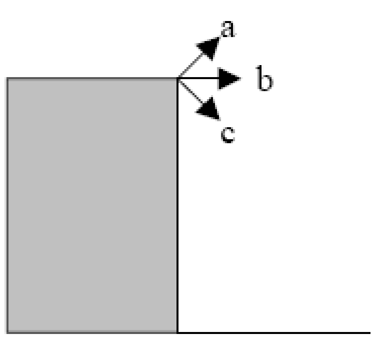
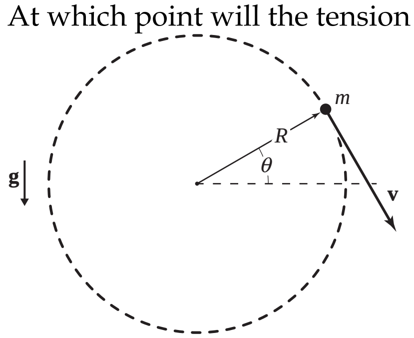
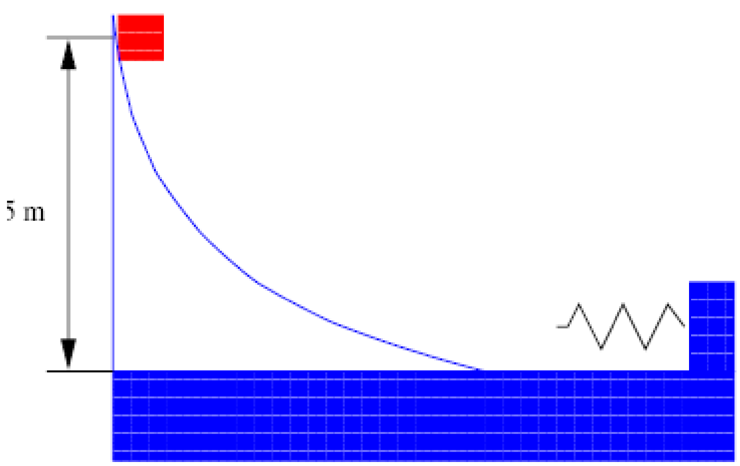
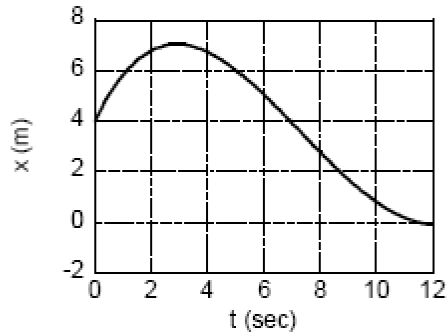
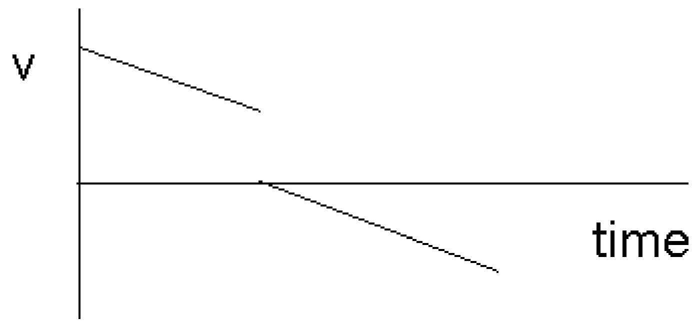
Final on DEC 09 2009 - Physics 105 – R. Schad

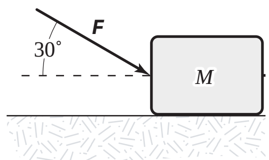
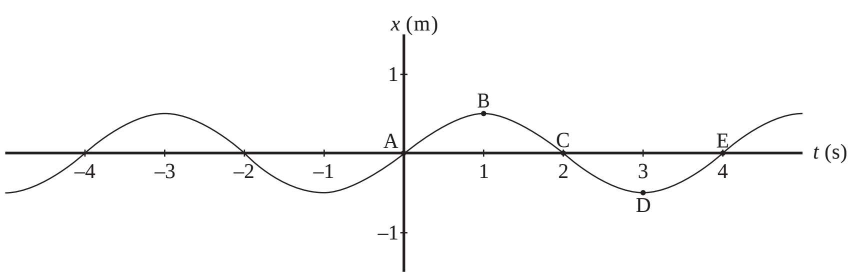
YOUR NAME

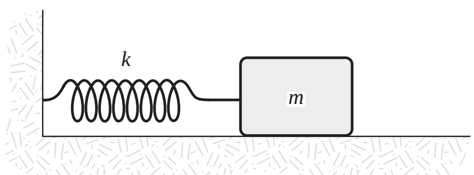
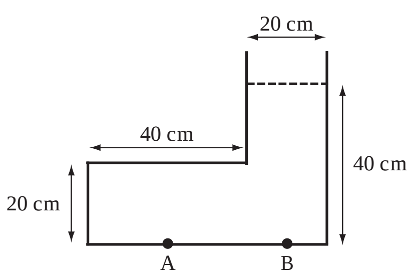
name & student number on the answer sheet

1.	**This is to identify the exam version you have – IMPORTANT** **Mark the A**
2.	**This is to identify the exam version you have – IMPORTANT** **Mark the B**
3.	1. A projectile is fired from the edge of a building with a speed v_0. Assume air resistance can be neglected. Which of the directions shown will give the largest speed just before it hits the ground? (a) direction a (b) direction b (c) direction c (d) all the same (e) none of these 
4.	An object attached to the end of a string swings in a vertical circle (R = 1.2 m) with constant speed [here on earth]. At which point will the tension of the string have the smallest value?  **a.** everywhere the same **b.** at the top **c.** at the bottom **d.** left and right

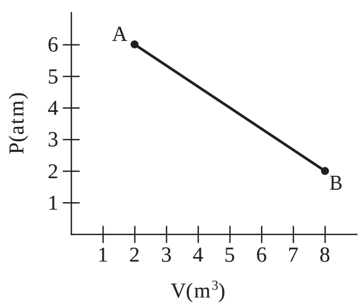
5.	An object undergoes un-damped simple harmonic oscillation. (a) The total mechanical energy is always equally divided between kinetic energy and potential energy. (b) The total mechanical energy of the oscillator is proportional to the amplitude of the oscillation. (c) The restoring force of the oscillatory system is constant in time. (d) The maximal value of the potential energy equals the maximal value of the kinetic energy.
6.	In absence of any force a moving object will: (a) Slow down and eventually stop. (b) Immediately come to rest. (c) Go faster and faster. (d) Move at constant velocity.
7.	A ball is thrown straight up. When it reaches the highest point: (a) Its velocity and acceleration are both zero. (b) Its velocity is zero, but its acceleration is not zero. (c) Neither its velocity, nor its acceleration is zero. (d) Its acceleration is zero, but its velocity is not zero.
8.	A small block with a mass of 100 g is released from a height of 5 m as shown in the figure. The block following a curved path transitions to a linear horizontal path and hits the spring fixed to a wedge. If no friction is involved and the spring constant is 1000 N/m, find the maximum compression of the spring.  (a) 0.1 m (b) 0.2 m (c) 3.1 m (d) 9.8 m

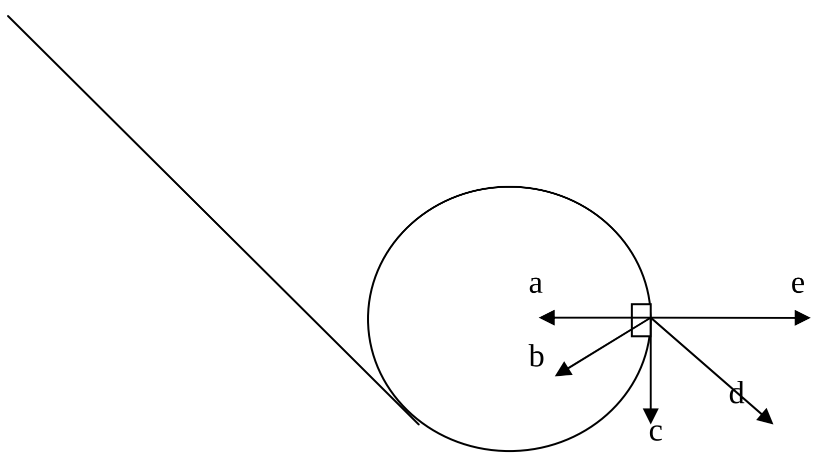
9.	The position of a particle is given in the graph below as a function of time.  At what time is the acceleration approximately zero? a) 0 sec b) 3 sec c) 8 sec d) 12 sec
10.	The graph below shows the velocity versus time graph for a ball. Which explanation best fits the motion of the ball as shown by the graph?  **a.** The ball is falling, is caught, and is thrown down with greater speed. **b.** The ball is rolling, stops, and then continues rolling. **c.** The ball is rising, hits the ceiling, and falls down. **d.** The ball is falling, hits the floor, and bounces up. **e.** The ball is rising, is caught, and then is allowed to fall.

11.	The horizontal surface on which the block slides is frictionless. If *F* = 20 N, acting at an 30º angle, and *M* = 5.0 kg, what is the magnitude of the resulting acceleration of the block?  **a.** 5.3 m/s^2 **b.** 6.2 m/s^2 **c.** 7.5 m/s^2 **d.** 4.7 m/s^2 **e.** 3.5 m/s^2
12.	Mass m exerts a gravitational force F on mass M when they are a distance R apart. When the two masses are a different distance apart, the force m exerts on M is 0.25F. This different distance is: (a) R (b) 2R (c) 4R (d) R/2 (e) R/4
13.	A graph of position versus time for an object oscillating at the free end of a horizontal spring is shown below. A point or points at which the object has zero velocity and negative acceleration is(are)  **a.** B **b.** C **c.** D **d.** B or D **e.** A or E

14.	Tommy and his skateboard have a combined mass of 50 kg. John and his skateboard total 100 kg. You push each of them with the same force F, but you push Tommy for 2 seconds and John for 1 second. After you finish pushing them, (a) Tommy is moving faster than John (b) John is moving faster than Tommy (c) they are both moving the same speed (d) there is not enough information to decide about their speeds.
15.	A mass *m* = 2.0 kg is attached to a spring having a force constant *k* = 290 N/m as in the figure. The mass is displaced from its equilibrium position and released. Its frequency of oscillation (in Hz) is approximately  **a.** 12 **b.** 0.50 **c.** 0.01 **d.** 1.9 **e.** 0.08
16.	The figure below shows a container filled with water to the height shown. When we compare the pressure at A to the pressure at B, we find that  **a.** $p_A = \frac{1}{4} p_B$. **b.** $p_A = \frac{1}{2} p_B$. **c.** $p_A = p_B$. **d.** $p_A = 2p_B$. **e.** $p_A = 4p_B$.

17.	How much power is theoretically available from a mass flow of 1000 kg/s of water when it falls a vertical distance of 100 meters? **a.** 980 kW **b.** 98 kW **c.** 4900 W **d.** 980 W **e.** 9600 W
18.	One mole of an ideal gas has a temperature of 25°C. If the volume is held constant and the pressure is doubled, the final temperature (in °C) will be **A.** 174 C **B.** 596 C **C.** 50 C **D.** 323 C **E.** 25 C
19.	A bubble having a volume of 1.00 cm^3 is released from the bottom of a swimming pool where the depth is 5.00 m. What will the volume of the bubble be when it reaches the surface? (The density of water is 1.00×10^3 kg/m^3. air pressure is 1.00×10^5 Pa) **A.** **1.00** **B.** **0.49** **C.** **2** **D.** **1.49** **E.** **infinity**
20.	Two identical containers, *A* and *B*, hold equal amounts of the same ideal gas at the same P_o, V_o and T_o. The pressure of *A* then decreases by a half while its volume doubles; the pressure of *B* doubles while its volume decreases by a half. Which statement correctly describes the temperatures of the gases after the changes? **a.** $T_A = 0.5T_B = T_o$. **b.** $T_B = 0.5T_A = T_o$. **c.** $T_B = T_A = T_o$. **d.** $T_A = 2T_B = T_o$. **e.** $T_B = 2T_A = T_o$.

21.	Five moles of an ideal gas expands isothermally at 100°C to five times its initial volume. Find the heat flow into the system. **a.** 2.5×10^4 J **b.** 1.1×10^4 J **c.** 6.7×10^3 J **d.** 2.9×10^3 J **e.** 7.0×10^2 J
22.	An 8 000-kg aluminum flagpole 100-m long is heated by the sun from a temperature of 10°C to 20°C. Find the heat transferred (in J) to the aluminum if the specific heat of aluminum is 0.215 cal/g °C. **a.** 7.2×10^5 **b.** 7.2×10^7 **c.** 7.2×10^3 **d.** 7.2×10^1 **e.** 7.2×10^2
23.	A gas expands as shown in the graph. If the heat taken in during this process is 1.02×10^6 J and 1 atm= 1.01×10^5 N/m^2, the change in internal energy of the gas (in J) is  1. -2.42×10^6 **2.** -1.40×10^6 3. -1.02×10^6 4. 1.02×10^6 5. 1.40×10^6

24.	Ocean waves with a wavelength of 120 m are coming in at a rate of 8 per minute. What is their speed? **a.** 8.0 m/s **b.** 16 m/s **c.** 24 m/s **d.** 30 m/s **e.** 4.0 m/s
25.	Write the equation of a wave, traveling along the $+x$ axis with an amplitude of 0.02 m, a frequency of 440 Hz, and a speed of 330 m/sec. **a.** $y = 0.02 \sin [880\pi (x/330 - t)]$ **b.** $y = 0.02 \cos [880\pi x/330 - 440t]$ **c.** $y = 0.02 \sin [880\pi(x/330 + t)]$ **d.** $y = 0.02 \sin [2\pi(x/330 + 440t)]$ **e.** $y = 0.02 \cos [2\pi(x/330 + 440t)]$
26.	An ice cube is released from rest and slides (without friction) down a ramp into a vertical "loop-the-loop." Assume the cube has enough energy to make it all the way around the loop. When it is halfway up the loop, as shown, in what direction does its acceleration vector point? 

key
3d
4b
5d
6d
7b
8a
9c
10e
11e
12b
13a
14a
15d
16c
17a
18d
19d
20c
21a
22b
23b
24b
25a
26b

velocity acceleration gravitational acceleration	$\mathbf{v} = d\mathbf{x}/dt$ $\mathbf{a} = d\mathbf{v}/dt$ $\lvert\mathbf{a}\rvert = g = 9.8\ m/s^2$ downwards	
Kinematics (1-dimensional)	$\mathbf{v}_f = \mathbf{v}_i + \mathbf{a}\cdot t$ $\mathbf{x}_f = \mathbf{x}_i + \mathbf{v}_i\cdot t + ½\cdot\mathbf{a}\cdot t^2$ $\mathbf{v}_f^2 = \mathbf{v}_i^2 + 2\mathbf{a}\cdot(\mathbf{x}_f - \mathbf{x}_i)$	
Projectile Motion (2-dimensional)	$v_{xf} = v_{xi}$ $x_f = x_i + v_{xi}\cdot t$	$v_{yf} = v_{yi} + a \cdot t$ $y_f = y_i + v_{yi}\cdot t + ½ \cdot a \cdot t^2$

Newton's Law	$\mathbf{F} = m\cdot\mathbf{a}$
Friction	$F_{friction} = F_N\ \mu$
Circular Motion – Radial Force	$F_{radial} = mv^2/r$
Conservation of Energy	$K_i + U_i + W_{in/out} = K_f + U_f$
Energy	Kinetik (linear): $K_{lin} = ½\ mv^2$ Kinetik (rotation): $K_{rot} = ½\ I\omega^2$ Potential (gravity): $U_g = m\ g\ h$ Pot. (univ. gravity): $U_{Gr} = -\ G\ (m_1\cdot m_2)\ /\ r$ Potential (spring): $U_s = ½\ k\ x^2$
Work	$W = \int \vec{F} d\vec{x}$
Power	P = W/t = E/t
momentum	$\mathbf{p} = m\ \mathbf{v}$
conservation of momentum	$\mathbf{p}_{1i} + \mathbf{p}_{2i} = \mathbf{p}_{1f} + \mathbf{p}_{2f}$
impulse (change of momentum)	$\Delta\mathbf{p} = \int \vec{F} dt$
Radial Force	$F_{radial} = mv^2/r = \omega^2\ r$
Frequency, Period	f = revolutions/s = $1/T = \omega/2\pi$
Angle in radians	2π rad = 360° = 1 revolution
Hooke's Law (spring force)	$F_{spring} = -k\ x$
oscillation	$x = A\cos(\omega t + \phi)$ $v = -A\omega\sin(\omega t + \phi)$ $a = -A\omega^2\cos(\omega t + \phi)$
Oscillation frequency spring pendulum	$f = \frac{1}{2\pi}\sqrt{k/m}$ $f = \frac{1}{2\pi}\sqrt{g/L}$

Wave Wave velocity	$y(x,t) = A \sin(kx - \omega t)$ $k = 2\pi / \lambda$ $\omega = 2\pi / T$ $v = f \lambda = \omega / k$
Standing wave	$y = 2A \sin(kx) \cos(\omega t)$
Density	$\rho = m/V$
Pressure	$P = F / A$
Buoyant force	$F_b = \rho_{fluid} \cdot V_{object} \cdot g$
Law of Gravitation	$F_{Gr} = G (m_1 \cdot m_2) / r^2$ $G = 6.673 \cdot 10^{-11}$ Nm^2/kg^2 $U_{Gr} = - G (m_1 \cdot m_2) / r$ r measured from center
Universal gas law	$P \cdot V = n \cdot R \cdot T$; $R = 8.3$ J/(K·mol)
Heat	$Q = m \cdot c \cdot \Delta T$ $Q = m \cdot L$
1^{st} Law of Thermodynamics [conservation of energy]	$E_{int,initial} \pm W \pm Q = E_{int,final}$ [for ideal gas: **E_{int} is proportional to the temperature**]
Work done on a gas: for isothermal process:	$W = \int PdV$ $W = nRT \ln(V_i/V_f)$
quadratic equation $x^2 + px + q = 0$	$x_{1,2} = -p/2 \pm (p^2/4 - q)^{1/2}$