Homework 5 chapter 7

chapter - 7 Homework - 5 [8, 9, 55, 56]
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Q8] The first book is already in position, so no work is required. Second book should be moved upward by distance, force to its weight. The force & displacement are in same direction. 3rd book need to move at 2d by same force and this is aplied to all the seven books

$W = mgd + 2mgd + 3mgd + 4mgd + 5mgd + 6mgd + 7mgd$
$= 28\,mgd = 28(1.8\,kg)(9.8\,m/s^2)(0.040\,m) = \boxed{2.0 \times 10^1\,J}$

Q9] box accerelation is constant so,

$d = x - x_0 = v_0 t + \frac{1}{2}at^2$
$= 0 + \frac{1}{2}(2.0\,m/s^2)(7.0\,s)^2$
$= 49\,m$

So work done to move crate is found using

$W = Fd\cos 0° = mad = (6.0\,kg)(2.0\,m/s^2)(49\,m)$
$= \boxed{590\,J}$

Q55] ball on the glove's force and glove on the balls force are opposite so using Newton's third law.

Work on the ball $= (K_2 - K_1)_{ball}$
$= \frac{1}{2}mv_2^2 - \frac{1}{2}mv_i^2$
$= 0 - \frac{1}{2}(0.145\,kg)(32\,m/s^2) = \boxed{-74.24\,J}$

and therefore for $W_{on glove} = 74.24 J$

But $W_{on glove} = F_{on glove} d \cos 0°$, because the force on the glove is in the same direction.

$74.24 J = F_{on glove} (0.25m) \rightarrow F_{on glove} = \frac{74.24 J}{0.25}$

$= \boxed{3.0 \times 10^2 N}$ direction of original velocity of the ball.

Q56] The force exerted by the bow on the arrow is in the same direction as the arrow.

$W = Fd \cos 0° = Fd = (105N)(0.75m) = 78.51 J$. But that work changes the kinetic energy of the arrow

$Fd = W = K_2 - K_1 = \frac{1}{2}mv_2^2 - \frac{1}{2}mv_1^2 \Rightarrow v_2 = \sqrt{\frac{2Fd}{m} + v_1^2}$

$= \sqrt{\frac{2(78.75J)}{0.085kg} + 0} = \boxed{43 m/s}$

Homework 5 Chapter 8

chapter-8 Homework-5 [3, 8, 15, 20, 29, 32, 70, 73]
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Q3] Spring is going to stretch. Force by the spring is equal to the weight of the mass.

$mg = k(\Delta x) \rightarrow \Delta x = \frac{mg}{k} = \frac{(2.5\,kg)(9.80\,m/s^2)}{63\,N/m} = \boxed{0.39\,m}$

Thus the rulers reading will be $39\,cm + 15\,cm = \boxed{54\,cm}$

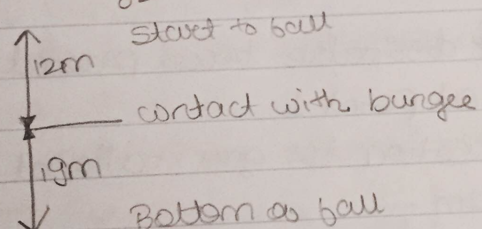
Q8] Force, $f_x = \frac{-\delta U}{\delta x} = -(6x+2y)$

$f_y = \frac{\delta U}{\delta y} = -(2x+8yz)$

$f_z = \frac{-\delta U}{\delta z} = -4y^2$

$\vec{F} = \hat{i}(-6x-2y) + \hat{j}(-2x-8yz) + \hat{k}(-4y^2)$

Q15]
a]



y = distance from the 0 gravitational potential energy
x = amount of bungee cord "stretch" from its unstretched length
Sub1 = jumper at start
Sub2 = jumper at lowest

$(x=0)$ we have $v_1=0$, $y_1=31m$ $x_1=0$, $v_2=0$
$y_2=0$, and $x_2=19m$
by conservation of energy

$E_1=E_2 \rightarrow \frac{1}{2}mv_1^2+mgy_1+\frac{1}{2}kx_1^2$
$=\frac{1}{2}mv_2^2+mgy_2+\frac{1}{2}kx_2^2 \rightarrow mgy_1=\frac{1}{2}kx_2^2 \rightarrow$

$K=\frac{2mgy_1}{x_2^2}=\frac{2(55\,kg)(9.80m/s^2)(31m)}{(19m)^2}$

$\boxed{=93N/m}$

b] Newtons second law for the force on the jumper

$F_{net}=F_{cord}-mg$

$=kx_2-mg=ma \rightarrow a=\frac{kx_2}{m}-g$

$=\frac{(92.57N/m)(19m)}{(55kg)}-9.80m/s^2$

$=\boxed{22.2m/s^2}$

Q20] As there are no dissipative forces present
Sub1 = coster at point 1
height at 0 = location for gravitational energy
$v_1=0$ and $y_1=32m$

<u>Point 2</u> $=\frac{1}{2}mv_1^2+mgy_1=\frac{1}{2}mv_2^2+mgy_2$

$y_2=0 \rightarrow mgy_1=\frac{1}{2}mv_2^2 \rightarrow v_2=\sqrt{2gy_1}$

$=\sqrt{2(9.80m/s^2)(32m)}=\boxed{25m/s}$

<u>Point 3</u> $=\frac{1}{2}mv_1^2+mgy_1=\frac{1}{2}mv_3^2+mgy_3$

$y_3=26m \rightarrow mgy_1=\frac{1}{2}mv_3^2+mgy_3 \rightarrow$

$v_3=\sqrt{2g(y_1-y_3)}=\sqrt{2(9.80m/s^2)(6m)}=\boxed{11m/s}$

Point 4 → $\frac{1}{2}mv_1^2 + mgy_1 = \frac{1}{2}mv_4^2 + mgy_4$

$y_4 = 14m \rightarrow mgy_1 = \frac{1}{2}mv_4^2 + mgy_1 \rightarrow$

$v_4 = \sqrt{2g(y_1 - y_4)} = \sqrt{2(9.80m/s^2)(18m)} = \boxed{19m/s}$

29] Kinetic energy is transformed to thermal energy

$E_{initial} = E_{final} \rightarrow \frac{1}{2}mv^2 = E_{thermal}$

$= \frac{1}{2}(2)(56{,}000 kg)\left[(95 km/h)\left(\frac{(1m/s)}{(3.6 km/h)}\right)\right]^2 = \boxed{3.9 \times 10^7 J}$

32] a] Sub 1 = ball as it is dropped

Sub 2 = ball reaches the ground

$v_1 = 0$, $y_1 = 14.0m$, $y_2 = 0$ Solve for v_2

$E_1 = E_2 \rightarrow \frac{1}{2}mv_1^2 + mgy_1 = \frac{1}{2}mv_2^2 + mgy_2$

$mgy_1 = \frac{1}{2}mv_2^2 \rightarrow v_2 = \sqrt{2gy_1} = \sqrt{2(9.80m/s^2)(14.0m)}$

$\boxed{= 16.6m/s}$

b] energy $= F_{fr}d$

d which is the frictional force that will be 14.0m

$v_2 = 8.00m/s$

$\frac{1}{2}mv_1^2 + mgy_1 = \frac{1}{2}mv_2^2 + mgy_2 + F_{fr}d \rightarrow mgy_1 = \frac{1}{2}mv_2^2 + F_{fr}d$

$\rightarrow F_{fr} = m\left(g\frac{y_1}{d} - \frac{v_2^2}{2d}\right) = (0.145 kg)\left(9.80m/s^2 - \frac{(8.00m/s^2)}{2(14.0m)}\right)$

$= \boxed{1.09N, \text{upwards}}$

70] The power is the work done per unit time.

$P = \frac{W}{t} = \frac{mgh}{t} = \frac{(21.0kg)(9.80m/s^2)(3.50m)}{60sec}$

$\boxed{= 12.0W}$

73] net rate of work done is the power, $P = Fv = mav$

velocity, $v = \frac{dx}{dt} = 15.0t^2 - 16.0t - 44$

$a = \frac{dv}{dt} = 30.0t - 16.0$

a] $P = mav = (0.28kg)([30.0(2.0) - 16.0]m/s^2)$
$[15.0(2.0)^2 - 16.0(2.0) - 44]m/s = -197.1W$

$\boxed{= -2.0 \times 10^2 W}$

b] $P = mav = (0.28kg)([30.0(4.0) - 16.0]m/s^2)$
$[15.0(4.0)^2 - 16.0(4.0) - 44]m/s = \boxed{3844W}$

Work done is changed by kinetic energy

$v(0) = -44m/s$ $v(2.0) = 15.0(2.0)^2 - 16.0(2.0) - 44$
$= \boxed{-16m/s}$ and $v(4.0) = 15.0(4.0)^2 - 16.0(4.0) -$
$44 = 13m/s$

c] $P_{avg\,0\,to\,2.0} = \frac{\Delta K}{\Delta t} = \frac{\frac{1}{2}m(v_f^2 - v_i^2)}{\Delta t} = \frac{\frac{1}{2}(0.28kg)[(-16m/s)^2 - (-44m/s^2)]}{2.0s} = \boxed{-120W}$

d] $P_{avg\,2.0\,to\,4.0} = \frac{\Delta K}{\Delta t} = \frac{\frac{1}{2}m(v_f^2 - v_i^2)}{\Delta t} = \frac{\frac{1}{2}(0.28kg)[132m/s^2) - 16m/s^2)]}{2.0s}$

$= \boxed{1200W}$