General College Physics I (PHY 103)

Exam 1

Fall 2018

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Equation Sheet

$x = x_0 + vt$	$\theta = \theta_0 + \omega t$
$v = v_0 + at$	$\omega = \omega_0 + \alpha t$
$x = x_0 + v_0 t + \frac{1}{2}at^2$	$\theta = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2$
$v^2 = v_0^2 + 2a(x - x_0)$	$\omega^2 = \omega_0^2 + 2\alpha(\theta - \theta_0)$
$F_{\text{net}} = ma$	$\tau_{\text{net}} = I\alpha$
$F_{\text{gravity}} = mg$	$F = -kx$
$V_x = V\cos\theta$	$x = x_0 \cos\omega(t - t_0)$
$V_y = V\sin\theta$	$v = -\omega x_0 \sin\omega(t - t_0)$
$V = \sqrt{V_x^2 + V_y^2}$	$a = -\omega^2 x_0 \cos\omega(t - t_0)$
$\tan\theta = V_y/V_x$	$\omega = \sqrt{k/m},\ \omega = \sqrt{g/l}$
$a_{\text{R}} = v^2/r$	$a_{\tan} = r\alpha$
$F = Gm_1m_2/r^2$	$f = 1/T$
$F_{\text{fr}} = \mu_k F_{\text{N}}$	$\omega = 2\pi f$
$F_{\text{fr}} \leq \mu_s F_{\text{N}}$	$v = \lambda/T$
$W = F_{\vert\vert}d = Fd_{\vert\vert} = Fd\cos\theta$	$\tau = rF_{\perp} = r_{\perp}F = rF\sin\theta$
$\text{KE} = \frac{1}{2}mv^2$	$\text{KE} = \frac{1}{2}I\omega^2$
$W_{\text{net}} = \Delta\text{KE}$	
$\text{PE}_{\text{grav}} = mgh$	$\Delta E_{\text{th}} = mc\Delta T$
$\text{PE}_{\text{spring}} = \frac{1}{2}kx^2$	$F_{\text{spring}} = -kx$
$\text{ME} = \text{KE} + \text{PE}$	$s = r\theta$
$W_{\text{net,NC}} = \Delta\text{ME}$	$v = r\omega$
$\mathbf{p} = m\mathbf{v}$	$L = I\omega$
$\Delta\mathbf{P} = \mathbf{F}_{\text{net,ext}}\Delta t$	

$g = 9.8 \text{ m/s}^2$

$G = 6.67 \times 10^{-11} \text{ N} \cdot \text{m}^2/\text{kg}^2$

$R = 8.314 \text{ J/mol} \cdot \text{K} = 0.0821 \text{ L} \cdot \text{atm/mol} \cdot \text{K}$

$k = 1.38 \times 10^{-23} \text{ J/K}$

1 mi = 1609 m

1 atm = 101,325 N/m^2

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$C = 2\pi r$$

$$A = \pi r^2$$

Earth mass	5.98×10^{24} kg
Moon mass	7.35×10^{22} kg
Sun mass	1.99×10^{30} kg
Earth radius (mean)	6.38×10^{6} m
Moon radius (mean)	1.74×10^{6} m
Sun radius (mean)	6.96×10^{8} m
Earth-Moon distance (mean)	3.84×10^{8} m
Earth-Sun distance (mean)	1.496×10^{11} m

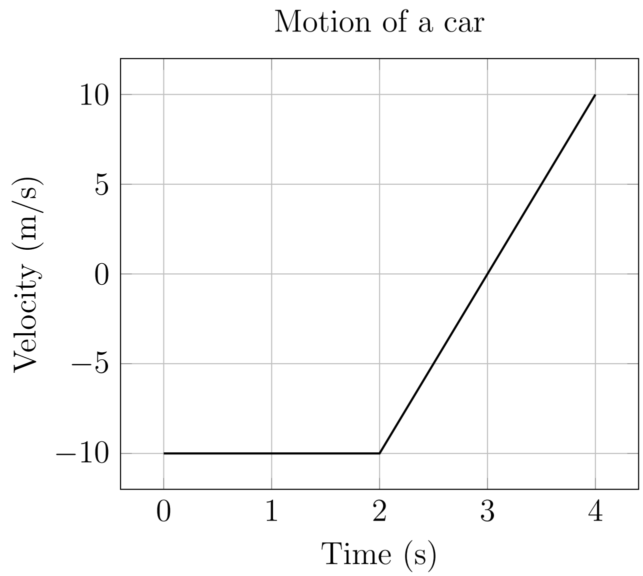
Substance	Specific Heat (J/kg·°C)
Aluminum	900
Copper	390
Iron or steel	450
Lead	130
Silver	230
Water	
Ice (-5°C)	2100
Liquid (15°C)	4186
Steam (110°C)	2010

Substance	Melting Point (°C)	Heat of Fusion (J/kg)	Boiling Point (°C)	Heat of Vaporization (J/kg)
Water	0	333,000	100	2.26×10^{6}
Lead	327	25,000	1750	870,000

Object	Axis	Moment of Inertia
Solid cylinder	central axis	$I = \frac{1}{2}MR^2$
Cylindrical shell	central axis	$I = MR^2$
Solid ball	central axis	$I = \frac{2}{5}MR^2$
Rod	through center $\perp$ to rod	$I = \frac{1}{12}ML^2$
Rod	through end $\perp$ to rod	$I = \frac{1}{3}ML^2$

Question 1 (4 points) Two cars emerge side by side from a tunnel. Car A is traveling with a speed of 60 km/h and has an acceleration of 40 km/h/min. Car B has a speed of 40 km/h and has an acceleration of 60 km/h/min. Which car is passing the other as they come out of the tunnel? Explain your reasoning.

Question 2 (4 points) The horizontal motion of a car is shown in the graph below. Sketch graphs of position and acceleration as functions of time for this car.



Question 3 (4 points) A car is heading east while the driver turns left and increases speed. Draw vectors for the velocity and acceleration of this car.

Question 4 (4 points) Can the magnitude of a vector ever (a) equal, or (b) be less than, one of its components?

Problem 1 (8 points) There is a song in which a driver is instructed to be silent, and to take charge of a car that can accelerate "from 0 to 60 in 3.5". Assuming the "0 to 60" describes velocity in miles per hour, and the "3.5" describes the time, in seconds, required to achieve that change in velocity, how far does this car travel in that 3.5 seconds?

Problem 2 (8 points) A shot-putter throws the “shot” (mass = 8.04 kg) with an initial speed of 18.0 m/s at a 46.6° angle to the horizontal. Calculate the horizontal distance traveled by the shot if it leaves the athlete’s hand at a height of 0.847 m above the ground.

Problem 3 (8 points) A football is kicked at ground level with a speed of 18.0 m/s at an angle of 31.0° to the horizontal. How much later does it hit the ground?