# SAMPLE FINAL

## Name:____________________

| | SCORE |
|---|---|
| Part 1 (24 pts) | |
| Part 2 (80 pts) | |
| % OUT OF 100 | |

This sample final is indicative of the style of your final exam. Don't expect to see the same questions on your final. Notice that the topics that can be covered on this exam are limited. Don't expect to see the same topical coverage as this sample exam. You should be prepared to answer questions from any topic that was covered during the semester.

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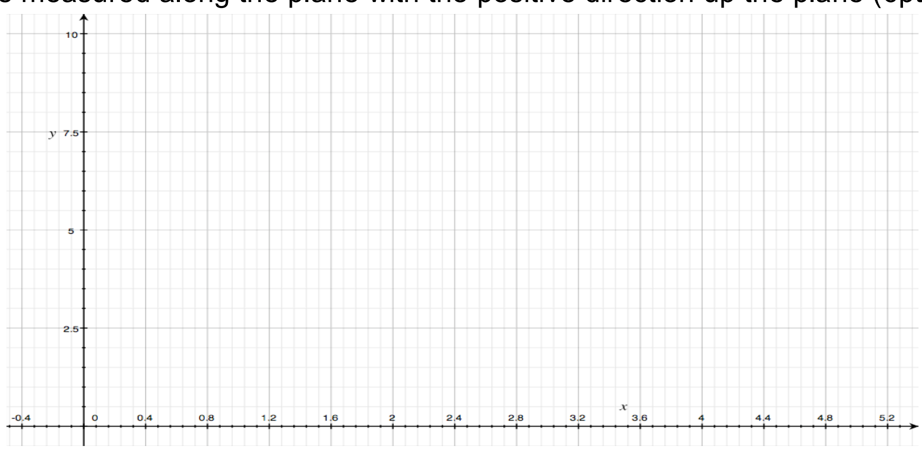
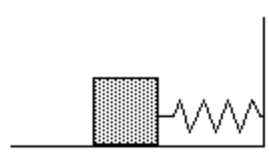
**Part 1 Conceptual Questions (3 points each, unless noted)**

**Answer the first plus six of the remaining nine questions. You <u>must clearly indicate</u> the questions to be graded; otherwise the first seven completed problems will be graded.**

1. A 1.0kg object is given an initial velocity of 7.35m/s up a frictionless incline plane. The angle the plane makes with the horizontal is $30.0^{o}$. Accurately graph the position versus time graph of the object from the time it is released until the time it returns. Assume the position of the object is measured along the plane with the positive direction up the plane (6pts).




2. A block of mass M is attached to a spring on a horizontal frictionless table. The spring is stretched from its equilibrium position and released. A lump of sticky putty of mass M is dropped onto the block. If the lump of putty hits (and sticks) the block when it has achieved maximum velocity, the change in mechanical energy of the system is equal to
   a. the total initial energy
   b. three-fourths of the total initial energy
   c. one-half of the total initial energy
   d. one-fourth of the total initial energy
   e. no energy is lost because this is an inelastic collision



3. As an object sinks in a fluid, the buoyant force acting on it
   a. decreases
   b. increases
   c. doesn't change

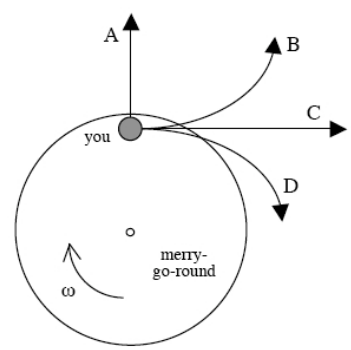
4. Two identical objects are accelerated through the same distance by different forces such that one object gains a velocity twice that of the other object. One can conclude that the force on the faster object is
   a. Half that of the slower object
   b. The same as that of the slower object.
   c. Twice that of the slower object
   d. Four times that of the slower object.

5. A metal object is suspended in a container of water. The pressure is greatest against:
   a. the side of the object
   b. the top of the object
   c. the bottom of the object.
   d. same on all sides.

6. Which body is in equilibrium?
   a. a satellite moving around Earth in a circular orbit
   b. a cart rolling down a frictionless incline
   c. an apple falling freely toward the surface of Earth
   d. a block sliding at constant velocity across a tabletop

7. On the surface of the earth Joe's mass is 75kg. What is Joe's mass at a distance above the earth that is equal to the radius of the earth?
   a. 18kg
   b. 75kg
   c. 180kg
   d. 750kg
   e. Not enough information given.

8. You are riding near the edge of a merry-go-round, spinning at a constant angular speed ω, when a big playground bully suddenly stops it. **As you fly off** the merry-go-round through the air (but ignoring air resistance), your body follows which one of the paths shown? ***(Circle the correct letter on the diagram at right.)***



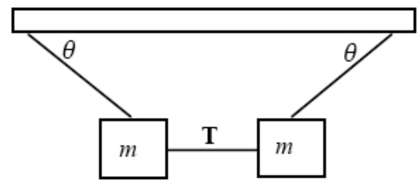

9. During an adiabatic expansion of a gas:
   a. W=0 where W is the work done on a gas
   b. $\Delta V=0$, where V is volume of the gas
   c. $\Delta P=0$, where P is pressure on the gas
   d. Q=0, where Q is the heat added to the gas
   e. $\Delta U=0$, where U is the internal energy of the gas

10. Objects A and B are dropped into two Styrofoam cups containing equal volumes of a liquid at $100^{o}$C. Object B has a higher specific heat than object A. At equilibrium, which object has a higher temperature change?
    a. A
    b. B
    c. Both are at the same temperature.

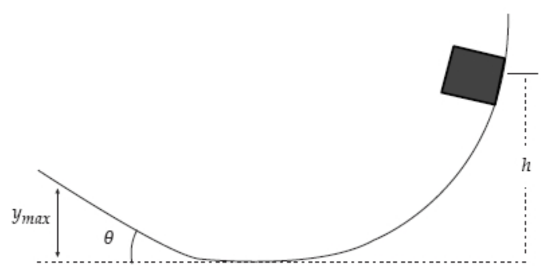
## Part 2 Problems (10 points each)

**Answer any eight of the ten problems. You must clearly indicate the problems to be graded; otherwise the first eight completed problems will be graded. Problems will be graded as no credit, half-credit, or full credit only! Please show work for full or half credit.**

11. Two blocks, each of mass $m$=10.0kg, hang from strings as shown in the figure below. Which of the following gives a correct expression for the magnitude $T$ of the tension in the string between the blocks, assuming θ=30.0 degrees)
    a. T=170N b. T=49.0N c. 17.3N d. T=8.7N e. T=196N

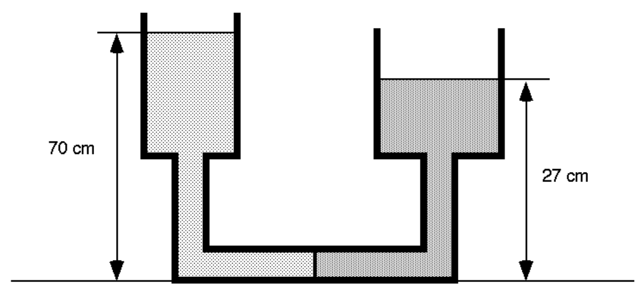



12. A box starts from rest and slides down a curved frictionless track and then up a rough inclined plane making an angle q = 37° with the horizontal. The coefficient of kinetic friction between the block and the inclined plane is 0.25. The maximum height $y_{max}$ reached by the block is
    a. 0.9h b. 0.4h c. 0.75h d. 0.01h e. 1.6h



13. A child sitting on a large horizontal rotating platform crawls radially outward from the center of the platform. The coefficient of static friction between the child and the platform is 0.95. If the platform completes one revolution every four seconds, approximately how far from the center of the platform can the child get before he begins to slip?
 a. 1.8m b. 1.2m c. 0.4m d. 3.8m e. 2.6m

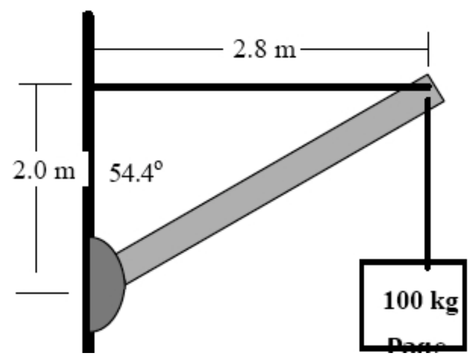
14. A column of an unknown liquid 70 cm high supports a column of mercury as suggested in the figure. Assume that both liquids are at rest and that the density of mercury is 13600 kg/m$^3$. Determine the density of the unknown liquid.
 a. 3294kg/m$^3$ b. 5246kg/m$^3$ c. 2688kg/m$^3$ d. 3371kg/m$^3$ e. 7596kg/m$^3$




15. A pistol fires a 0.0050-kg bullet with a muzzle velocity of 1000.0 m/s. The bullet then strikes a 10.0-kg wooden block resting on a horizontal frictionless surface and becomes embedded in the block. The block and bullet then slide across the surface. What was work done on the block and the impulse delivered to the bullet during the collision?
 a. 250J, 12.5N-s b. 12J, 12.5N-s c. 1.2J and -5.0N-s
 d. 0.15J, -2.5N-s e. 38J, 7.5N-s

16. An object is thrown horizontally (eastward) off a 33.0m high building with a speed of 12.0m/s. What is the object's direction of motion when it is 13.4m above the ground?
 a. westward but $24^{o}$ below the horizontal
 b. eastward but $31^{o}$ below the horizontal
 c. eastward but $51^{o}$ below the horizontal
 d. eastward but $39^{o}$ below the horizontal
 e. eastward but $59^{o}$ below the horizontal

17. A uniform 150kg strut that is 3.44 m long, is pinned at one end and supported at the other end by a horizontal cable, as shown. The tension in the cable is closest to:
 a. 600N  b. 1200N  c. 1800N  d. 2400N  e. 3000N




18. You are on the home planet of the Romulan Empire. You drop a ball of mass 1.24 kg from a 334m tower and it takes 6.54 s to reach the ground. The diameter of the Romulan home world is 1.55 times the diameter of the Earth. What is the mass of this planet in terms of the mass of the earth $M_E$?
 a. $0.18M_E$  b. $0.35M_E$  c. $1.56M_E$  d. $2.46\ M_E$  e. $3.81M_E$

19. A gas inside a movable piston is compressed. The process is isobaric with 1590 Joules of work done on the gas. The gas inside the piston consists of 84.6 moles of an ideal gas that remains at a constant pressure of 8.6 atm as the piston moves. If the initial temperature of the gas is 12.6$^o$C, what is the final temperature of the gas (in $^o$C) after work is performed on the gas?
a. -3.70$^o$C b. 7.80$^o$C c. 10.4$^o$C d. 29.4$^o$C e. 283.5$^o$C

20. Suppose a 100.0W light bulb is sealed inside a cubical box 20.0 cm on a side, which is constructed from 1.2 cm thick concrete panels. The thermal conductivity of concrete is 0.8W/mK. The temperature of the surrounding air is 20.0$^o$C and the surface area of the filament in the bulb is $10^{-3}$ m$^2$. Assume the emissivity of the filament in the bulb is the same as that of a blackbody. Determine the temperature inside the box and the temperature of the filament in the bulb?
a. 278K, 934K b. 325K, 1250K c. 299K, 1154K d. 308K, 835K e. 355K, 1460K

21. If 0.28 moles of an ideal gas is isothermally compressed to half its initial volume, what is the change in entropy?
a. -1.6J/K b. -0.5J/K c. -1.3J/K d. -2.7J/K e. not enough information given

## Additional Practice

1. List 10 different scalar quantities (along with SI units) that you learned about this semester.
2. What do kilo, milli, mega, micro, nano, and centi mean?
3. List 10 different vector quantities (along with SI units) that you learned about this semester.
4. What to Newton-seconds and Newton/kilogram represent?
5. How many significant figures does your basic meter-stick and triple-beam balance give you?
6. What is the difference between the significant figure rule for adding and dividing?
7. What is Hooke's Law? What is the work done by a spring when it is stretched by a distance x?
8. Explain the normal force. Does it always point upward? Does it ever point horizontally? Can it ever be directed at other angles? Give examples.
9. What is the acceleration of a projectile at its highest point?
10. What is the velocity of a projectile at its highest point?
11. A 50.0cm string is tied to a 100.0g mass to form a pendulum. The pendulum is displaced 60 degrees to the left of the vertical and released. When it is at 30 degrees from the vertical,
    a. What is its speed?
    b. What are the x and y components of its velocity vector?
    c. What are the x and y components of its position vector?
    d. What is its centripetal acceleration?
    e. What is the tension in the string? What is the work done by this force?
    f. What is its tangential acceleration?
    g. What is the magnitude of its acceleration?
    h. What is the torque due to gravity?
    i. What is the work done by gravity?
    j. The continues to the bottom of its motion (zero degrees with the vertical), whereupon it collides with and sticks to a 50.0g object of that was moving in the opposite direction at half the pendulum's speed. What is the maximum angle for this system? What is the tension in the string at this point?
    k. If instead, the pendulum collided inelastically with a 50.0g object moving at twice the speed, what would happen?
12. A 1.0kg object is given an initial velocity of 7.35m/s up a rough incline plane. The angle the plane makes with the horizontal is $30.0^{o}$, and the coefficient of kinetic friction is 0.20. What is its acceleration up the incline plane? What is its acceleration when it moves down the plane? Plot its position velocity and acceleration from the time it starts going up the plane until it returns.
13. Estimate the buoyant force acting on your body.
14. Do you weigh more at the equator or at the earth's poles? Explain. What is the percent difference in your weight between the Equator and the North Pole?
15. The average distance between the Earth and the moon is 385,000km. Estimate the time between full moons.

| |
|---|
| 1 mile= 5280 feet (exact) |
| 1 day= 24 hours (exact) |
| 1 km =0.6214 miles |
| 1 year=365.25 days |
| 1 inch= 2.54 cm (exact) |
| 1 hour=60 minutes (exact)=3600 sec |
| 1 km=1000 meters (exact) |
| 1 slug=14.59 kg |
| 1lb=0.454kg |
| 1ft=30.48$cm_e$ |
| 1 foot= 12 inches |
| 1 gallon =3.785 liters=231 $in^3$ |
| 1 meter=39.37 inches |
| 1 cm=0.01meters=10 mm (exact) |
| $A_{circle}=\pi r^2$; Circumference=$2\pi r$ |
| $A_{sphere}=4\pi r^2$; $V_{sphere}=(4/3)\pi r^3$ |
| G=$6.67 \times 10^{-11}$ $Nm^2/kg^2$ |
| $M_{EARTH}=5.98 \times 10^{24}$kg; $R_{EARTH}=6.37 \times 10^6$m |
| $M_{SUN}=1.99 \times 10^{30}$kg |
| Distance to sun $1.5 \times 10^{11}$m=1 A.U. |
| Distance to moon $3.85 \times 10^8$m |
| $M_{MOON}=7.22 \times 10^{22}$kg |
| 1atm=101300Pa=101300N/$m^2$=14.7psi |

| | $\alpha$ ($^oC^{-1}$) | c(J/kg$^o$C) | $L_F$ (J/kg) | $L_V$(J/kg) |
|---|---|---|---|---|
| *Water* | *$2.1 \times 10^{-4}$* | *4186* | *$3.33 \times 10^5$* | *$2.26 \times 10^6$* |
| *Lead* | *$29 \times 10^{-6}$* | *128* | *$2.45 \times 10^4$* | *$8.70 \times 10^5$* |
| *Aluminum* | *$24 \times 10^{-6}$* | *900* | *$3.97 \times 10^5$* | *$1.14 \times 10^7$* |
| *Copper* | *$17 \times 10^{-6}$* | *387* | *$1.34 \times 10^5$* | *$5.06 \times 10^6$* |
| *Mercury* | *$1.82 \times 10^{-4}$* | *138* | *$1.1 \times 10^4$* | *$2.94 \times 10^5$* |
| *Ice* | *$5 \times 10^{-6}$* | *2090* | | |
| *Steam* | | *2010* | | |

$$\vec{v}_{avg} = \frac{\Delta \vec{x}}{\Delta t} \qquad \vec{a}_{avg} = \frac{\Delta \vec{v}}{\Delta t}$$

*Equations* of Motion for Constant Acceleration

$$\Delta x = x - x_o = v_o t + 1/2 a t^2$$

$$v_f = v_i + at$$

$$v_f^2 = v_i^2 + 2a\Delta x$$

$$v_{avg} = \frac{\Delta x}{\Delta t} = \frac{1}{2}(v_f + v_i)$$

$$a = -g = -9.80\, m/s^2 = 32.2\text{ft/s}^2 \text{ for free fall}$$

$$v_x = v\cos\theta; \quad v_y = v\sin\theta$$

$$\Delta x = v_x t; \quad \Delta y = y - y_o = v_y t - 1/2 g t^2$$

*Newton's* 2nd Law

$$\vec{F} = m\vec{a} \qquad \mathrm{f_k} = \mu_k N \qquad \mathrm{f_s} = \mu_s N$$

Equilibrium

$$\sum \vec{\mathrm{F}} = 0, \text{means} \sum \mathrm{F_x} = 0 \text{ and } \sum \mathrm{F_y} = 0$$

$$Weight = mg$$

$$W = |\vec{F}||\Delta\vec{x}|\cos\theta$$

$$W_{net} = KE_{FINAL} - KE_{INITIAL} = \frac{1}{2}mv_{final}^2 - \frac{1}{2}mv_{initial}^2$$

$$GPE = mgy; \quad \Delta GPE = mgy_{final} - mgy_{initial}$$

$$\Delta EPE = \frac{1}{2}kx_{final}^2 - \frac{1}{2}kx_{initial}^2$$

$$\text{Conservation of Energy}: \Delta \mathrm{PE} + \Delta \mathrm{KE} = 0$$

$$\mathrm{W_{NC}} = \Delta \mathrm{PE} + \Delta \mathrm{KE}$$

$$P_{avg} = \frac{\Delta W}{\Delta t} = F v_{avg}$$

Conservation of Momentum

$$\sum \vec{p}_{initial} = \sum \vec{p}_{final} \text{ where } \vec{\mathrm{p}} = \mathrm{m}\vec{\mathrm{v}}$$

$$\text{Impulse Momentum Theorem} \Rightarrow \vec{I} = \vec{F}\Delta t = \Delta\vec{p}$$

$$\textit{Kinetic} \text{ Energy in terms of p;} \quad \mathrm{K} = \frac{p^2}{2m}$$

Equilibrium

$\sum \vec{F} = 0; \quad \sum \vec{\tau} = 0; \quad where \quad |\tau| = F(lever\,arm)$

$a_c = \frac{v^2}{r}; \quad F_c = \frac{mv^2}{r} = mr\omega^2 \quad F_{gravity} = \frac{GM_1M_2}{r^2}$

$Kepler's\ 3rd\ Law; \frac{T^2}{R^3} = \mathrm{K} =; \quad K = 1\ if\ R\ in\ A.U.\&T\ in\ years$

$Period = \mathrm{T} = \mathrm{f}^{-1} \quad \mathrm{f = frequency:} \quad \omega = 2\pi\mathrm{f}$

$\omega_{\mathrm{average}} = \frac{\Delta\theta}{\Delta t}; \quad \alpha_{\mathrm{average}} = \frac{\Delta\omega}{\Delta t}; \quad \sum \tau = I\alpha$

$s = r\theta; \quad v_t = r\omega; \quad a_t = r\alpha$

$KE_{rotation} = \frac{1}{2}I\omega^2 \quad KE_{rolling} = \frac{1}{2}I\omega^2 + \frac{1}{2}mv^2$

$L_i = L_f = I_i\omega_i = I_f\omega_f$

$\rho = \frac{M}{V}; \quad BF = \rho_{fluid}gV_{fluid}; \quad P = P_{atm} + \rho gh = \frac{F}{A}; \quad \frac{F_1}{A_1} = \frac{F_2}{A_2}$

$T_K = T_C + 273.15; T_F = \frac{9}{5}T_C + 32$

$\Delta L = L - L_o = \alpha\Delta TL_o; \Delta A = A - A_o = 2\alpha\Delta TA_o = \gamma\Delta TA_o$

$\Delta V = V - V_o = 3\alpha\Delta TV_o = \beta\Delta TV_o$

$\rho = \frac{M}{V}; P = P_{atm} + P_{gauge} = \frac{F}{A};$

$PV = nRT = NkT; n = \frac{m}{molarmass} = \frac{N}{N_A}$

$P = \rho_M RT; \rho_M = \frac{n}{V}$

$R = 0.0821 L - atm/mol - K = 8.315 J/mol - K$

$k = 1.38x10^{-23} J/K; N_A = 6.02x10^{23}\ atoms/mol$

$Q = mc\Delta T = nC\Delta T; \sum Q = 0;\ Q_{PHASECHANGE} = \pm mL$

$P_{CONDUCTION} = \frac{kA\Delta T}{L}; P_{NET\,RADIATION} = \frac{\sigma eA(T - T_o)}{L}$

$\Delta U = Q + W; W_{ISOBARIC} = -P\Delta V;\ W_{ISOTHERMAL} = -NRT\ln\frac{V_f}{V_i}$

$\Delta U = \frac{3}{2}nRT\ for\ monatomic\ gas$

$C_P = \frac{5}{2}R; C_V = \frac{3}{2}R;\ for\ monatomic\ gas$

$\varepsilon = \frac{W}{Q_H} = 1 - \frac{Q_C}{Q_H}; \varepsilon_{CARNOT} = 1 - \frac{T_C}{T_H}$

$COP_{FRIDGE} = \frac{Q_C}{W}; COP_{HEAT\,PUMP} = \frac{Q_H}{W}$

$\Delta S = \frac{Q}{T}$