FORCE, MASS, ACCELERATION

$$F = m \times a$$

F = FORCE (N)

m = MASS (kg)

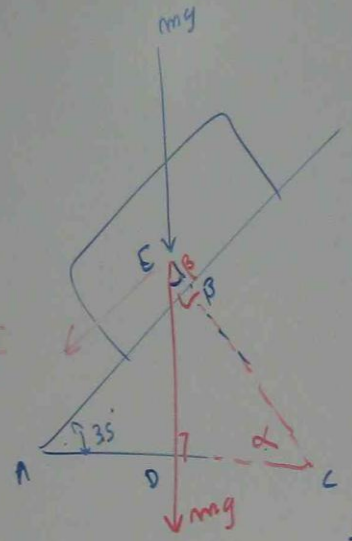
a = ACCELERATION (m/s^2)

WEIGHT = $m \times g$ (N)

$g = 9.8\ m/s^2$

GRAVITY

pb



DETERMINE THE ACCELERATION of A BODY SLIDING DOWN A SMOOTH SURFACE INCLINED TO THE HORIZONTAL AT 35°

ΔABC

$\alpha = 180 - (90 + 35) = 55°$

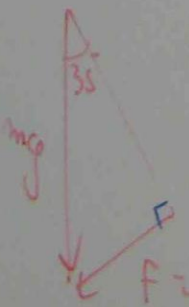
ΔCDE

$\beta + \alpha + 90 = 180$

$\beta + 55 + 90 = 180 \rightarrow \beta = 35°$

$F = m \times a$

$$a = \frac{f}{m}$$



$f = mg \sin 35$

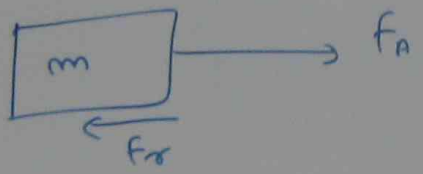
$$a = \frac{mg \sin 35}{m}$$

$= g \sin 35$

$= 9.81 \times \sin 35$

$= 5.63\ m/s^2$

ACCELERATION AGAINST RESISTANCE



f_A = ACTION FORCE

f_r = RESISTANCE FORCE

F_{NET} = NET FORCE

$$F_{NET} = f_A - f_r$$

$$a = \frac{F_{NET}}{m} = \frac{f_A - f_r}{m}$$

pb

A TRAIN of TOTAL MASS 120 TONS IS TRAVELLING AT 60 Km/hr ON LEVEL TRACK. THE TRACTIVE RESISTANCE IS 80 N/TON. CALCULATE THE TRACTIVE EFFORT REQUIRED TO ACCELERATE THE TRAIN TO 100Km/hr in 30 sec.

$$V_1 = 60 Km/hr = \frac{60 \times 10^3}{3600} = 16.67 m/s$$

$$V_2 = 100 Km/hr = \frac{100 \times 10^3}{3600} = 27.78 m/s$$

$$V_2 = V_1 + at$$

Pb

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$$V_2 = V_1 + at$$

$$a = \frac{V_2 - V_1}{t}$$

$$= \frac{27.78 - 16.67}{30}$$

$$= 0.37\,m/s^2$$

$$a = \frac{F_A - F_r}{m}$$

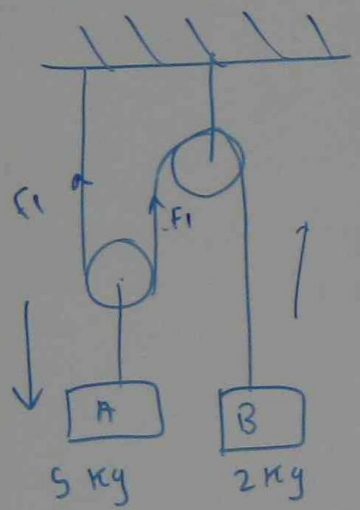
$$0.37 = \frac{F_A - 120\times80}{120}$$

$$0.37\times120 = F_A - 120\times80$$

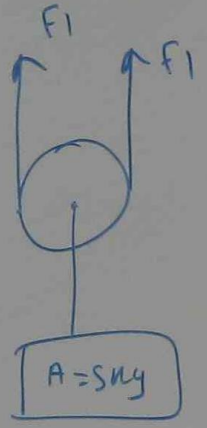
$$F_A = 0.37\times120 + 120\times80$$

$$= 120\times80.37 = 32.7\,N$$

Pb DETERMINE THE ACCELERATION OF BODIES A AND B AND THE FORCE OF TENSION IN THE CORD FOR THE SYSTEM IN FIGURE



(A)



$F_1 = m_B\, g$

$= 2 \times 9.81$

$m_A \times g - 2F_1 = m_A \times a_A$

$5 \times 9.81 - 2 \times [2 \times 9.81] = 5 \times a_A$

$5 \times 9.81 - 4 \times 9.81 = 5 \times a_A$

$a_A = \dfrac{9.81}{5} = 1.962\ m/s^2$

pb

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$V_2 = V_1 + at$

$a = \frac{V_2 - V_1}{t}$

$= \frac{27.78 - 16.67}{30}$

$= 0.37 m/s^2$

$a = \frac{F_A - Fr}{m}$

$0.37 = \frac{F_A - 120 \times 80}{120}$

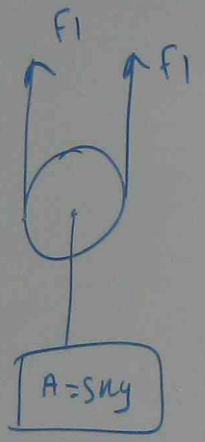
$0.37 \times 120 = F_A - 120 \times 80$

$F_A = 0.37 \times 120 + 120 \times 80$

$= 120 \times 80.37 = 32.7 N$

A AND B AND THE FORCE of TENSION

URE



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$5 \times 9.81 - 4 \times 9.81 = 5 \times a_A$

$a_A = \frac{9.81}{5} = 1.962\ m/s^2$

(3)

$5 \times 9.81 = 2F_1$

$F_1 = \frac{5 \times 9.81}{2} = 2.5 \times 9.81$

$F_1 - m_B \times g = m_B \times a$

$2.5 \times 9.81 - 2 \times 9.81 = 2 \times a$

$\frac{0.5 \times 9.81}{2} = a_B$

$a_B = 0.25 \times 9.81$

$= 2.45\ m/s^2$

ANGULAR ACCELERATION

LINEAR (V) m/s

ANGULAR (ω) rad/sec

$$\omega_2 = \omega_1 + \alpha t$$

α = ANGULAR ACCELERATION

rad/sec²

TOTAL ANGULAR MOVEMENT $\theta = \frac{\omega_1 + \omega_2}{2} \times t$

$$\omega_2^2 = \omega_1^2 + 2\alpha\theta$$

Pb

A FLY WHEEL STARTS FROM REST AND IS ACCELERATED AT THE RATE of $2.4\ rad/s^2$ FOR 30 sec. CALCULATE ANGULAR VELOCITY REACHED AFTER 30 sec

$\omega_1 = 0$

$\alpha = 2.4\ rad/s^2$

$t = 30\ sec$

$\omega_2 = ?$

$\omega_2 = \omega_1 + \alpha t$

$= 0 + 2.4 \times 30$

$= 72\ rad/sec.$

Pb

IF AFTER ROTATING FOR SOME TIME AT ANGULAR VELOCITY OF 72 rad/s BRAKES ARE APPLIED TO THE FLY WHEEL PRODUCING A RETARDATION OF 4 rad/s^2. DETERMINE TIME TAKEN TO REDUCE IT'S ANGULAR VELOCITY TO 40 rad/s.

$\omega_1 = 72$ rad/sec

$\alpha = -4$ rad/sec^2

$\omega_2 = 40$ rad/sec

$t = ?$

$\omega_2 = \omega_1 + \alpha t$

$40 = 72 + (-4) \times t$

$40 = 72 - 4t$

$4t = 72 - 40$

$t = \frac{72-40}{4} = \frac{32}{4} = 8$ sec