Name: ____________________ Student ID #: ____________________

You must show your work to get credit

Examination 2	Fall 2001	Physics 1403	Professor:	Philip Cole
			Date:	16 October 2001

Test Time: 80 minutes
Possible Score: 100 points.

Write your name on each page. Do the easier problems first. If a problem seems too difficult, skip it, and return to it once you have completed all of the other problems first. There are five pages to this test. Good Luck!

Problem 1	________	(40 pts)
Problem 2	________	(30 pts)
Problem 3	________	(30 pts)
Total	________	(100 pts)

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Problem 1 A block of mass m is pushed against a spring and compresses the spring a distance x. The spring has a force constant k. The mass is then released and the spring projects the block along a **smooth, frictionless horizontal surface**. The block then travels up a **rough inclined plane**. The coefficient of kinetic friction between the rough inclined plane and the block is μ_k. The inclined plane makes an angle of θ with respect to the horizontal. You may assume that the block comes to a complete stop after traveling a distance d along the inclined plane, i.e. at a height $h = d \sin\theta$ above the horizontal surface. Hint from Mr. Hooke: $U^{\mathrm{el}} = \frac{1}{2}kx^2$

(a) What is the potential energy stored in the spring?
(b) What is the kinetic energy of the block as it leaves the spring in terms of k and x?
(c) What is the speed of the block just before it reaches the inclined plane in terms of k, m, and x?
(d) What is the mechanical energy of the block as once it comes to a complete stop after traveling a distance d along the inclined plane in terms of m, g, d, and θ?
(e) What is the work done by friction on the block in terms of m, g, d, θ, and μ_k? Hint: You will need to draw a free-body diagram of the block on the incline.
(f) How far up the incline does the block travel? That is, calculate d in in terms of x, k, m, g, d, θ, and μ_k

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Problem 2 Answer the following with a short, clear explanation. Do not exceed three sentences for each part.

(a) When is linear momentum conserved (*mathematically*)?
(b) Let us assume we have a conservative force. An object goes from the initial point to a final point along a path of length ℓ. The object now travels back to the initial point along a path of length 2ℓ. For this round trip, what is the total work done by this conservative force?
(c) What is the work–kinetic energy theorem (*mathematically*)?
(d) What is the impulse–momentum theorem (*mathematically*)?
(e) What two things are conserved for perfectly elastic collisions?
(f) Can Newton's Laws be derived from first principles? Explain.
(g) Imagine you are in the middle of a frozen pond. You are unable to get to the shore because of a lack of friction between your shoes and the ice and you may not take off any articles of clothing. Besides your clothes, you only have your heavy physics textbook with you. What should you do to get to shore? If you stay you will freeze.

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Problem 3 On planet Austin PIV, where the acceleration due to gravity is 10.000 m/s^2, Dr. Evil decides to engage in some much needed water therapy. He steps off a 5.0-m high diving platform and begins to fall from rest. Dr. Evil's mass is 75 kg. Three (3.0) seconds after reaching the water, Dr. Evil comes to a rest.

(a) What is the speed of Dr. Evil as he enters the water?
(b) Draw a free-body diagram of Dr. Evil when he is immersed in the water.
(c) What average force did the water exert on Dr. Evil? q