

Set 5.

Initial speed $u = 55 \text{ km/h}$.

Distance $= s = 69 \text{ cm} = 0.69$

Final speed $= v = 0$.

Let acceleration $= f$.

$$\Rightarrow v^2 = u^2 - 2fs$$

$$f = \frac{u^2}{2s}$$

$$u = \left(\frac{55 \times 5}{18} \right) = 15.28 \text{ m/s}$$

$$f = \frac{15.28^2}{2 \times 0.69} = 169.19 \text{ m/s}^2$$

Mass $= 39 \text{ kg}$

$$F = mf = (39 \times 169.19) \text{ N} = 6598.41 \text{ N}$$

$$= 6.60 \times 10^3 \text{ N}$$

P5.02

Initial h. of the ball $= 32.0 \text{ m}$,

$m = 0.502 \text{ kg}$

(i) Velocity of the ball before reaching ground

$$= v_1 = \sqrt{2gh_1}$$

$$= \sqrt{2 \times 9.8 \times 32} = 25.04 \text{ m/s}$$

v_2 (after bouncing)

$$v_2 = \sqrt{2gh_2}$$

$$= \sqrt{(2)(9.8)(19.2)} = 19.40 \text{ m/s}$$

$$\Delta, \text{ in Velocity} = (25.04 + 19.40) \text{ m/s}$$

$$= 44.44 \text{ m/s}$$

Average force exerted on ball

$$m = 0.502 \quad t = 1.81 \text{ s}$$

$$f = \frac{m(v_1 + v_2)}{t}$$

$$= \frac{(0.502)(44.44)}{1.81 \times 10^{-3}}$$

$$= 1.23 \times 10^4 \text{ N}$$

P5.03

(a) Initial momentum = final momentum

$$M_1 v_1 + M_2(0 \text{ m/s}) = (M_1 + M_2) v_2$$

$$= M_1 = 2.35 \text{ kg} \quad M_2 = 2.82 \text{ kg}$$

$$v_1 = 1.30 \text{ m/s} \quad v_2 = ?$$

$$(2.35)(1.30) = (2.82)x$$

$$\frac{3.055}{2.82} = \frac{2.82x}{2.82} = 1.08$$

$$(2.35)(1.30) = (2.82 + 2.35)x_2$$

$$\frac{3.055}{5.17} = \frac{5.17x}{5.17}$$

$$v_2 = 0.591 \text{ m/s}$$

(ii) Conserv. Energy -

$$\frac{1}{2} M v^2 = \frac{1}{2} k x^2$$

$$M v^2 = k x^2$$

$$x^2 = \frac{M v^2}{k}$$

$$a = \sqrt{\frac{mv^2}{k}}$$

$$= \sqrt{\frac{(m_1 + m_2)v^2}{k}}$$

$$= \sqrt{\frac{(2.82 + 2.35)(0.591)^2}{55.7 \text{ N/m}}}$$

$$= 0.18005 \text{ J}$$

$$= \underline{1.8 \times 10^{-1} \text{ J}}$$

(ii) Max Compression.

$$KE_i + PE_i = KE_f + PE_f$$

$$\left(\frac{1}{2}\right)mv_i^2 + \left(\frac{1}{2}\right)kx_i^2 = \left(\frac{1}{2}\right)mv_f^2 + \left(\frac{1}{2}\right)kx_f^2$$

$$= \left(\frac{1}{2}\right)(5.17)(0.591)^2 + 0 = \left(\frac{1}{2}\right)(55.7)x_f^2$$

$$\frac{0.903}{130} = \frac{130}{130} x_f^2$$

$$0.903 = 27.85 x_f^2$$

$$x_f^2 = \frac{0.903}{27.85} = 0.03242$$

$$f = \sqrt{\frac{0.903}{27.85}}$$

$$= 0.18 \text{ m} = \underline{18 \text{ cm}}$$

PS.04

We know:

$$K.E = p^2 / 2m$$

" If mass is less K.E is more.

⇒ Object C has the highest K.E. as it has the smallest mass, followed by A & lastly B. ~~(CAB)~~ (CAB)

B. In case of Momentum, the larger the mass, the more the momentum. So C will have smallest momentum, B will have largest followed by A. ~~(BAC)~~ (BAC)

PS.06.

$$F = 1.46 \text{ N}$$

$$\text{Mass} = 0.10 \text{ kg}$$

$$T = 5.00 \text{ Min}$$

$$W_{\text{tot}} = Fd$$

$$d = 0 \Rightarrow (1.46)(0) = \underline{0.00 \text{ J}}$$

PS.07.

$$F = (2.76\hat{i} - 4.91\hat{j})$$

$$D = (-2.87\hat{i} + 7.33\hat{j})$$

$$W_{\text{tot}} = F \cdot d$$

$$= (2.76)(-2.87) + (-4.91)(7.33)$$

$$= -43.915 \text{ J}$$

$$\approx \underline{\underline{-43.9 \text{ J}}}$$

P.08
Kinetic Energy
 $KE = \frac{1}{2}mv^2$

$$\text{Jogger A} = KE_A = \frac{1}{2}mv^2 = 0.5mv^2$$

$$\text{Jogger B} = KE_B = \left(\frac{1}{2}\right)\left(\frac{M}{3}\right)v^2 = 0.67mv^2$$

$$\text{Jogger C} = KE_C = \left(\frac{1}{2}\right)(2M)\left(\frac{v}{3}\right)^2 = 0.112mv^2$$

$$\text{Jogger D} = KE_D = \left(\frac{1}{2}\right)(9M)\left(\frac{v}{3}\right)^2 = 0.5mv^2$$

i. from highest to lowest
ii. from lowest to highest.

$$= C < A = D < B$$

P.09.

kinetic energy lost.

$$KE = \frac{1}{2}M(v_1^2 - v_f^2)$$

$$KE = (0.5)(0.375)((8.19)^2 - (5.67)^2)$$

$$KE = (0.5)(0.375)(34.7)$$

$$KE = 6.50625 \text{ J}$$

$$KE_{\text{lost}} = \underline{\underline{6.51 \text{ J}}}$$

(b) Coefficient of KE. friction.

$$D = C = 25 \text{ m}$$

$$C = 2 \times 3.14 \times 1.58 = 9.9224 \text{ m}$$

Work done = $f_f \times C$

$$\text{So } F_f = 6.51 \text{ J} / 9.9224 \text{ m}$$

$$= 0.65609 \text{ N} \cdot (\text{friction force})$$

$$F_f = \mu mg$$

$$= 0.65609 / (0.375)(9.81)$$

$$\approx 0.178$$

$$= \underline{\underline{1.78 \times 10^{-1}}}$$

(c) Total No. of Rev.

$$\text{Initial KE} = \left(\frac{1}{2}\right)Mv_1^2$$

$$KE = (0.5)(0.375)(8.19^2) = 12.577 \text{ J}$$

$$\text{Then } n F_f C = 12.58 \text{ J}$$

$$\text{So } n = \frac{12.58}{(0.656)(9.9224)}$$

$$= \underline{\underline{1.93}}$$

P.10

Power = $Fv \rightarrow \text{Constant}$

$$F \propto \frac{1}{v} \Rightarrow a \propto \frac{1}{v}$$

$$\frac{dv}{dt} \propto \frac{1}{v} \Rightarrow v^2 \propto t$$

reach

i. To double the speed, the required rev = 4 times

Also.

Since power is constant -

$$\frac{1}{2} m v^2 = P t.$$

$$P = \frac{\frac{1}{2} m v^2}{t}$$

$$P = \frac{(1/2)(1060)(35^2)}{6} \approx 108,208.33$$

$$\approx \underline{\underline{108.2 \text{ kW}}}$$

PS.12

Graph D -

By conservation of energy,

Total mechanical energy remains conserved & constant. Hence

Figure D represents Total Mechanical Energy as a function of height.

v) Gravitational potential energy $= mgh$.

It means gravitational potential

is directly proportional to height &

its linear proportional so,

Figure G represents the gravitational ~~force~~ potential energy as a function of its height.

(iii) Since Mechanical energy is constant

kinetic energy will reduce if the

same rate at which potential energy

will also increase.

Figure A represents the KE as a function of height.

times

PS: 13

$$\text{Work} = 3.87 \text{ J}$$

$$\text{Stretch} = 10.8 \text{ cm} = 0.108 \text{ m}$$

$$\text{Work} = \left(\frac{1}{2}\right)(k)(x^2)$$

$$3.87 = 10.8 \text{ cm} = 0.108 \text{ m}$$

Initial k -

$$3.87 = (0.5)(k)(0.108^2)$$

$$\frac{3.87}{0.005832} = k$$

$$k = 663.58 \text{ N/m}$$

Initial k -

$$= \left(\frac{1}{2}\right)(663.58)(0.208^2 - 0.108^2)$$

$$= (0.5)(663.58)(0.0316)$$

$$= 10.484 \text{ J}$$

$$\approx \underline{\underline{1.05 \text{ J}}}$$