BOARD OF STUDIES
NEW SOUTH WALES

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Kinematics Worksheet 3 – Eqns. of Uniformly Accelerated Motion

1. $u = 0\ ms^{-1}$, $V = 5\ ms^{-1}$, $t = 2\ s$

From $V = u + at$

$$\therefore a = \frac{V-u}{t} = \frac{5-0}{2} = 2.5\ ms^{-2}$$

∴ Acceleration of car is $2.5\ ms^{-2}$ in direction of motion.

2. $a = -9.8\ ms^{-2}$ ↑ $u = 250\ ms^{-1}$, upwards

← gun barrel

$V = 0$ at max. height

Note: As a and u are in opposite directions, one must be made negative. a is down, so let it be -ve.

From $V^2 = u^2 + 2as$

$$\therefore s = \frac{V^2-u^2}{2a} = \frac{0^2-(250)^2}{-2\times 9.8} = 3188.8\ m$$

∴ Height reached is 3189 m. (3.189 km)

3. $u = 27\ ms^{-1}$, $t = 5\ s$, $a = -4\ ms^{-2}$, $s = ?$, $V = ?$

From $s = ut + \frac{1}{2}at^2$

$$= (27\times 5) - \tfrac{1}{2}\times 4\times 5^2$$

$$= 85\ m$$

3. Cont.) From either $V = u + at$ or $V^2 = u^2 + 2as$ we can find V.

$\therefore V = u + at$

$= 27 - (4 \times 5)$

$= 7 \text{ ms}^{-1}$

$\therefore$ Distance travelled while braking $= 85$ m and final velocity $= 7 \text{ ms}^{-1}$ in direction of original motion.

4. (a) At $t = 2.5$ s, gravity produces the acceleration, so

$a = -9.8 \text{ ms}^{-2}$, $u = 0 \text{ ms}^{-1}$

From $s = ut + \frac{1}{2}at^2$

we have $s = (0 \times t) - \frac{1}{2} \times 9.8 \times 2.5^2$

$= \underline{30.625 \text{ m}}$

So, building is 30.6 m tall.

(b) Since mass is NOT a parameter in the relevant equation, $s = ut + \frac{1}{2}at^2$, a stone twice as heavy will take same time to fall. $\therefore$ Time of fall $= \underline{2.5 \text{ s}}$.

5. (a) $u = 20 \text{ ms}^{-1}$, $V = 40 \text{ ms}^{-1}$, $t = 5$ s, $V_{av} = \frac{u+V}{2} = \frac{20+40}{2}$

$= \underline{30 \text{ ms}^{-1}}$

(b) From $v = u + at$, $a = \frac{v-u}{t} = \frac{40-20}{5} = \underline{4\ ms^{-2}}$

(c) From $V_{av} = \frac{\Delta s}{\Delta t}$, $\Delta s = V_{av} \times \Delta t$

$= 30 \times 5$

$= \underline{150\ m}$

6. $u = 2\ ms^{-1}$, $a = 4\ ms^{-2}$, $s = 12\ m$, $t = ?$

From $s = ut + \frac{1}{2}at^2$

$12 = 2t + \frac{1}{2} \times 4 \times t^2$

$\therefore 6 = t + t^2$

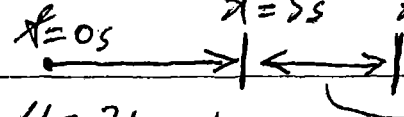
$\therefore t^2 + t - 6 = 0$

$(t-2)(t+3) = 0$

$\therefore t = 2$ or -3

As time is always +ve, time taken is $\underline{2\ s}$.

7.



Let's write two equations for displacement, one for displacement at $t = 5$ and the other for displacement at $t = 6$. The difference between S_6 and S_5 is 54 cm.

$S_5 = 21 \times 5 + \frac{1}{2} a \times 5^2$

So, $S_5 = 105 + 12.5a$ — (1)

$S_6 = 21 \times 6 + \frac{1}{2} a \times 6^2$

So, $S_6 = 126 + 18a$ — (2)

Now eqn (2) − eqn (1):

$S_6 - S_5 = (126 - 105) + (18a - 12.5a)$

and $S_6 - S_5 = 54$ cm

So, $54 = 21 + 5.5a$

$\therefore a = 6 \text{ cms}^{-2}$

Acceleration of particle is 6 cms^{-2}.

Note: Clearly, mathematics is very important in Physics.