

$$v = \sqrt{4x + 6x^2 + 100}$$

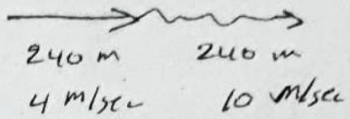
problems page 52 Physics Part 1

(1) Compare your average speed in the following 4 cases. (a) you walk 240 m at a speed of 4.0 m/sec and then run 240 m at a speed of 10 along a straight track.

(b) you walk for 1.0 min at a speed of 4.0 m/sec and then run for 1.0 min at 10 m/se along a st.

a) time required for walk

$= \frac{240}{4} = 60$ sec



time required for run

$= \frac{240}{10} = 24$ sec

Total time $= 60 + 24 = 84$ sec

speed $\Rightarrow \bar{v} = \frac{240+240}{84} = 5.7$ m/sec

b) The displacement $= 4 \times 60 + 10 \times 60$

$= 240 + 600$

$= 840$ m

the time $= 60 + 60 = 120$ sec

$\therefore$ speed $\bar{v} = \frac{840}{120} = 7$ m/sec

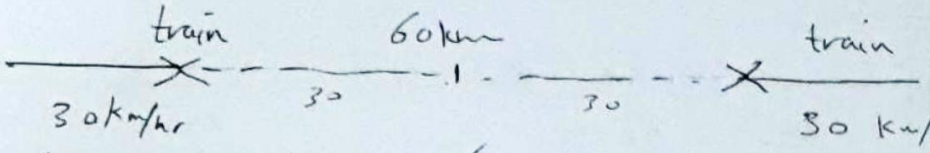
OR

لأن السرعة في الحالتين قطعت في نفس الزمن = 60 ثانية

average speed $\bar{v} = \frac{v_1 + v_2}{2} = \frac{10+4}{2} = 7$ m/sec

السؤال الثاني
اكتوبر خاطئ

(3) Two trains each having a speed of 30 km/hr are headed at each other on the same straight tra A bird that can fly 60 km/hr flies off one tra when they are 60 km apart and heads directly for the other train. On reaching the other tra it flies directly back to the first train and s. forth.



each train walk at $\frac{60}{2} = 30$ km

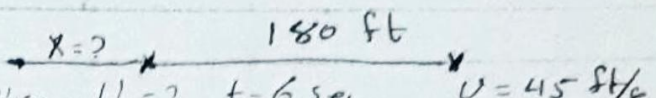
Total time of the trip = $\frac{30 \text{ km}}{30 \text{ km/hr}} = 1 \text{ hr}$

Distance of the Bird = vt = 60 km/hr x 1 hr
= 60 km.

prob 16 p.54

A car moving with const. acc^{n} covers the distance between two points 180 ft apart in 6.0 sec. Its speed as it passes the second points is 45 ft/sec.

a) What is its speed at the first point?
b) what is its acc^{n} ?
c) At what prior distance from the first point was the car at rest ?



a) $v = v_0 + at$

$45 = v_0 + 6a$

$$a = \frac{45 - v_0}{6} \quad \text{----} (1)$$

$$x = v_0 t + \frac{1}{2} a t^2$$

$$180 = 6v_0 + \frac{1}{2}\left(\frac{45 - v_0}{6}\right) 36$$

$$180 = 6v_0 + 3(45 - v_0)$$

$$180 = 6v_0 + 135 - 3v_0$$

$$180 - 135 = 3v_0$$

$$v_0 = \frac{180 - 135}{3} = \frac{45}{3} = 15 \text{ ft/sec}$$

b) from eqn. (1)

$$a = \frac{45 - 15}{6} = \frac{30}{6} = 5 \text{ ft/sec}^2$$

c) $v^2 = v_0^2 + 2ax$

$(15)^2 = 0 + 2(5)(x)$

$225 = 10x$

$\therefore x = 22.5 \sim 23$ ft

Ex

A ball dropped from a bridge strikes the water in 5 sec. Calculate (a) the speed with which it strickes (b) the height of the bridge

Sol.

(a) $v_f = v_0 + gt$

$= 0 + 9.8 \times 5$

$= 49$ m/sec

(b)

$y = v_0 t + \frac{1}{2} g t^2$

$= 0 + \frac{1}{2}(9.8)(5)^2$

$= 123$ m

prob 19 page 54

a) With what speed must a ball be thrown vertically upward in order to rise to a height of 50 ft ?

b) How long will it be in the air?

a) $v^2 = v_0^2 - 2gy$

$0 = v_0^2 - 2(32)(50)$

$v_0^2 = 3200$

$v_0 = \sqrt{3200} = 56.5 \simeq 57$ ft/sec

b) $v = v_0 - gt$

$0 = 57 - 32t$

$t = \frac{57}{32} = 1.78 \sim 1.8$ sec

All time $= 1.8 \times 2 = 3.6$ sec

Ex

A body falls freely from rest. Find (a) the distance it falls in 3 sec. (b) its speed after falling 70 m (c) the time required to reach a speed of 25 m/sec d) the time taken to fall 300 m.

Sol.

(a) $y = v_0 t + \frac{1}{2} g t^2$

$= 0 + \frac{1}{2} 9.8 (3)^2$

$y = 44 m$

(b) $v_f^2 = v_0^2 + 2gy$

$= 0 + 2 \times 9.8 \times 70$

$v_f^2 = 1372 \ m^2/sec^2$

$v_f = 37 \ m/sec$

(c) $v_f = v_0 + gt$

$25 = 0 + 9.8t$

$t = 2.55 \ sec$

(d) $y = v_0 t + \frac{1}{2} g t^2$

$300 = 0 + \frac{1}{2} \times 9.8 \times t^2$

$t = 7.8 \ sec$