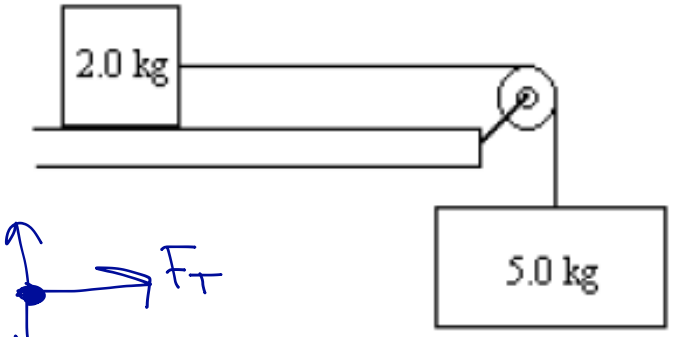
FORCES, CONSERVATION OF ENERGY

Exam Review Questions

FORCES – NEWTON'S 2ND LAW

No friction

1. A 2.0 kg mass, placed on a smooth, level table, is attached by a light string passing over a frictionless pulley to a 5.0 kg mass hanging freely over the edge of the table, as illustrated. Calculate
   (a) the tension in the string
   (b) the acceleration of the 2.0 kg mass.



F_N

F_T

F_g

$F_{NET} = F_T$

$ma = F_T$

$(2.0\,kg)a = F_T$ ①

F_T

F_{NET}

F_g

$F_{NET} = F_g - F_T$

$ma = mg - F_T$

② $(5kg)a = (5kg)(9.8 m/s^2) - F_T$

Sub ① into ②

$(5kg)a = (5kg)\left(9.8\frac{m}{s^2}\right) - (2kg)a$

$(5kg)a + (2kg)a = (5kg)\left(9.8\frac{m}{s^2}\right)$

$(7kg)a = 49\,kg\,m/s^2$

$a = \frac{49\,kg\,m/s^2}{7\,kg}$

$a = 7\,m/s^2$

① $F_T = (2kg)a$

$F_T = (2kg)(7\,m/s^2)$

$F_T = 14\,N$

CONSERVATION OF ENERGY

A girl on a sled with a total mass of 90kg starts from an elevation of 100meters. At the bottom of the run her speed is 30m/s. How much energy in joules was lost due to friction?

$E_m = E_g + E_k$

All E_g

$E_m = E_g + E_k$

$E_m = (90\,kg)(9.8\,m/s^2)(100\,m)$

$E_m = 88\,200\,J$

100 m

$E_m = E_g + E_k$

$E_m = E_k = \frac{mv^2}{2}$

$E_m = \frac{(90\,kg)(30\,m/s)^2}{2}$

$E_m = 40500\,J$

$E_{LOST} = 88200\,J - 40500\,J$

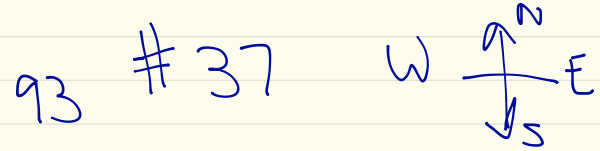
$= 47700\,J$

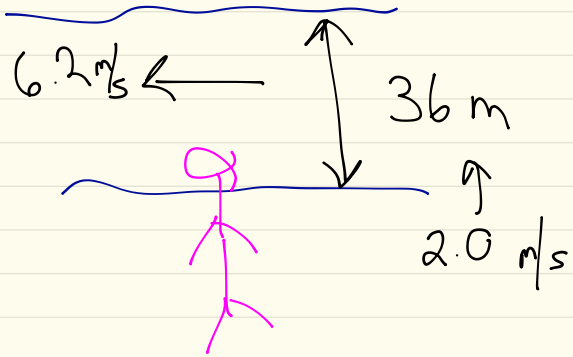
1 sig dig

$E_{LOST} = 50\,000\,J$

$= 50\,kJ$

Pg 93 #37



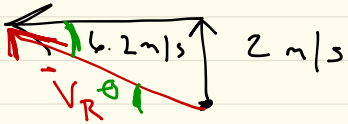


a)

$\Delta t = 36\text{ m} / 2.0\text{ m/s}$

$\Delta t = 18\text{ s}$

b)



$|\vec{V}_R| = \sqrt{2^2 + 6.2^2}$

$|\vec{V}_R| = 6.5\text{ m/s}$

$\theta = \tan^{-1}\left(\frac{2}{6.2}\right)$

$\theta = 18^\circ$

$\vec{V}_R = 6.5\text{ m/s}\ [W\ 18^\circ N]$

c) $d = vt$

$= (6.2\text{ m/s})(18\text{ s})$

$= 111.6\text{ m}$

$= 110\text{ m}$

Pg 263 #31

$$W = \overline{F} \Delta d$$
$$= \Delta E_k$$

$$\Delta E_k = E_{kf} - E_{ki}$$
$$= 0\,J - \frac{mv^2}{2}$$

$$72\ km/h \times 1000\frac{m}{km} \times \frac{1h}{3600s}$$

$$v_i = 20\ m/s$$

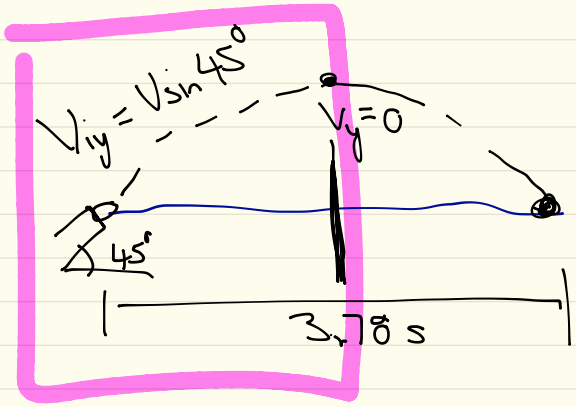
$$\Delta E_k = W = 0\,J - \frac{(2600kg)(20m/s)^2}{2}$$

$$W = 0 - 520\,000\,J$$

$$W = F\Delta d$$
$$-520\,000J = -8200N(\Delta d)$$

$$\Delta d = 63m$$

Pg 93 #41



$$\frac{3.78\,s}{2} = 1.89\,s$$

$$\vec{a}_y = -9.8\ m/s^2$$

$$V_f = V_i + a\Delta t$$

$$0 = V_{iy} - (9.8\ m/s^2)(1.89\,s)$$

$$0 = V_{iy} - 18.522\ m/s$$

$$V_{iy} = 18.522\ m/s$$

$$V\sin 45^\circ = 18.522\ m/s$$