1. (10pts) A car travels 20 kilometers at an average speed of 80 km/h and then stops for 15 minutes to get fuel. It then continues on in the same direction for 20 kilometers at an average speed of 40 km/h in the same direction. The average speed of the car for this 40-km trip is about:

(a) 40 km/h
(b) 45 km/h
(c) 48 km/h
(d) 53 km/h
(e) 60 km/h

2. (10pts) Consider the two vectors $\vec{A} = 5\hat{i} + 4\hat{j}$ and $\vec{B} = -3\hat{i} + 10\hat{j}$.
What is the magnitude of $\vec{C} = \vec{A} - \vec{B}$?

(a) 2.3
(b) 7
(c) 9
(d) 10
(e) 15.4

(Use this information for Problems 3 and 4)
A model rocket is fired vertically from ground level, starting from rest. It ascends with a vertical acceleration of $5\ \mathrm{m/s^2}$ for 10.0 s. Its fuel is then exhausted, so it continues upward as a free-fall particle and then falls back down to the ground.

3. (5pts) What is the speed of the rocket when the fuel runs out?

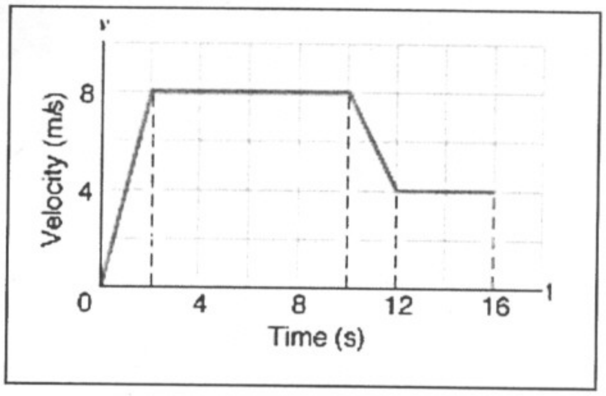
(a) 100 m/s
(b) 50 m/s
(c) 5 m/s
(d) -9.8 m/s
(e) zero

4. (10pts) What is the speed of the rocket 13 s after launch?

(a) zero
(b) 9.8 m/s
(c) 20.6 m/s

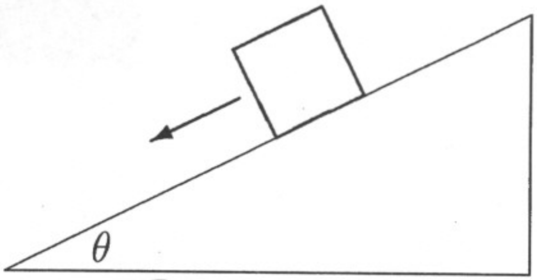
(d) 50 m/s
(e) not enough information given

5. (10pts) How far does the runner, whose velocity-time graph is shown below, travel between t = 8s and t = 16s?



(a) 64 m
(b) 46 m
(c) 44 m
(d) 32 m
(e) 10 m

6. (5pts) A 10 kg block is allowed to slide down a long frictionless incline. The angle of the incline is θ = 30 deg. If it starts from rest, what will its speed be after sliding 1.63 m along the incline?



(a) zero
(b) 1.5 m/s
(c) 3.3 m/s
(d) 9.8 m/s
(e) 4.0 m/s

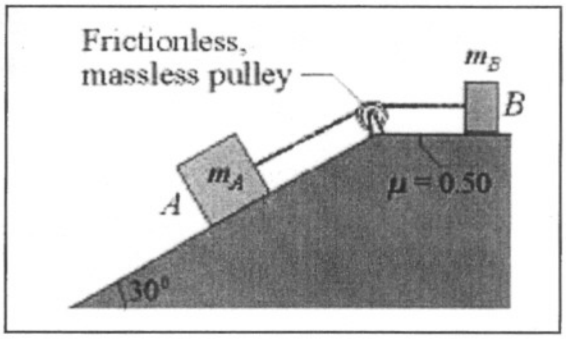
7. (5pts) A football is thrown at angle of 50 deg into the air. Which statement below is true about the highest point of the football's motion?

(a) The football's speed is zero.
(b) The horizontal component of football's velocity is zero.
(c) The vertical component of football's velocity is zero.
(d) The football's acceleration is zero.
(e) The magnitude of the football's vertical and horizontal velocities are the same.

(Use this information for Problems 8, 9, and 10)
Block *A* in the figure below has mass $m_A = 8.0$ kg and is sliding down the ramp. Block *B* has mass $m_B = 4.0$ kg. The coefficient of kinetic friction between block *B* and the horizontal plane is 0.50. The inclined plane is frictionless and at angle 30°.

8. (5pts) What is the frictional force on m_B?

(a) 19.6 N
(b) 39.2 N
(c) 5.3 N
(d) zero
(e) its equal to the tension in the string



9. (10pts) What is the magnitude of the acceleration of the blocks?

(a) 9.8 m/s^2
(b) 5.2 m/s^2
(c) 3.3 m/s^2
(d) 1.6 m/s^2
(e) it can't be determined without further information

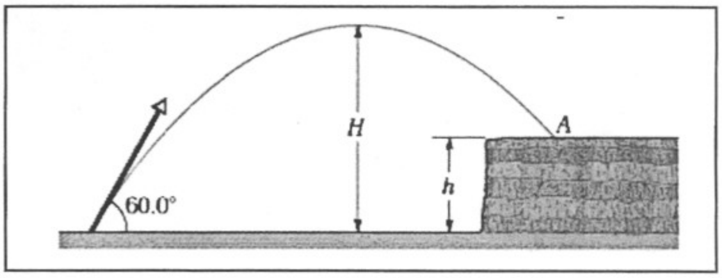
10. (5pts) What is the tension in the string connecting the blocks?

(a) 39.2 N
(b) 30.1 N
(c) 26.1 N
(d) 19.6 N
(e) 13.1 N

(Use this information for Problems 11 and 12)
In the figure below, a stone is projected at a cliff of height $h = 60$ m with an initial speed of 75.0 m/s directed 60.0° above the horizontal.

11. (10pts) When does the stone strike the top of the cliff?

(a) 12.3 s
(b) 9.8 s
(c) 4.3 s
(d) 1.0 s
(e) 0.5 s



12. (5pts) What is the speed of the stone just before it hits the cliff?

(a) zero
(b) 9.8 m/s
(c) 55 m/s
(d) 67 m/s
(e) 38 m/s

13. (5pts) An astronaut on the space station whirls a 0.5 kg mass attached to a string in a circle of radius 1.6 m. If the speed of the mass is 8 m/s, what is the tension in the string?

(a) 64 N
(b) 32 N
(c) 20 N
(d) 4.9 N
(e) none of the above

14. (5pts) Two forces are applied to a 2 kg object floating out in space. One force has a magnitude of 20 N and the other has magnitude of 30 N. Which of the following represent the minimum and maximum of the possible acceleration that the object can have, depending on the relative directions of the two forces? (consider magnitudes only)

(a) 0.0 m/s^2, 15 m/s^2
(b) 0.0 m/s^2, 10 m/s^2
(c) 2.1 m/s^2, 4.4 m/s^2
(d) 5.0 m/s^2, 25.0 m/s^2
(e) 0.0 m/s^2, 8.3 m/s^2

Formula Sheet for LSU Physics 2101 Exams, Fall '09

Units:

$1\,\text{m} = 39.4\,\text{in} = 3.28\,\text{ft}$ $\quad 1\,\text{mi} = 5280\,\text{ft}$ $\quad 1\,\text{min} = 60\,\text{s},\quad 1\,\text{day} = 24\,\text{h}$ $\quad 1\,\text{rev} = 360° = 2\pi\,\text{rad}$

$1\,\text{atm} = 1.013{\times}10^5\,\text{Pa}$ $\quad 1\,\text{cal} = 4.187\,\text{J}$ $\quad T = \left(\frac{1\,K}{1°\text{C}}\right) T_\text{C} + 273.15\,\text{K}$ $\quad T_\text{F} = \left(\frac{9\,°\text{F}}{5°\text{C}}\right) T_\text{C} + 32°\text{F}$

Constants:

$\text{g} = 9.8\,\text{m/s}^2$ $\quad \text{R}_{Earth} = 6.37 \times 10^6\,\text{m}$ $\quad \text{M}_{Earth} = 5.98{\times}10^{24}\,\text{kg}$

$\text{G} = 6.67{\times}10^{-11}\,\text{m}^3/(\text{kg}{\cdot}\text{s}^2)$ $\quad \text{R}_{Moon} = 1.74 \times 10^6\,\text{m}$ $\quad \text{M}_{Moon} = 7.36{\times}10^{22}\,\text{kg}$

Earth-Sun distance $= 1.50{\times}10^{11}\,\text{m}$ $\quad \text{M}_{Sun} = 1.99{\times}10^{30}\,\text{kg}$ $\quad$ Earth-Moon distance $= 3.82{\times}10^8\,\text{m}$

$k = 1.38 \times 10^{-23}\,\text{J/K}$ $\quad R = 8.31\,\text{J/(mol}{\cdot}\text{K)}$ $\quad$ Avogadro's # $= 6.02 \times 10^{23}$ particles/mol

Properties of H_2O:

Density:	$\rho_\text{water} = 1000\ \text{kg/m}^3$	
Specific heat:	$c_\text{water} = 4187\ \text{J/(kg K)}$	$c_\text{ice} = 2220\ \text{J/(kg K)}$
Heats of transformation:	$L_\text{vaporization} = 2.256 \times 10^6\ \text{J/kg}$	$L_\text{fusion} = 3.33 \times 10^5\ \text{J/kg}$

Quadratic formula: for $ax^2 + bx + c = 0,\ \ x_{1,2} = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Magnitude of a vector: $|\vec{a}| = \sqrt{a_x^2 + a_y^2 + a_z^2}$

Dot Product: $\vec{a} \cdot \vec{b} = a_x b_x + a_y b_y + a_z b_z = |\vec{a}|\,\left|\vec{b}\right| \cos(\phi)$ (ϕ is smaller angle between $\vec{a}$ and $\vec{b}$)

Cross Product: $\vec{a} \times \vec{b} = (a_y b_z - a_z b_y)\hat{\imath} + (a_z b_x - a_x b_z)\hat{\jmath} + (a_x b_y - a_y b_x)\hat{k}, \quad \left|\vec{a} \times \vec{b}\right| = |\vec{a}|\,\left|\vec{b}\right| \sin(\phi)$

Equations of Constant Acceleration:

linear equation along x	missing	missing	rotational equation
$v_x = v_{ox} + a_x t$	$x - x_o$	$\theta - \theta_o$	$\omega = \omega_o + \alpha_x t$
$x - x_o = v_{ox} t + \frac{1}{2} a_x t^2$	v_x	ω	$\theta - \theta_o = \omega_o t + \frac{1}{2}\alpha t^2$
$v_x^2 = v_{ox}^2 + 2a_x(x - x_o)$	t	t	$\omega^2 = \omega_o^2 + 2\alpha(\theta - \theta_o)$
$x - x_o = \frac{1}{2}(v_{ox} + v_x)t$	a_x	α	$\theta - \theta_o = \frac{1}{2}(\omega_o + \omega)t$
$x - x_o = v_x t - \frac{1}{2} a_x t^2$	v_{ox}	ω_o	$\theta - \theta_o = \omega t - \frac{1}{2}\alpha t^2$

Vector Equations of Motion for Constant Acceleration: [illegible] $= \vec{r}_o + \vec{v}_o t + \frac{1}{2}\vec{a}t^2, \quad \vec{v} = \vec{v}_o + \vec{a}t$

Projectile Motion: (with + direction pointing up from Earth)

$x - x_o = (v_o \cos\theta_o)t$ $\qquad y - y_o = (v_o \sin\theta_o)t - \frac{1}{2}gt^2$

$v_x = v_o \cos\theta_o$ $\qquad v_y = (v_o \sin\theta_o) - gt$

$v_y^2 = (v_o \sin\theta_o)^2 - 2g(y - y_o)$ $\qquad y = (\tan\theta_o)x - \dfrac{gx^2}{2(v_o \cos\theta_o)^2}$ $\qquad R = \dfrac{v_o^2 \sin(2\theta_o)}{g}$

Newton's Second Law: $\sum \vec{F} = m\vec{a}$

Uniform circular motion: $F_c = \dfrac{mv^2}{r} = ma_c \quad T = \dfrac{2\,\pi\,r}{v}$

Force of Friction: Static: $f_s \leq f_{s,max} = \mu_s F_N$, Kinetic: $f_k = \mu_k F_N$

Elastic (Spring) Force: Hooke's Law $F = -kx$ (k = spring (force) constant)

Kinetic Energy (nonrelativistic): Translational $K = \frac{1}{2}mv^2$

Work:

$W = \vec{F} \cdot \vec{d}$ (constant force), $W = \int_{x_i}^{x_f} F(x)\,dx$ (variable 1-D force), $W = \int_{r_i}^{r_f} \vec{F}(\vec{r}) \cdot d\vec{r}$ (variable 3-D force)

Work - Kinetic Energy Theorem: $W = \Delta K = K_f - K_i$ where W is the *net* work