PH 111 EXAM II-warm-up

Exam #2 will look familiar, with eqns and constants provided. The exam will be more 'conceptual' than 'calculational'. There will be 25 questions worth 2 points, 10 worth 3 pts, and 5 worth 4 points.

The following questions are mostly true/false. Choice: **1 = TRUE** **2 = FALSE**

T **1)** The work done by the normal force when sliding a book across a level table is zero?
F **2)** The forces of friction and gravity are both conservative?
F **3)** To keep moving in a circle, one must overcome the centrifugal force?
T **4)** To either stretch or compress a spring, one must do positive work?
T **5)** Power is the rate of doing work?
F **6)** Polar orbits can be geo-synchronous?
F **7)** The change in momentum for any object in a closed system must be zero?
F **8)** The speed of the space shuttle (in stable circular orbits) increases with altitude?
F **9)** Astronauts in orbit are weightless?
T **10)** The total work done by the sun on a comet in an elliptical orbit for one orbit is zero?
F **11)** To lift a 10 kilogram rock upwards 10 meters in one second requires about 100 Watts?
T **12)** The energy something has because of its position is called its potential energy?
T **13)** Is it theoretically possible to rotate a large cylindrical space station at just the proper speed so that the people inside will experience a force that feels just like gravity?
F **14)** Because the Earth & Moon are attracted towards each other, they will eventually hit?
F **15)** If the Earth had twice its current mass and twice its current radius, we'd still weigh the same?
☺ **16)** How could you get to the shore on a frictionless, iced-over, lake?
F **17)** The gravitational field strength at the very center of the Sun is enormous?
F **18)** You "weigh" yourself on a bathroom scale in an elevator that is accelerating upwards; you "weigh" the same as you normally do?
T **19)** Satellites in low but stable orbits go once around in about 90 minutes?
T **20)** Both the speed and velocity of a satellite in an elliptical orbit is constantly changing?
F **21)** A baseball pitcher throws a baseball and the batter hits it. During the hit, the baseball receives a greater impulse than the bat.
F **22)** A perfectly elastic superball is dropped and bounces to the same height. Momentum is conserved for the following reason: The speed of the ball is the same just before and after the collision with the ground, and because its mass is constant, the value of m times v is the same.
F **23)** Airbags protect people by decreasing the impulse suffered during crashes?
T **24)** When a baseball is hit by a bat, it is possible for the ball to accelerate at several hundred g^s.
T ~56 vs 30~ **25)** One day you will be telling your kids with their new drivers licenses that speed kills and to please be careful. If they respond that 75 mph is not that much faster than 55 mph, **can you** properly say that there is nearly 200% as much energy to do work on their bodies at that higher speed as at 55?
F **26)** You are standing in a small rowboat that has the same mass as you do. Considering the water as frictionless, if you walk forward 2 meters, the boat moves backwards two meters. With respect to the water, your net displacement is therefore zero. Tricky!
F **27)** If the Earth had half its current mass and half its current radius, we would still weigh the same.
F ✗ **28)** You "weigh" yourself on a bathroom scale at the North Pole and in Flagstaff. The scale reads more in Flagstaff.
NO NO **29)** Is momentum always conserved for any system? How about KE?
NADA **30)** A penguin walks forwards and backwards on a boat floating frictionless in water. The COM does..?

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Multiple Choice Questions: {numbers are relative difficulty on scale of 1-easy to 5-hard}

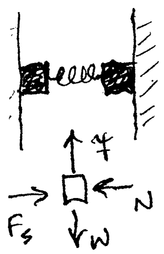
31) Drop a one kilogram mass from a height of 2 meters onto a vertically oriented spring (with spring constant k = 100). Find the maximum compression distance, and the compression at equilibrium when the mass is at rest. {4} $\frac{1}{2}kx^2 = mg(2\text{meters}) + mgx$

32) Now orient the spring horizontally on a flat and level table top. Fix one end of the spring to a wall. Compress the other end with the one kilogram mass by 25 cm. How far will the mass slide on the table with mu (static) = 0.4 and mu (kinetic) = 0.35? The mass and spring are not connected, and the mass of the spring is negligible. {3} $\frac{1}{2}kx^2 \Rightarrow$ heat via Friction = $f \cdot d = \mu mgd$

33) What is the total work done by friction in problem #32? {2!!} $\frac{1}{2}kx^2$

34) The acceleration due to gravity on the surface of the Sun is: {2} $g_{local} = \frac{GM}{R^2}$

35) A block (m) slides on a frictionless loop-the-loop from a starting height of two loop diameters (**D**). At the bottom of the loop its kinetic energy is? {2} $mg(2D) \Rightarrow \frac{1}{2}mv^2$



36) A horizontal spring is compressed a distance x = L as shown. The spring is responsible, along with friction, for holding two objects in place against the walls without touching the floor. Find a relationship between mu-static and the spring constant k. {4} $f = \mu N \geq W$ w/ $F_s = kx = N$

37) Find the distance from the *center* of the moon to a satellite in a (circular) moon-synchronous orbit. The moon takes 27 days to complete one revolution. {4} $F = \frac{GMM}{R^2}$ and $2\pi R = vT$ w/ $T = 27$ days

38) Assume the Earth is a perfect sphere (R = 6.36 x 10^7 meters). Compared to your weight (as measured with a bathroom scale) at the north pole, your weight at the equator is: {3} account for mv^2/R

39) An escalator is used to carry 20 people every minute from one floor to another five meters up. If each person has a mass of 60 kg, the required power is about: {2} $mgh/t = P$

40) Why do raindrops have a constant speed during the end of their fall? {2} $\Sigma f = 0$ b/c air resistance

41) Three masses (6, 4, and 2 kg) are tied together with string, as shown, and are being accelerated to the right. The acceleration is steady and is 6 m/s^2 for the 6 kg mass. The tension in the string marked TT is: {1} we've done lots of these

yes **42)** Right now there are 2 astronauts in orbit traveling at nearly 8000 m/s. The other nearly 6.4 billion people on Earth are moving with an average speed somewhat under 0.5 m/s. This means about 10% of all the kinetic energy possessed by all the peoples of the world belongs to these 2 energetic astronauts. {1}

43) A bullet (mass = 15 grams, speed = 300 m/s) imbeds itself in a stationary block of wood (m=1500 grams). What is the final speed of the wood assuming no loss of material for either substance? How high up a frictionless incline could the mass climb? How far could the mass skid on a level table with a static mu of 0.7 and a kinetic mu of 0.5? {4} $mv)_{bullet} \Rightarrow (m+M)V_{wood}$: $\frac{1}{2}MV^2 \rightarrow mgh \rightarrow \mu_k mgd$

44) An elevator in the Empire State building in N.Y. can carry 20 people to the 102nd floor observation deck in one minute. If each person has a weight of 600 Newtons, and each floor is 4 meters, the required power is about: {2} mgh/t

45) A bullet (mass = 15 grams, speed = 300 m/s) hits a stationary block of steel (m=1500 grams). The bullet bounces straight back off of the steel with a speed of 50 m/s. What is the final speed of the steel assuming no loss of material for either substance? {3} $mv)_{bi} = mv)_{bf} + Mv)_{steel}$

46) Two ice skaters (zero friction) push off of each other while initially standing still. The 80 kg. skater is then moving north at 4.3 m/s. What is the 60 kg. skater doing? {2} $0 = P_i \Rightarrow M_1V_1 + M_2V_2 = 0$

47) The 15 balls on a pool table are put into the triangle, and the cue ball is used to "break". If the mass of each ball is the same 0.4 kg., and the initial speed of the cue ball is 6 m/s immediately before the collision, what is the total momentum of all 16 balls immediately after the collision? What, if anything, can you say about the total momentum 2 seconds after the break? {3} $P_i = P_f$ unless $F_{ext} \neq 0$

48) What can be said about the potential energy vs. position graph shown? What is the fate of an object that is in this potential and has an energy of this or that? {4} more of a phy 161 question but speeds on a roller coaster, for example are good illustrations of this idea.