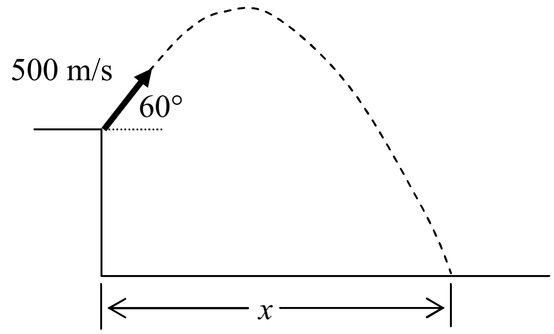
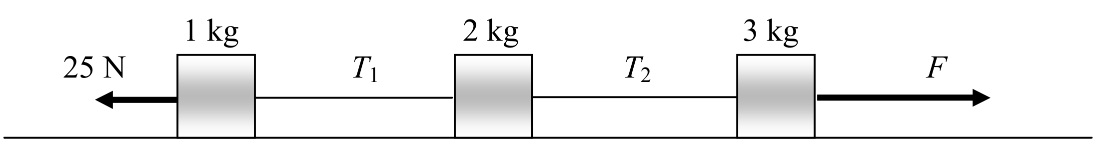
*Directions: Solve each problem using the formulas listed on the last page. Show your work to receive full credit. Box your final answer and record its appropriate unit.*

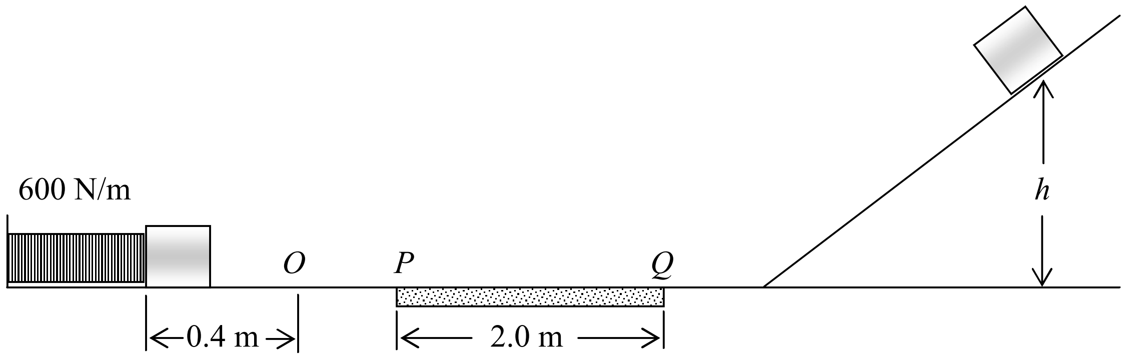



1) A model rocket is launched from a tall cliff (height 380 m) with an initial velocity of 500 m/s at an angle of 60° to the horizontal. The rocket crashes $x$ meters from the base of the cliff. Calculate
(A) the time it takes the rocket to reach the ground.
(B) the distance $x$ along the ground.

2) A plane travels 170 miles southeast, 60 miles east, and 40 miles at 20° north of east. Calculate
(A) the magnitude of the total displacement
(B) direction (angle) of the total displacement.

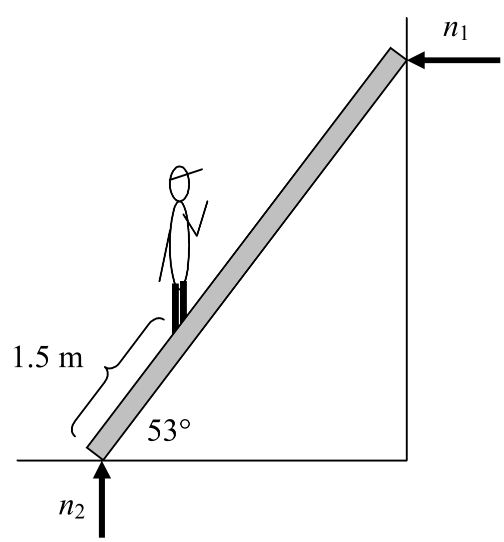



3) Three blocks are connected by two light strings as shown above. The system is accelerated by a force $F$ at 8.0 m/s$^2$ to the right along a horizontal surface. The 1-kg block experiences a 25-N force of kinetic friction. Calculate
(A) force $F$.
(B) tension $T_1$.
(C) tension $T_2$.




4) A 2.5-kg block is compressed 0.4 m against a horizontal spring of constant 600 N/m. When it is released, the block leaves the spring at point $O$. Between points $P$ and $Q$, the block experiences kinetic friction with a coefficient of 0.33. After passing point $Q$, the block then slides up a ramp to a maximum height $h$. Calculate
(A) the total mechanical energy of the block at point $O$.
(B) the total mechanical energy of the block at point $Q$.
(C) the maximum height $h$.

5) A 0.05-kg bullet is shot to the right toward a 1.5-kg target initially at rest on a flat frictionless surface. The bullet lodges in the target and the bullet-target system moves at 10 m/s to the right. Calculate
(A) the impulse experienced by the target.
(B) the impulse experienced by the bullet.
(C) the initial velocity of the bullet.




6) An 80-kg painter stands 1.5 m from the bottom of a uniform ladder of mass 20 kg and length 5.0 m. The ladder sits at an angle of 53° to the floor as shown above. Find
(A) normal force $n_1$. (*Hint*: Use CW = CCW with the pivot at the bottom of the ladder.)
(B) normal force $n_2$. (*Hint*: Use UP = DOWN.)

7) A grinding wheel rotating at 400 rpm takes 1 minute to come to rest. The wheel has a rotational inertia of 0.0648 kg-$m^2$. Find
(A) its angular acceleration in rad/$s^2$.
(B) the number of revolutions it makes during this time interval.
(C) the net torque acting on it.

8) A 0.5-kg mass is attached to a horizontal spring. The mass is pulled a distance of 0.40 m away from its equilibrium position and then is released. The system undergoes simple harmonic motion, attaining a maximum speed of 6.4 m/s. Calculate
(A) the angular frequency in rad/s.
(B) the spring constant in N/m.
(C) the period of oscillation in seconds.
(D) the maximum spring force in N.

9) A van is traveling at 32 m/s north along a two-way street. An ambulance approaches the van at 30 m/s in the southbound lane. The frequency of the sound emitted by the ambulance's siren is 780 Hz. Assume that the speed of sound equals 331 m/s. Calculate the frequency heard by the van.

10) 2.0 moles of an ideal gas are kept at a constant temperature of 57° C while it expands to twice its volume. Calculate
(A) the work done by the gas.
(B) the change in entropy of the gas.

# PHYS 218 FINAL EXAM FORMULA SHEET

$F_{net} = ma$ $w = mg$ $f = \mu n$ $F_{grav} = \dfrac{Gm_1m_2}{r^2}$

$s_{av} = \dfrac{d}{t}$ $v_{av} = \dfrac{\Delta x}{t}$ $a_{av} = \dfrac{\Delta v}{t}$ $G = 6.67\times10^{-11}\ \text{N·m}^2/\text{kg}^2$

$v_f = v_i + at$ $\Delta y = v_i t + \frac{1}{2}at^2$ $\Delta x = v_x t$ $g = 9.8\ \text{m/s}^2$

$v_f^2 = v_i^2 + 2a\Delta y$ $\Delta y = \frac{1}{2}(v_i + v_f)t$ $a = -g$ (free fall)

$d = r\Delta\theta$ $v = r\omega$ $\omega = \dfrac{2\pi}{T}$ $a_c = \dfrac{v^2}{r} = \omega^2 r$ $F_c = ma_c$

1 rev = 2π rad = 360° $v_{orb} = \sqrt{\dfrac{GM}{r}}$ $v_{orb} = \dfrac{2\pi r}{T}$ $a_T = r\alpha$

$\omega_f = \omega_i + \alpha t$ $\Delta\theta = \frac{1}{2}(\omega_f + \omega_i)t$ $\omega_f^2 = \omega_i^2 + 2\alpha\Delta\theta$ $\Delta\theta = \omega_i t + \frac{1}{2}\alpha t^2$

$W = F\Delta x\cos\theta$ $W_f = -\mu_k n\Delta x$ $P = \dfrac{\Delta E}{t}$ $K = \frac{1}{2}mv^2$ $U_{grav} = mgy$

$U_{elastic} = \frac{1}{2}kx^2$ $E = K + U$ $E_1 + W_f = E_2$ $p = mv$ $\Delta p = m\Delta v = F_{net}t$

$\tau = rF\sin\theta$ $\tau_{net} = I\alpha$ $K_{rot} = \frac{1}{2}I\omega^2$ $L = I\omega$

$P = \dfrac{F}{A}$ $P = P_{atm} + P_{gauge}$ $\dfrac{F_1}{A_1} = \dfrac{F_2}{A_2}$ $\rho = \dfrac{m}{V}$ $P = P_{atm} + \rho gd$ $\dfrac{\Delta V}{t} = Av$

$1\ \text{atm} = 1.013\times10^5\ \text{Pa}$ $1\ \text{g/cm}^3 = 1000\ \text{kg/m}^3$ $A_1v_1 = A_2v_2$ $P + \frac{1}{2}\rho v^2 + \rho gy = \text{const}$

$\dfrac{F}{A} = Y\cdot\dfrac{\Delta L}{L}$ $F_{spring} = -kx$ $\omega_{spring} = \sqrt{\dfrac{k}{m}}$ $\omega_{pend} = \sqrt{\dfrac{g}{L}}$ $v_{\max} = \omega A$ $a_{\max} = \omega^2 A$

$f = \dfrac{1}{T}$ $\omega = 2\pi f$ $v = f\lambda$ $v_{string} = \sqrt{\dfrac{F_T}{\mu}}$ $\mu = \dfrac{m}{L}$ $f_n = nf_1$ $f_1 = \dfrac{v}{2L}$

$I = \dfrac{P}{4\pi r^2}$ $I_1r_1^2 = I_2r_2^2$ $\beta = 10\log\left(\dfrac{I}{I_0}\right)$ $I = 10^{\frac{\beta}{10}-12}$ $I_0 = 10^{-12}\ \text{W/m}^2$ $f_o = \left(\dfrac{v - v_o}{v - v_s}\right)\cdot f_s$

$Q = mc\Delta T$ $Q = mL$ $\Delta U = Q + W$ $W_{isobaric} = P(V_i - V_f)$ $W_{isothermic} = nRT\ln\left(\dfrac{V_i}{V_f}\right)$

$Q_H = |Q_C| + |W|$ $e = \dfrac{|W|}{Q_H}$ $e_{\max} = 1 - \dfrac{T_C}{T_H}$ $\Delta S = \dfrac{Q}{T}$ $R = 8.31\ \text{J/(mol-K)}$