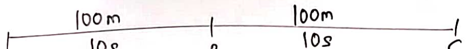
Thursday
20-6-24

* The early bird catches the worm *

Sub:-

Uniform Motion.



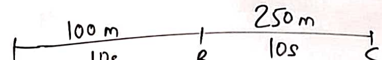
For A to B:

$$\text{Speed} = \frac{100\,m}{10\,s} = 10\ m/s$$

For B to C

$$\text{Speed} = \frac{100\,m}{10\,s} = 10\ m/s$$

Non uniform Motion.



For A to B:

$$\text{Speed} = \frac{100\,m}{10\,s} = 10\ m/s$$

For B to C

$$\text{Speed} = \frac{250\,m}{10\,s} = 25\ m/s$$

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Sub:-

Acceleration (a)

- A: 0 m/s, 0 s
- B: +20 m/s, 10 s
- C: +20 m/s, 20 s
- D: +10 m/s, 30 s

① For A to B

$a = \frac{+20 - 0}{10\,s}$

$= \frac{+20\,m/s}{10\,s}$

$\boxed{a = +2\,m/s^2}$

metre per second square.

② For B to C

$a = \frac{+20 - 20}{10\,s}$

$a = \frac{0\,m/s}{10\,s}$

$\boxed{a = 0\,m/s^2}$

③ For C to D

$a = \frac{+10 - 20}{10\,s}$

$a = \frac{-10\,m/s}{10\,s}$

$\boxed{a = -1\,m/s^2}$

Acceleration = $\frac{\text{change in velocity}}{\text{Time}}$

$= \frac{\text{final velocity }(v) - \text{initial velocity }(u)}{\text{Time }(t)}$

$\boxed{a = \frac{v - u}{t}}$

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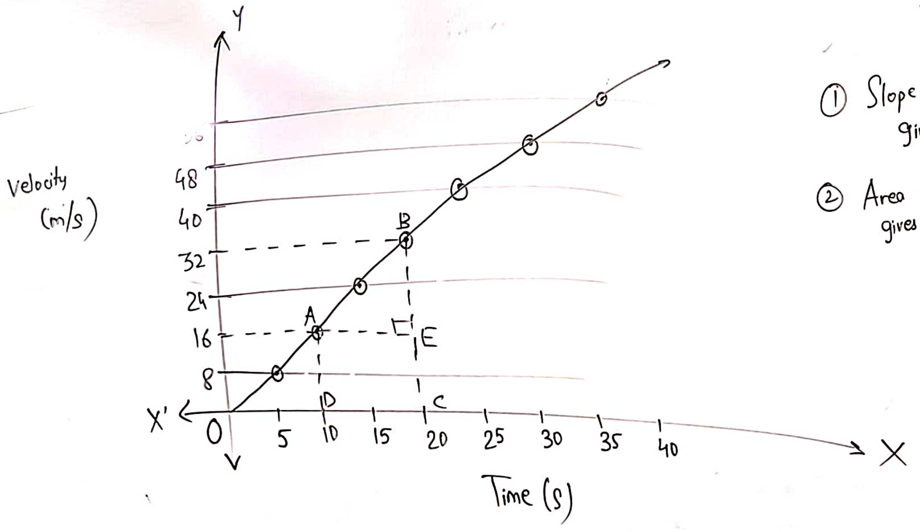
Sub:-



① Slope of v–t graph gives acceleration

② Area under v–t graph gives displacement

Slope : A to B	$A(\square ADCB) = A(\triangle AEB) + A(\square ADCE)$
$a = \frac{+32 - 16}{10}$	Average velocity (V_{avg})
$a = \frac{+16}{10}$	$V_{avg} = \frac{U+V}{2}$
$\boxed{a = +1.6\ m/s^2}$	$= \frac{16+32}{2} = \frac{48}{2} = \boxed{24\ m/s}$

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Sub:-

Equations of motion.

u = Initial velocity

v = Final velocity

s = displacement

a = acceleration

t = time

① $v = u + at$

② $s = ut + \frac{1}{2}at^2$

③ $v^2 = u^2 + 2as$.

1] Derivation for $v = u + at$.

initial velocity $= u = OD$

final velocity $= OC$

Time $= t = OE$

$$a = \frac{\text{final velocity} - \text{initial velocity}}{\text{time}}$$

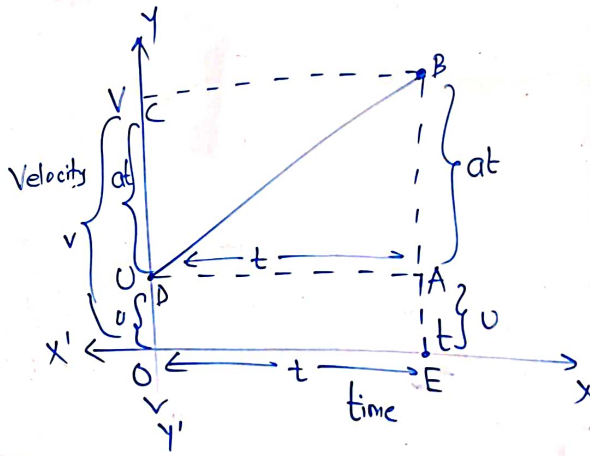
$$a = \frac{v - u}{t}$$

$$a = \frac{OC - OD}{t}$$

We know that $\boxed{OC - OD = CD.}$

$$a = \frac{CD}{t}$$

$\boxed{CD = at}$ — (1)



$OC = OD + CD$ (O-D-C)

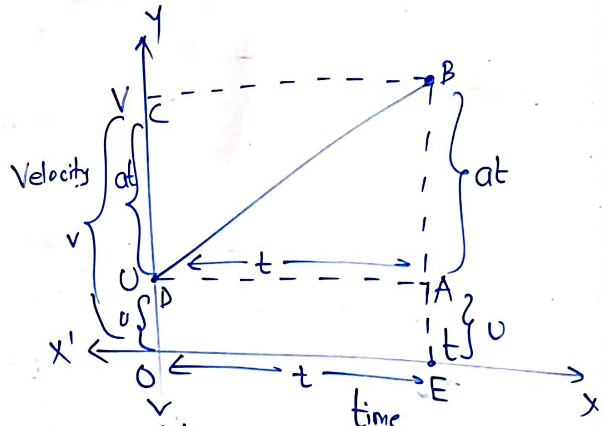
$\boxed{v = u + at}$

2] Derivation for $s = ut + \frac{1}{2}at^2$

initial velocity $= u = OD$

final velocity $= v \ldots OC$

Time $= t = OE$



Displacement $= s = A(\square DOEB) = A(\square DOEA) + A(\Delta DAB)$

$s = (l \times b) + \left(\frac{1}{2} \times b \times h\right)$

$s = (OE \times OD) + \left(\frac{1}{2} \times DA \times AB\right)$

$s = (t \times u) + \left(\frac{1}{2} \times t \times at\right)$

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

3) Derivation for $v^2 = u^2 + 2as$.

Initial velocity $= u = OD$

final velocity $= v = OC$

Time $= t = OE$

s = displacement = Area of trapezium DOEB

$s = \frac{1}{2} \times$ sum of length of parallel sides $\times$ height.

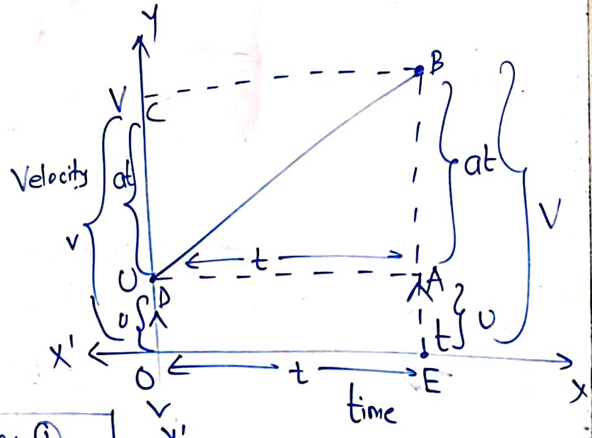
$s = \frac{1}{2} \times (OD + EB) \times OE$

$s = \frac{1}{2} \times (u + v) \times t$ — (1)

We know that,

$a = \frac{v-u}{t}$

$t = \frac{v-u}{a}$ — (2)



Put value of t in eq (1)

$s = \frac{1}{2} \times (u+v) \times \frac{(v-u)}{a}$

$s = \frac{(v+u)(v-u)}{2a}$

$(a+b)(a-b) = a^2 - b^2$

$s = \frac{v^2 - u^2}{2a}$

$2as = v^2 - u^2$

$2as + u^2 = v^2$

$v^2 = u^2 + 2as$

Newton's First Low of Motion.

$\boxed{\text{Inertia}}$

The tendency of an object to continue it's existing state is called inertia.

Newton's Second Low of Motion.

$\boxed{\text{Momentum } (p)}$

$p = \text{mass} \times \text{velocity}$

$\boxed{p = m \times v}$

Unit of momentum:

$p = kg \times m/s$

$= \boxed{kg \cdot m/s}$

Force

mass

velocity.

momentum

vector quantity.

Newton's Second Law of Motion.

Rate of change of momentum ↑ $\propto$ Force ↑ (F)

↓ is directly proportional to.

$$\text{Rate of change of momentum} = \frac{\text{final momentum} - \text{initial momentum}}{\text{Time}}$$

$$= \frac{mv - mu}{t}$$

$$= \boxed{\frac{m(v-u)}{t}} \quad \text{— (1)}$$

We know that,

$$a = \frac{v-u}{t}$$

Put value of $\frac{v-u}{t}$ in eq (1)

Rate of change of momentum $= ma$

$ma \propto F$

$F \propto ma$

$F = k \times ma$

For $k = 1$,

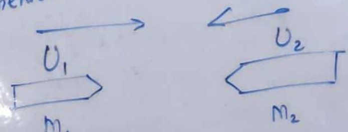
$F = 1 \times ma$

$$\boxed{F = ma}$$

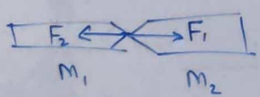
$P = m \times V$.

k = constant

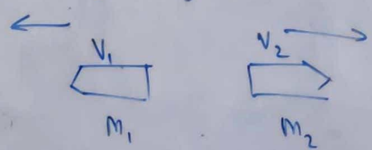
Law of conservation of momentum.



① Before collision



② During collision.



③ After collision.

$$F_2 = -F_1$$

Law of conservation of momentum.

$$F_2 = -F_1$$

$$m_2 \quad = -m_1 a_1$$

We know that,

$$\boxed{a = \frac{v-u}{t}}$$

$$m_2 \frac{(v_2 - u_2)}{\cancel{t}} = -m_1 \frac{(v_1 - u_1)}{\cancel{t}}$$

$$m_2 (v_2 - u_2) = -m_1 (v_1 - u_1)$$

$$m_2 v_2 - m_2 u_2 = -m_1 v_1 + m_1 u_1$$

$$m_2 v_2 + m_1 v_1 - m_2 u_2 = m_1 u_1$$

$$m_2 v_2 + m_1 v_1 = m_1 u_1 + m_2 u_2$$

$$m_1 u_1 + m_2 u_2 = m_1 v_1 + m_2 v_2$$

Total initial momentum = Total final momentum.

1)

1) $u = 2\ m/s$

$a = 4\ m/s^2$

$t = 3s$

$v = ?$

$$v = u + at$$

$$v = 2 + (4)(3)$$

$$= 2 + 12$$

$$\boxed{v = 14\ m/s}$$

2]

1) $u = 5\ m/s$

$a = 12\ m/s^2$

$t = 3s$

$s = ?$

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

$$s = (5)(3) + \frac{1}{\cancel{2}_{1}} \times \overset{6}{\cancel{12}} \times (3)^2$$

$$s = 15 + (6)(9)$$

$$s = 15 + 54$$

$$\boxed{s = 69m}$$

3]

1) $u = 4\ m/s$

$a = 3\ m/s^2$

$s = ?$

$v = 8\ m/s$

$$v^2 = u^2 + 2as$$

$$(8)^2 = (4)^2 + 2 \times 3 \times s$$

$$64 = 16 + 6s$$

$$64 - 16 = 6s$$

$$48 = 6s$$

$$6s = 48$$

$$s = \frac{48}{6} = \boxed{8m}$$

4]
1) $u = 2 \, m/s$
$a = 4 \, m/s^2$
$t = 3s$
$v = ?$

$V = u + at$
$v = 2 + (4)(3)$
$= 2 + 12$
$\boxed{V = 14 \, m/s}$

2]
1) $u = 5 \, m/s$
$a = 12 \, m/s^2$
$t = 3s$
$s = ?$

$S = ut + \frac{1}{2} at^2$
$S = (5)(3) + \frac{1}{\cancel{2}_1} \times \overset{6}{\cancel{12}} \times (3)^2$
$s = 15 + (6)(9)$
$s = 15 + 54$
$\boxed{s = 69m}$

3]
1) $u = 4 \, m/s$
$a = 3 \, m/s^2$
$S = ?$
$v = 8 \, m/s$

$v^2 = u^2 + 2as$
$(8)^2 = (4)^2 + 2 \times 3 \times s$
$64 = 16 + 6s$
$64 - 16 = 6s$
$48 = 6s$
$6s = 48$
$s = \frac{48}{6} = \boxed{8m}$

Q 7

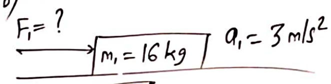
a) Average speed $= \dfrac{\text{Total distance}}{\text{Total time}}$

$= \dfrac{18 + 22 + 14}{3 + 3 + 3}$

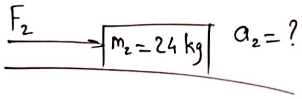
$= \dfrac{54}{9}$

$= \boxed{6 m/s}$

b)



$\boxed{F_1 = F_2}$



Given: $m_1 = 16\ kg$

$a_1 = 3 m/s^2$

$m_2 = 24\ kg$

To find: ① $F_1 = ?$

② $a_2 = ?$

Solution: $F = ma$

$F_1 = m_1 \times a_1$

$F_1 = 16 \times 3$

$\boxed{F_1 = 48\ N}$

$F_1 = F_2 = 48\ N$

$F_2 = m_2 \times a_2$

$48 = 24 \times a_2$

$a_2 = \dfrac{48}{24} = \boxed{2 m/s^2}$

Q 1

c.) Given: For bullet:

$m_1 = 10g = \frac{10}{1000} = \frac{1}{100} = 0.01 \text{ kg}$

$u_1 = 1.5 \text{ m/s}$

For plank:

$m_2 = 90g = \frac{90}{1000} = \frac{9}{100} = 0.09 \text{ kg}$

$u_2 = 0 \text{ m/s}$

After collision:

$\boxed{v_1 = v_2 = v}$

To find: $v = ?$

Solution: By law of conservation of momentum.

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

$m_1u_1 + m_2u_2 = m_1\underline{v} + m_2\underline{v}$

$m_1u_1 + m_2u_2 = (m_1 + m_2) \times v$

$(0.01 \times 1.5) + (0.09 \times 0) = \underline{(0.01 + 0.09)} \times v$

$0.015 + 0 = 0.10 \times v$

$0.015 = 0.1 \times v$

$v = \frac{0.015}{0.1} = \frac{0.015 \times 10}{0.1 \times 10} = \frac{0.15}{1} = \boxed{0.15 \text{ m/s}}$

$$\begin{array}{r} 0.01 \\ \times 1.5 \\ \hline 005 \\ +0010 \\ \hline 0.015 \end{array}$$