Physics 231: General University Physics

Fall 1997

9:00 AM Lecture

Test II (Yellow)

Wednesday, October 22, 1997

Chem-Phys 155

Name (print): ______________________

Signature: ______________________

Student Number: ______________________

Your Seat Number (on back of chair): ______________________

Circle your recitation section

001	003	005	007	009	011
8 AM	9 AM	10 AM	11 AM	9 AM	11 AM
CP 367	CP 367	CP 367	CP 367	CP 287	CP 287
Ndefru	Liu	Popescu	Liu	Postolache	Popescu

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1. This test comes in two colors. If you have a yellow (green) exam, sit in an odd– (even–) numbered seat.
2. Immediately enter the requested information on this cover page. Do not turn this cover page over until you are told to do so.
3. This is a closed book exam. You are permitted a single $8\frac{1}{2}$" × 11" sheet of paper on which *you have written* anything you wish. You may use a calculator if you wish. Do not use any scratch paper. Use the blank backs of pages if you wish. Do not consult with your classmates nor look at their papers.
4. This exam consists of 10 true/false questions, 6 multiple-choice questions and 2 longer problems.
   - For the latter, show all of your work, including diagrams and equations, and place a box around each final answer. Problems will be graded for orderliness and coherence as well as for correctness. Justify the use of any formulas you use. Partial credit will be awarded. A correct numerical final answer with no intermediate steps shown will *not* be given full credit.

Do not write below this line

Problems	Your grade	Maximum possible
A (1–10)		20
B		25
C (1–6)		30
D		25
Total		100

For each of the statements regarding the **leading** statement, circle whether the statement is true or false. (There may be any number of true (or false) responses for each leading statement. Each T/F response is worth 2 points. No partial credit will be awarded for an incorrect response.)

If any T/F response takes you longer than about a minute, move on, and come back to it later. Pace yourself.

$\mu = n$

1. A block slides **up** a **rough** inclined plane.

T or F The work done by the force of gravity is negative.

T or F The gravitational potential energy of the block decreases.

T or F The work-energy theorem is not true because of the work done by friction.

T or F Mechanical energy is not conserved.

$m_1 \neq m_2, \mu = 0, v_1 = v_2, \Delta K \neq 0$

2. Two objects with **different** masses travel towards each other on a horizontal, frictionless surface with **equal** speeds. They collide and stick together. All forces other than the forces of collision can be neglected.

T or F Momentum is conserved.

T or F Kinetic energy is conserved.

T or F The final speed of each object is zero.

T or F The final total kinetic energy is zero.

F_{NC}, F_C

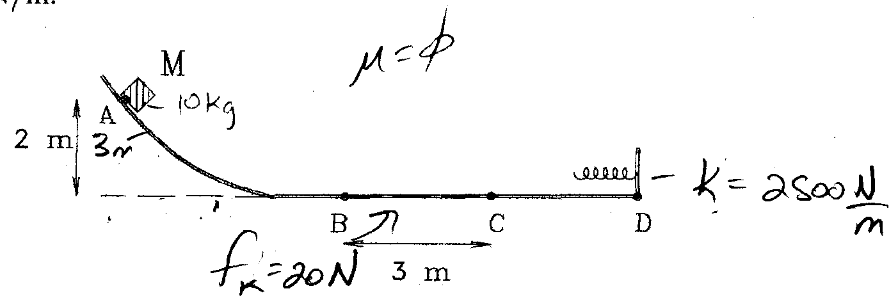
3. A nonconservative force and a conservative force act on an object. The work done by the nonconservative force is negative and yet the object's speed increases.

T or F The potential energy decreases and the mechanical energy increases.

T or F The potential energy increases and the mechanical energy decreases.

B. [25 points; **show the details of your calculations**; put a box around each final [answer].]

A 10 kg block is released from a height of 2.0 m at point A on the track $ABCD$. The track is frictionless except for a rough horizontal portion BC of length 3 m, where the frictional force on the block is 20.0 N. The block travels down the track and hits a Hooke's-law spring of force constant 2500 N/m.



1. [7 points] What is the speed of the block as it passes point B? 6.3 m/s ✓
2. [10 points] What is the speed of the block as it passes point C? 3.7 ✗ ✗
3. [8 points] What is the maximum amount that the block will compress the spring? $x = 0.23$ m

$\frac{1}{2}mv^2 = \frac{1}{2}kx^2$

$\sqrt{\frac{mv^2}{k}}$

$\Delta E = \Delta K + \Delta U + f_k d = 0$

$= K_f + U_f + (K_i + U_i) + f_k d = 0$

$= \frac{1}{2}mv^2 - mgh$

$v = \sqrt{\frac{(mgh)2}{m}} = \sqrt{\frac{10 \cdot 9.8 \cdot 2 + 20 \cdot 3}{10}}$

$K = -f_k d$

$\frac{1}{2}mv^2 = -f_k d$

$v = \sqrt{\frac{-f_k d 2}{m}} = \sqrt{\frac{20 \cdot 3}{10}}$

$\Delta E = \Delta K + f_k d$

$= K_f - K_i + f_k d =$

$v = \sqrt{\frac{2(K_i - f_k d)}{m}} = \sqrt{\frac{\frac{1}{2}(10)6.26^2 - 20 \times 3}{10}}$

C. **Multiple-choice questions** [30 pts. (5 pts. each)]

Each question should be solvable by simply identifying the correct principle and/or equation(s). Write down the appropriate equation(s) and solve, and circle the correct solution. If an incorrect answer is circled, some partial credit will be awarded **if** the appropriate work is written **clearly, coherently, and completely** in the space adjacent to the multiple-choice answers.

If a multiple-choice question takes you more than about 2 minutes, move on, do the other multiple-choice questions and the two long problems, and come back to it later. Pace yourself.

1. Two constant forces $\vec{F}_1 = -3.0\,\mathrm{N}\hat{\mathbf{i}}$ and $\vec{F}_2 = 4.0\,\mathrm{N}\hat{\mathbf{j}}$ are the only ones acting on an object of mass 2.0 kg. What is the **net work** done on the object as it moves from a point with (x, y) coordinates (7 m, 8 m) to another with coordinates (9 m, 8 m)?
   (a) 0 J
   (b) −6 J
   (c) +6 J
   (d) −10 J
   (e) +10 J
   (f) It cannot be determined because we are not told whether the forces are conservative.

2. What average net force need be exerted on a 2 kg object traveling at 6 m/s to bring it to rest (i.e. stop it) in a distance of 3 m?
   (a) 1 N
   (b) 2 N
   (c) 6 N
   (d) 12 N
   (e) It cannot be determined because we are not told the time duration for which the force was applied.

3. A truck of mass 3000 kg travels on a flat, horizontal road around a circular curve of radius 50 m at a constant speed of 20 m/s. What is the magnitude of the total frictional force exerted on the truck by the road?
   (a) 2.4×10^4 N
   (b) 2.9×10^4 N
   (c) 1.2×10^3 N
   (d) 8.0×10^1 N
   (e) It cannot be determined because we are not told the coefficient of friction.

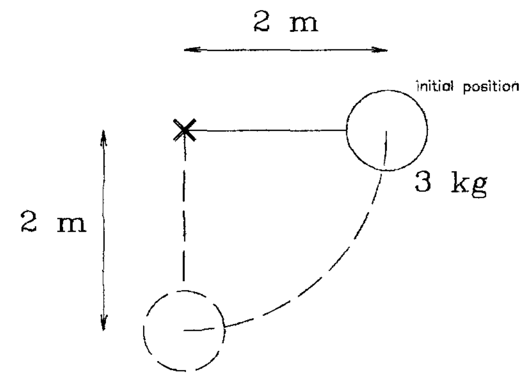
4. A 3 kg ball is thrown off the top of a 3 m tall building with a speed of 9 m/s. How fast is the ball going just before it strikes the ground?
   (a) 11.8 m/s
   (b) 10.5 m/s
   (c) 9.0 m/s
   (d) 7.2 m/s
   (e) 4.7 m/s

5. A Hooke's-law spring of spring constant 4900 N/m is compressed by 0.02 m. This spring, inside a toy gun, is used to fire a 0.050 kg bullet directly upwards. How high does the bullet go (relative to its position when the spring was compressed)? (Neglect air friction and other such complications.)
   (a) 1.0 m
   (b) 2.0 m
   (c) 4.0 m
   (d) 8.0 m

6. During a sleet storm, the roads are covered with frictionless ice. A truck of mass 2000 kg traveling at a speed of 6 m/s slams into a stationary car of mass 1000 kg. The bumpers lock together and the car and truck move together at a common velocity into the intersection after the collision. With what speed?
   (a) 6 m/s
   (b) 4 m/s
   (c) 3 m/s
   (d) 2 m/s

D. [25 points; show the details of your calculations; put a box around each final $\boxed{\text{answer}}$.]

A pendulum bob of mass 3.0 kg is released **from rest** such that the (massless, taut) string of length 2.0 m is horizontal. The bob is released and swings down in a circular arc.



1. [3 pts] Immediately after the bob is released, what is the magnitude of the **centripetal acceleration** of the bob.
2. [4 pts] Immediately after the bob is released, what is the magnitude of the **tangential acceleration** of the bob.
3. [8 pts] What is the speed of the bob when it reaches its lowest point (the bottom of the circular arc)?
4. [4 pts] What is the magnitude of the centripetal acceleration of the bob when it reaches its lowest point?
5. [6 pts] What is the tension in the string when the bob is at its lowest point?