Midterm Review

① Momentum:

$p = mv$

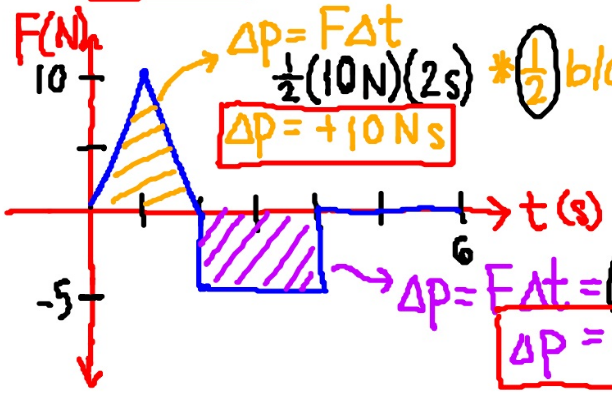
Units: $(kg)(\frac{m}{s})$

② Impulse/Change in Momentum:

$\Delta p = F\Delta t = m\Delta v = m(v_f - v_i)$

Units: $(N)(s) = (kg)(\frac{m}{s})$

Force v. time graph → area under curve!



$\Delta p = F\Delta t$
$\frac{1}{2}(10N)(2s)$ * $\frac{1}{2}$ b/c triangle *
$\Delta p = +10\,Ns$

$\Delta p = F\Delta t = (-5N)(2s)$
$\Delta p = -10\,Ns$

③ Conservation of Momentum:

↳ closed and isolated system

closed → no mass gained/loss

isolated → no external forces, $\Sigma F = 0\,N$

$p_i = p_f$

$p_{ci} + p_{Di} = p_{cf} + p_{Df}$

$m_c v_{ci} + m_D v_{Di} = m_c v_{cf} + m_D v_{Df}$

④ Work

↳ energy gained or loss

$$W = F\Delta d = \underbrace{mgh}_{PE} = \underbrace{\tfrac{1}{2}mv_f^2 - \tfrac{1}{2}mv_i^2}_{KE_f - KE_i = \Delta KE}$$

$(N)(m)$ $(kg)\left(\frac{m}{s^2}\right)(m)$ $(kg)\left(\frac{m^2}{s^2}\right)$

Units: $J = Nm = \frac{kg\,m^2}{s^2}$

↳ the amount of energy needed to displace an object using an exerted force.

⑤ Kinetic Energy:

↳ energy of motion

$$KE = \tfrac{1}{2}mv^2$$

Units: $(kg)\left(\frac{m^2}{s^2}\right)$ = J

$\Delta KE = W$

Potential Energy

$PE = mgh$ or $mg\Delta y$

Units: $(kg)\left(\frac{m}{s^2}\right)(m)$ = J

Mechanical Energy (sum of PE and KE)

$$ME = KE + PE$$

* conservation of Energy *

$$ME_i = ME_f$$

$$KE_i + PE_i = KE_f + PE_f$$

$$\tfrac{1}{2}mv_i^2 + mgh_i = \tfrac{1}{2}mv_f^2 + mgh_f$$

⑥ Power

↳ rate in which energy is used.

$$P = \frac{Work}{time} = \frac{W}{t} = \frac{F\Delta d}{t} = F\underline{V}$$

Units: $\frac{J}{s} = \frac{N\,m}{s} = N\frac{m}{s}$

Watt (W)

P1

Work & PE

G:

$m = 150\,Kg$

$g = 9.8\,\frac{m}{s^2}$

$h = 8.0\,m$

U:

$W = \_\_\_\,J$

Eqn:

$W = mgh$

S/S:

$W = (150\,Kg)(9.8\,\frac{m}{s^2})(8.0\,m)$

$W = 11760\,J$

$W = 12{,}000\,J$

$W = 12\,KJ$

P2 *Work & Power*

if it took 5s to exert this force, what is the power needed?

G:

$W = 2.20\times10^5 J$

$\Delta d = 8.00 m$

U:

$F = \_\_ N$

Eqn:

$\frac{W}{\Delta d} = \frac{F\Delta d}{\Delta d}$

$F = \frac{W}{\Delta d} = \frac{2.20\times10^5 J}{8.00 m}$ (J → Nm)

$F = 27500 N$

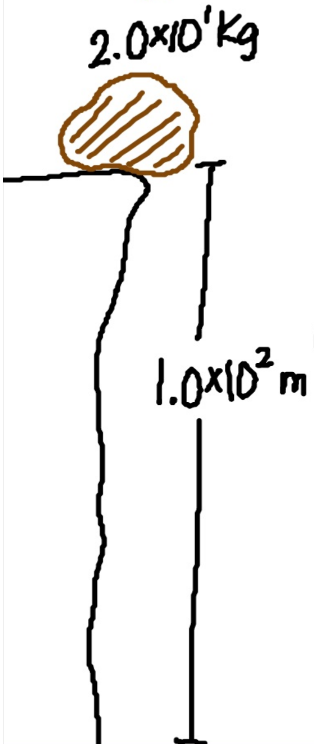
$2.75\times10^4 N$

$P = \frac{W}{t}$

$= \frac{2.2\times10^5 J}{5 s}$

$P = 44{,}000 W$

P3 *PE, KE, conservation of energy*



G:

$m = 20 kg$

$h = 100 m$

$g = 9.8 \frac{m}{s^2}$

U:

(a) $PE_i = \_\_ J$

(b) $KE_f = \_\_ J$

(c) $V_f = \_\_ \frac{m}{s}$

Eqn:

$KE_i + PE_i = KE_f + PE_f$

KE_i: 0 J (stone is NOT moving); PE_i: 20,000 J; KE_f: ?; PE_f: 0 J (falls to ground)

(a) $PE_i = mgh_i$

$= (20 kg)(9.8 \frac{m}{s^2})(100 m)$

$= 19{,}600$

$PE_i = 2.0\times10^4 J$ (a)

(b) $KE_f = PE_i = 2.0\times10^4 J$

(c) $KE_f = \frac{1}{2} m V_f^2$

$\frac{KE_f}{\frac{1}{2}m} = \frac{\frac{1}{2}mV_f^2}{\frac{1}{2}m}$

$\sqrt{\frac{2KE}{m}} = \sqrt{V_f^2}$

dividing by $\frac{1}{2}$ is the same as multiplying by 2

$V_f = \sqrt{\frac{2KE}{m}}$

$V_f = 45 \frac{m}{s}$