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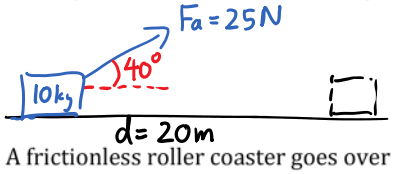
Unit Test 3: Power and Energy **Practice Test** **Name:** _____

1) A 25 N force directed at 40° above the horizontal moves a 10 kg crate along a horizontal surface at constant velocity. How much work is done by this force in moving the crate a distance of 20 m?

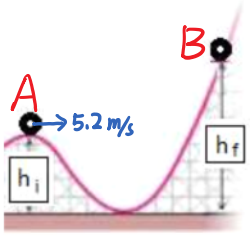


$W = Fd\cos\theta = 25(20)\cos 40°$

$W = 383\ J$

Ans) 383 J

2) A frictionless roller coaster goes over the top of a 20m high hill (h_i) with a speed of 5.2 m/s. It then runs down another hill and up a huge slope (h_f) . How high up the second slope does the rollercoaster go before stopping?

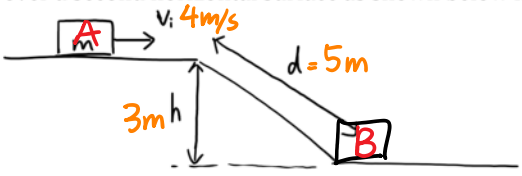


$Ep_A + Ek_A = Ep_B \quad mgh + \frac{1}{2}mv^2 = mgh$ (20, 5.2)

$209.52 = gh \quad h = 21.4\ m$

Ans) 21.4 m

3) A 10 kg model car slides along a frictionless surface at a constant speed of 4.0 m/s. the car then slides down a frictionless incline and over a second horizontal surface as shown below h=3.0 m and d=5.0 m



a) what is the kinetic energy of the crate as it slides on the upper surface

$Ek_A = \frac{1}{2}mv^2 = \frac{1}{2}(10)(4)^2 = 80J$

Ans) 80 J

b) while on the upper surface, how much gravitational potential energy does it have with respect to the lower surface?

$Ep_A = mgh = 10(9.8)(3) = 294\ J$

Ans) 294 J

c) what is the kinetic energy of the car as it slides on the lower surface

$E_{Total\,A} = E_{Total\,B} \quad \therefore Ek_B = 80\ J + 294\ J = 374\ J$

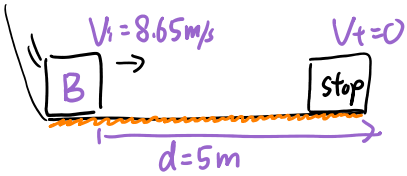
Ans) 374 J

d) what is the speed of the car as it slides on the lower surface?

$Ek_B = \frac{1}{2}mv^2 \quad 374 = \frac{1}{2}(10)v^2 \quad v = 8.65\ m/s$

Ans) 8.65 m/s

e) what minimum coefficient of kinetic friction is required to stop the car over a distance of 5 m along the lower surface?



$v_f^2 = v_i^2 + 2ad$

$0 = 8.65^2 + 2a(5)$

$a = 7.48\ m/s^2$

$F_{net} = ma$

$F_f = 10(7.48)$

$F_f = 74.8$

$F_f = \mu F_N$

$\mu = \frac{74.8}{98} = 0.763$

$F_N = F_g = 10mg = 98\ N$

Ans) 0.763

4) P_{in}

A 400 W motor is used to lift a 67 kg person a vertical distance of 5 m in 20 s. What is the efficiency of the motor?

$W_{out} = \Delta Ep = 67mgh(5) = 3283\ J$

$Eff = \frac{P_{out}}{P_{in}} \times 100$

D, W_{out} 3283

$W_{out} = \Delta E_p = mgh = 3283\ J$

$P_{out} = \frac{W_{out}}{t} = \frac{3283}{20\,sec} = 164\ W$

$Eff = \frac{P_{out}}{P_{in}} \times 100$

$= \frac{164}{400} \times 100$

ans) 41 %

5) Bruce, a 75 kg passenger in a van, is wearing a seat-belt when the van moving at 15 m/s collides with a concrete wall. The front end of the van collapses 0.50 m in coming to rest.

a. What was Bruce's kinetic energy before the crash?
b. What average force did the seat belt exert on Bruce during the crash?

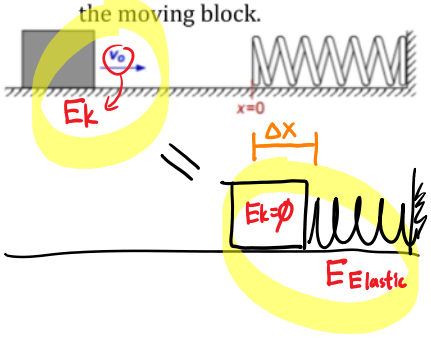
a) $E_{k_i} = \frac{1}{2} mv^2 = \frac{1}{2}(75)(15)^2 = 8437.5\ J$ $\quad E_{k_f} = \emptyset$

b) $W = F_a \cdot d$ $\quad -8437.5\ J = F_a (0.5m)$

ΔE_k $\quad F_a = -16875\ N$

a) 8438 J
b) 16875 N

6) A block (m= 5.0 kg) is moving at a velocity of Vo=15 m/s along a horizontal frictionless surface toward a massless spring ($k = 8\ N/m$) that is attached to a wall. How much will the spring be compressed if it stops the moving block.



$E_{k_{initial}} = \frac{1}{2} m v^2 = \frac{1}{2}(5)(15)^2 = 562.5\ J$

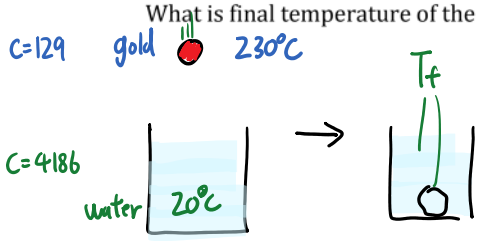
$E_{Elastic} = \frac{1}{2} k x^2$

$562.5 = \frac{1}{2}(8)(x)^2$

$x = 11.86\ m/s$

ans) 11.86 m/s

7) While preparing dinner, Mr. Cheung's 50 g gold wedding ring was left in the oven and baked to 230° C. He drops the gold ring into a pot of 0.5 kg of water at 20° C until the temperature reach thermal equilibrium. What is final temperature of the gold ring and the water?



$Q_{lost}^{gold} + Q_{gain}^{water} = \emptyset$

$m_g C_g \Delta T_g + m_w C_w \Delta T_w = \emptyset$

$0.05(129)(T_f - 230) + (0.5)(4186)(T_f - 20°C) = \emptyset$

$6.45 T_f - 1483.5 + 2093 T_f - 41860 = \emptyset$

$2099.45 T_f = 43343.5$

$T_f = 20.6\ °C$

ans) 20.6°C