Name:

Make your work clear to the grader. Show formulas used. Give correct units and significant figures. Partial credit is available if your work is clear. Point values are given in parenthesis. Exact conversions: 1 inch = 2.54 cm, 1 ft = 12 in., 1 mile = 5280 ft. Prefixes: f=10^{-15}, p=10^{-12}, n=10^{-9}, $\mu = 10^{-6}$, m=10^{-3}, c=10^{-2}, k=10^3, M=10^6, G=10^9, T=10^{12}, P=10^{15}. Use g=9.80 m/s^2.

1. (2) A car is moving down a straight road at constant speed. The net force on the car is equal to

   a. the normal force of the road on its tires. b. the friction force of the road on the tires.
   c. the difference of the gravitational force and normal force. d. zero.

2. (2) In a football game, KSU's 250-lb quarterback runs head-on into Nebraska's 320-lb tackle. While our quarterback is plowing over the Nebraska tackle, what is true about the magnitudes of the forces?

   a. The force of the QB on the tackle is greater than the force of the tackle on the QB.
   b. The force of the QB on the tackle is less than the force of the tackle on the QB.
   c. The force of the QB on the tackle is equal to the force of the tackle on the QB.

3. (2) A car accelerates forward on a straight level road at an acceleration of 0.75g. Which force acting on the car has the greatest magnitude?

   a. the normal force of the pavement on the tires. b. the friction from the pavement on the tires.
   c. air resistance slowing the car down. d. the gravitational force.

4. (2) The acceleration of a block sliding down a frictionless incline with an angle θ above horizontal is

   a. g b. $g\cos\theta$ c. $g\sin\theta$ d. $g\tan\theta$.

5. (2) A block has been propelled up an incline of angle θ above the horizontal, and now is "coasting" up the incline with no applied force pushing it. The magnitude of its acceleration along the incline is

   a. g b. $g\cos\theta$ c. $g\sin\theta$ d. $g\tan\theta$.

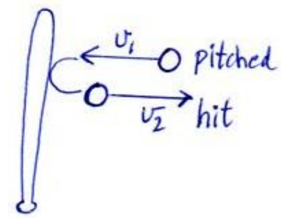
6. (14) A bucket of sand of total mass 3.6 kg is suspended from a rope as shown. At a certain instant of time, the tension in the rope is 45 newtons.

a) (6) What is the net force on the sand bucket at this instant?

b) (4) What, if any, is the instantaneous acceleration of the sand bucket? Give its magnitude and direction.

c) (4) At this instant, is the sand bucket moving up or down? Explain.

7. (6) A 145-gram baseball moving horizontally at 44 m/s is hit by the batter and flies away in the opposite direction at 56 m/s. If it was in contact with the bat for 5.0 ms, what was the average force of the bat on the ball?



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8. (3) A 22-kg box sets on a level surface. It requires a horizontal force of 65 N to get it started moving. The coefficient of static friction between the box and the surface is

a. 0.0 b. 0.10 c. 0.20 d. 0.30 e. 0.34

9. (3) The 22-kg box of question 8 exhibits an acceleration of 2.0 m/s^2 once it starts moving, when the 65 N horizontal force is applied. The coefficient of kinetic friction is

a. 0.091 b. 0.097 c. 0.22 d. 0.45 e. 0.68

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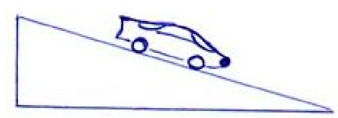
10. (14) A 1800-kg car is going down a 8.4° incline and applying the brakes. The coefficients of static and kinetic friction between tires and road are $\mu_s = 0.80$ and $\mu_k = 0.60$. The driver is applying the brakes to get the maximum effect without causing the wheels to lock or the tires to skid.



a) (4) Determine the magnitude of the component of the gravitational force on the car, acting along the incline.

b) (6) Determine the magnitude of the total friction force of the road on the tires.

c) (4) How large is the acceleration of the car, and is it up or down the incline?

Chapter 4 Equations

Newton's Second Law:

$\vec{F}_{\text{net}} = m\vec{a}$, which means $\Sigma F_x = ma_x$ and $\Sigma F_y = ma_y$.

Static friction (magnitude):

$f_s \leq \mu_s N$ or $F_{\text{fr}} \leq \mu_s F_N$.

Kinetic or sliding friction (magnitude):

$f_k = \mu_k N$ or $F_{\text{fr}} = \mu_k F_N$.

Gravitational force near Earth:

$F_G = mg$, downward.

Acceleration Equations

$\bar{v} = \frac{\Delta x}{\Delta t}, \quad \Delta x = x - x_0, \quad \text{slope of } x(t) = v(t).$

$\bar{a} = \frac{\Delta v}{\Delta t}, \quad \Delta v = v - v_0, \quad \text{slope of } v(t) = a(t).$

For constant acceleration in one-dimension:

$\bar{v} = \frac{1}{2}(v_0 + v), \quad v = v_0 + at, \quad x = x_0 + v_0 t + \frac{1}{2}at^2, \quad v^2 = v_0^2 + 2a(x - x_0).$

Vectors

Written $\vec{V}$ or $\mathbf{V}$, described by magnitude$=V$, direction$=\theta$ or by components (V_x, V_y).

$V_x = V\cos\theta, \quad V_y = V\sin\theta,$

$V = \sqrt{V_x^2 + V_y^2}, \quad \tan\theta = \frac{V_y}{V_x}.$ $\quad$ θ is the angle from $\vec{V}$ to $+x$-axis.

Addition: $\mathbf{A} + \mathbf{B}$, head to tail. Subtraction: $\mathbf{A} - \mathbf{B}$ is $\mathbf{A} + (-\mathbf{B})$, $-\mathbf{B}$ is $\mathbf{B}$ reversed.

Trig summary

$\sin\theta = \frac{(\text{opp})}{(\text{hyp})}, \quad \cos\theta = \frac{(\text{adj})}{(\text{hyp})}, \quad \tan\theta = \frac{(\text{opp})}{(\text{adj})}, \quad (\text{hyp})^2 = (\text{opp})^2 + (\text{adj})^2.$