Unit 2 Practice Test (Chapters 4, 5 & 6) Advanced Physics

Name________________________

1. A 2.0-kg block is held in equilibrium on an incline of 35° by a horizontal force, F, applied by the hanging mass of 1.0kg. What is the coefficient of friction (µ)?

\[ F_m = 9.8N \]
\[ F_N = 19.6N \]
\[ F_\parallel = 19.6N \cos 35° = 16.06N \]
\[ F_\perp = 19.6N \sin 35° = 11.24N \]

\[ F_{\parallel} = F_m + F_N \]
\[ F_{\parallel} = 11.24N - 9.8N = 1.45N \]
\[ \mu = \frac{F_{\parallel}}{F_N} = \frac{1.43N}{16.06N} = 0.089 \]

2. Find the tension in the two wires that support the 100-N light fixture. Each wire makes a 25° angle from the ceiling.

\[ \Sigma F_x = 0 \]
\[ T_1 \cos 25° - T_2 \cos 25° = 0 \]
\[ \Sigma F_y = 0 \]
\[ T_1 \sin 25° + T_2 \sin 25° - 100N = 0 \]
\[ T_1 = T_2 = \frac{100N}{2 \sin 25°} = 118N \]

3. You are in a roller coaster car that has a total mass of 400.0 kg and a velocity of 5.0 m/s at A. It follows the section of track shown below starting at 5.0 meters in the air at A. How high up B will the car go? (Use energy equations.)

\[ E_0 = mgh_0 + \frac{1}{2}mv_0^2 = (400 \times 9.8 \times 2.5m^2) + \frac{1}{2} \times 400 \times (5m/s)^2 = 24000J \]
\[ 24000J = 400 \times 9.8 \times h_0 + \frac{1}{2} \times 400 \times (6m/s)^2 \]
\[ h_f = 6.3m \]

4. A light string connects two masses over a light frictionless pulley as in the diagram below. The 5.00-kg mass is 4.00 m above the floor and the 3kg mass is on the floor.

a. What is the speed of each mass as they pass each other?

\[ E_0 = \frac{1}{2} \times 5 \times (9.8 \times 2.0)^2 + \frac{1}{2} \times 3 \times v^2 \]
\[ 196J = (5 \times 9.8 \times 2) + \frac{1}{2} \times 3 \times v^2 \]
\[ v = 3.15 m/s \]

b. Determine the speed as the 5.00-kg mass hits the ground.

\[ E_f = \frac{1}{2} \times 3 \times (4.33 m/s)^2 = 34J \]
\[ E_{\text{total}} = 147J \]
\[ 147J = 3 \times 9.8 \times h + 34J \]
\[ h = 1m \text{ higher} \]

5. How much higher will the 3.00-kg mass go after the 5.00-kg mass hit the ground?

\[ KE_0 = \frac{1}{2} \times 3 \times v_0^2 \]
\[ v_0 = 4.43 m/s \]
5. A 15g bullet is shot at 300.0 m/s by a 5.00 kg gun. What is the velocity of the recoil of the gun?

\[ P_0 = 0 \text{ kg m/s} \]
\[ P_{\text{Bullet}} + P_{\text{Gun}} = 0 \text{ kg m/s} \]
\[ P_{\text{Bullet}} = 0.015 \text{ kg} \times 300 \text{ m/s} = 4.50 \text{ kg m/s} \]
\[ 4.50 \text{ kg m/s} = 5.00 \text{ kg} V_{\text{Gun}} \]
\[ V_{\text{Gun}} = 0.90 \text{ m/s} \]

6. How long will it take to stop a 2.0x10^4 kg train moving at .50 m/s, if the average force it applies to the wall below is 8333 N?

\[ F \Delta t = \Delta P \]
\[ -8333 \text{ N} \Delta t = 2 \times 10^4 \text{ kg} \cdot 0 \text{ m/s} - 2 \times 10^4 \text{ kg} \cdot 0.50 \text{ m/s} \]
\[ \text{equal and opposite} \]
\[ \Delta t = 1.25 \text{ s} \]

7. What is the initial momentum of a 500.0 kg bumper car that strikes a glancing blow on a 450.0 kg car? The first car has a final speed of 8.00 m/s at 25° N of E and the second car travels at 10.0 m/s at 30.0° S of E.

\[ \tan \theta = \frac{540 \text{ kg m/s}}{7522 \text{ kg m/s}} \]
\[ \theta = 4.25^\circ \text{ S of E} \]