Sample Exam III

MULTIPLE CHOICE (4 pts each)

- 1) According to statistical data, the probability that an occupant of an automobile suffers a lethal injury during an accident is proportional to the square of the speed of the car (*i.e.*, to the KE!). If the probability of death is 3% at 50 mph, what is the probability of death at 75 mph?
 - A) 3% B) 4.5% C) 6.8%
- Consider two identical boxes being pushed very slowly up frictionless ramps, one gentle, the other steep. Compare the amount of work each person does in pushing his box up his ramp. Assume the applied forces are each applied parallel to the respective ramp.
 - A) A does more work than B.
 - B) B does more work than A.
 - C) A and B do the same amount of work.
 - D) It's impossible to know who does more work.
 - E) There is no Choice E.
- 3) The earth orbits the sun on a path that is not circular, but elliptical, as shown with great exaggeration in the figure. The gravitational force from the sun on the earth keeps the earth in orbit. At which of the labeled points will the earth's speed be least?
 - A) A
 - B) B
 - C) C
 - D) D
 - E) E



D) 9%

E) 14.3%



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- 4) Magnetic fields exert forces on electrical charges that are always perpendicular to the velocity of the charge and perpendicular to the field itself. Therefore, the power transferred by the magnetic field to a charged particle
 - A) is always positive
 - B) is always negative
 - C) is always zero
 - D) depends on the sign of the charge.
 - E) depends on the speed of the particle.
- 5) Consider two flowerpots in windows of an apartment building. Pot A is knocked off the third floor window ledge by Mr Smith's cat, and it hits the pavement below. Pot B, which has half the mass of Pot A, is knocked of its twelfth floor ledge by Mrs Jones's goldfish and it also hits the pavement. Which of these statements is correct?
 - A) Pot B will hit the pavement with twice the speed and twice the kinetic energy as does Pot A.
 - B) Pot B will hit the pavement with the same speed and twice the kinetic energy as does Pot A.
 - C) Pot B will hit the pavement with twice the speed and the same kinetic energy as does Pot A.
 - D) Pot B will hit the pavement with twice the speed and four times the kinetic energy as does Pot A.
 - E) Pot B will hit the pavement with four times the speed and twice the kinetic energy as does Pot A.

PROBLEM I (20 pts)

Derive the Work-Energy Theorem, $W_{TOTAL} = \Delta KE$. Consider the problem in only one dimension. Make use of the following relationships:

 $KE = \frac{1}{2} \text{ m v}^2$ W = F Δx (forget the cosine term for this derivation)

Show all work and justify any assumptions.

PROBLEM II (20 pts)

Andy and Bonnie fire identical caliber rifles (of reasonable lengths) using identical shells. The barrel of Andy's rifle is 2 cm longer than the barrel of Bonnie's rifle. The force of the expanding gases in the barrel accelerate the bullets.

Which bullet (if either) will have a higher muzzle velocity than the other? Be sure to explain fully (or at least sufficiently).

PROBLEM III (20 points)

Consider two cars on in an icy road that undergo a completely elastic *head-on* collision. Car 1 has mass $M_1 = 3500$ kg and initial speed $v_{1i} = 15$ m/s. Car 2 has mass $M_2 = 2000$ kg and initial speed v_{2i} = 10 m/s. Use the technique of relative velocities to determine the velocities of each car after the collision.



PROBLEM IIII (20 pts)

Consider two massless springs with *different* spring constants, $k_1 = 300$ N/m and $k_2 = 500$ N/m. A mass M=4 kg is pressed against the left spring, compressing it by 0.2 m. The mass is released from rest, slides across a rough portion of the floor (length L=0.4m and coëfficient of kinetic friction $\mu_K = 0.25$) and hits the spring on the right. By how much is the second spring compressed?