NAME: Key

Energy & Momentum Review Questions

1. A 300 W electric motor lifts a 25 kg object to a height of 10 m in 11.5 s. What is the efficiency of the motor?

$P_{out} = \frac{W}{t} = \frac{mgh}{t} = 213\ W$

$Eff = \frac{P_{out}}{P_{in}} = \frac{213\ W}{300\ W} = 71\%$

2. What force is required to accelerate a 20 kg mass from 7 m/s to 14 m/s in a distance of 100 m?

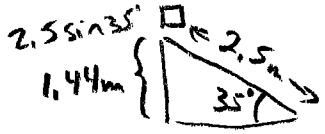
$W = \Delta E$

$F \cdot d = E_{K_f} - E_{K_0}$

$F(100) = 1960 - 490$

$F = 14.7\ N$

3. A 2.0 kg object slides from rest at the top of a 35° incline. If the length of the incline is 2.5 m and the speed at the bottom is 3.0 m/s, what is the average force of friction along the incline?



$E_b = E_a$

$E_p + E_K = E_p + E_K + E_H$ (the E_p and E_K terms are 0)

$mgh = \frac{1}{2}mv^2 + E_H$

$W_{fric} = F_f \cdot d$

$192\ J = F_f \cdot 2.5$

$F_f = 7.6\ N$

4. A 40 kg child starts at the top of a 7 m high waterslide with an initial speed of 6 m/s. If their speed at the bottom of the waterslide is 12 m/s, how much heat energy was produced?

$E_b = E_a$

$E_p + E_K = E_p + E_K + E_H$

$mgh + \frac{1}{2}mv^2 = \frac{1}{2}mv^2 + E_H$

$2744 + 720 = 2880 + E_H$

$E_H = 584\ J$

5. If a 0.15 kg object has 9.0 J of E_k, what is the magnitude of its momentum?

$E_K = \frac{1}{2}mv^2$

$9 = \frac{1}{2}(.15)v^2$

$v = 10.95\ m/s$

$p = mv$

$= (.15)(10.95) = 1.64\ kg\ m/s$

6. A 50 g bullet travelling at a velocity of 375 m/s becomes embedded 25 cm into a massive wood block. What is the average force exerted on the bullet by the wood?

$W = \Delta E$

$F \cdot d = E_{K_f} - E_{K_0}$

$F(.25) = 0 - \frac{1}{2}(.05)(375)^2$

$F = -14100\ N$

stopping force

7. A 50 g bullet travelling at a velocity of 375 m/s becomes embedded into a 2 kg wood block. If the block sits on a frictionless surface what will be the bullet & block combined velocity?

$P_b = P_a$

$m_1v_1 + m_2v_2 = (m_1 + m_2)v$ ($m_2v_2 = 0$)

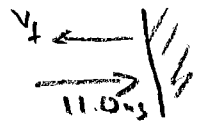
$18.75 = (2.05)v$

$v = 9.15\ m/s$

8. A 0.05 kg ball travelling east at 11.0 m/s hits a brick wall head on. If it experiences an impulse of 1.5 Ns [W], what is its final velocity?

$I = \Delta p = m\Delta v$

$1.5N[w] = (.05)(\Delta v)$



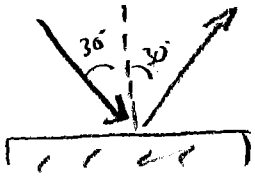
$\Delta v = 30 m/s = v_f - v_i$ (opposite direction)

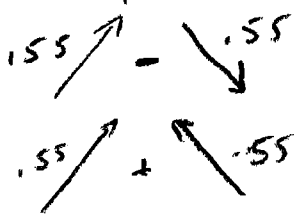
$= v_f - (-11 m/s)$

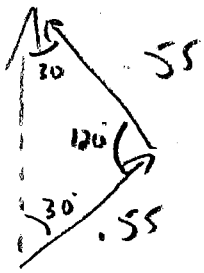
$v_f = 19 m/s$

9. A 0.05 kg ball travelling at 11.0 m/s hits a brick wall at an angle of 30° to the normal and rebounds of at the same angle and speed. Determine the impulse the wall exerts on the ball.

$I = \Delta p = p_f - p_i$







use cos law

$= .95 N \cdot s$ [N]

10. A 2.0 kg object is moving with a velocity of 5.0 m/s west when it collides with a stationary 3.0 kg object. After the collision, the 2.0 kg object is moving west at a velocity of 1.5 m/s. Calculate the velocity of the 3.0 kg object after the collision and show whether the collision is elastic or inelastic.

$p_b = p_a$

$m_1 v_1 + m_2 v_2^{\,0} = m_1 v_1' + m_2 v_2'$

$(2)(5) = (2)(1.5) + (3)v_2'$

$v_2' = 2.33$ [W]

$E_{k_b} = E_{k_a}$

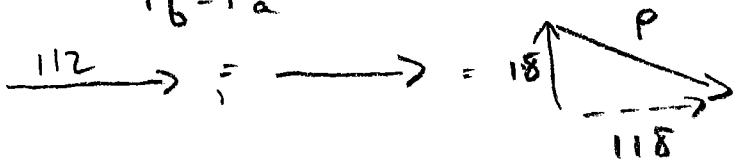
$\frac{1}{2}(2)(5)^2 = \frac{1}{2}(2)(1.5)^2 + \frac{1}{2}(3)(2.33)^2$

$25 J = 10.4 J$

not conserved

11. A 8 kg bowling ball rolling at 14 m/s [E] suddenly explodes into 2 pieces. If a 3 kg piece travels north at 6 m/s determine the speed and direction of the 2nd piece.

$p_b = p_a$



$P = 113.4 = mv$

$v = \frac{113.4}{5} = 22.7 @ 9$ [S of E]

Answers: 1) 71%, 2) 14.7 N, 3) 7.6 N, 4) 584 J, 5)1.64 kgm/s, 6) 14100 N, 7) 9.15 m/s, 8) 19 m/s [W], 9) 0.95 Ns [N], 10) 2.33m/s [W], no, 11) 22.7 m/s @ 9° [S of E]

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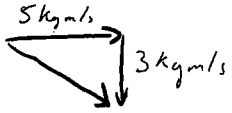
NAME: Key

Momentum Questions

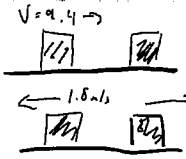
1. A 2.0 kg puck travelling due east at 2.5 m/s collides with a 1.0 kg puck travelling due south at 3.0m/s. They stick together on impact. What is the resultant direction of the combined pucks?

$P_b = P_a$



$\tan\theta = \frac{3}{5}$, $\theta = 31°$

2. A 5.20 kg block sliding at 9.40 m/s across a horizontal frictionless surface collides head on with a stationary 8.60 kg block. The 5.20 kg block rebounds at 1.80 m/s. How much kinetic energy is lost during this collision?



$P_b = P_a$

$m_1v_1 + m_2v_2 = m_1v_1' + m_2v_2'$

$(5.2)(9.4) + 0 = (5.2)(-1.8) + (8.6)(V_2')$

$V_2' = 6.77 \text{ m/s}$

$E_{k_b} = \frac{1}{2}(5.2)(9.4)^2 = 230 \text{ J}$

$E_{k_a} = \frac{1}{2}(5.2)(1.8)^2 + \frac{1}{2}(8.6)(6.77)^2 = 205 \text{ J}$

Loss = 25 J

3. Two carts collide while travelling on a smooth surface. It is found that the sum of the kinetic energies of the carts after the collision is the same as before the collision. This collision must be

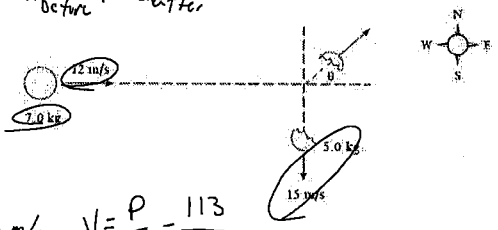
A. elastic. If $E_{k_{before}} = E_{k_{after}}$

B. inelastic.

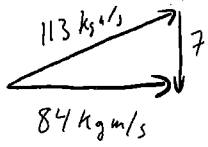
C. between carts of identical mass.

D. between carts that stick together. If $E_{k_{before}} \neq E_{k_{after}}$

4. A 7.0 kg object moving at 12 m/s to the east explodes into two unequal fragments. The larger 5.0 kg fragment moves at 15 m/s south. What is the velocity (speed and direction) of the smaller 2.0 kg fragment?



$P_b = P_a$



$V = \frac{P}{m} = \frac{113}{2} = 56.5 \text{ m/s}$

5. A 0.15 kg ball travelling at 25 m/s strikes a wall and bounces back in the opposite direction at 15 m/s. The ball is in contact with the wall for 0.030 seconds. What average force does the wall exert on the ball?

A. 25 N

B. 50 N

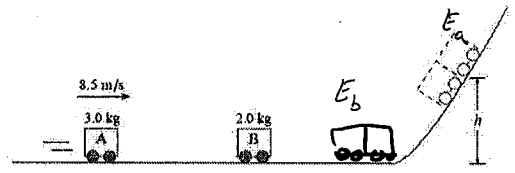
C. 1.0×10^2 N

D. 2.0×10^2 N

$\Delta p = m\Delta v = F\Delta t$

$(.15 \text{ kg})(40) = F(.03)$

6. A 3.0 kg car A travelling 8.5 m s on a frictionless track collides and sticks on to a stationary 2.0 kg car B. The combined cars will reach what height *h*?



$P_b = P_a$

$m_1v_1 + m_2v_2 = (m_1+m_2)v'$

$(3)(8.5) + 0 = 5(v')$

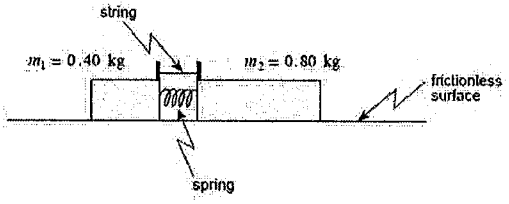
$v' = 5.1\ m/s$

$E_b = E_a$

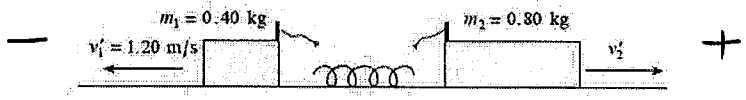
$\frac{1}{2}(5)(5.1)^2 = 5(9.8)h$

$h = 1.33m$

7. Two blocks are initially held together on a frictionless surface as shown in the diagram below.



When the string is cut, the blocks fly apart as shown.



What work was done on the blocks by the spring?

$P_b = P_a$

$0 = (.4)(-1.2) + (.8)(v_2)$

$v_2 = .6\ m/s$

$W = \Delta E$

$= E_k$

$= \frac{1}{2}(.4)(1.2)^2 + \frac{1}{2}(.8)(.6)^2$

$= 0.432\ J$