LAST NAME as on student card	First Name(s) as on student card	Student Number	Practical Group Code

PHY131H1S
Term Test 2 —version 1
Tuesday, March 15, 2011
Duration: 80 minutes

Aids allowed: A pocket calculator with no communication ability. A single aid-sheet prepared by the student, no larger than 8.5"x11", written on both sides.

- **Turn off** any communication device you may have and place it far from where you are sitting.
- **DO NOT separate the sheets of your question paper.** You can, however, "carefully" tear off the blank page at the end, as it does not have to be handed in.
- Before starting, please **PRINT IN BLOCK LETTERS your name, student number, and tutorial group code** at the top of this page **and** on the answer sheet.
- Check that the test-version numbers under the shaded circle at the top right of the answer sheet and in the title of your test paper match. If they do not, call an invigilator; if they do, **do not write anything on or near the circles.**

Scanned Area of the Answer Sheet:

1. **Use a dark-black, soft-lead pencil or a black pen.**
2. Mark in your student number by shading the circles in the student number area.
3. Indicate your answer to a multiple-choice question by **thoroughly** filling the appropriate circle on the answer sheet and also by recording your answer on the test paper.
4. If you wish to modify an answer, erase your pencil mark thoroughly, or use dry tape white-out sparingly.
5. **Do not write anything else on the answer sheet.** Use the blank sheets at the end or the back of the question sheets for rough work.

The test consists of **8** multiple-choice questions, worth 2 points each, or altogether 16 points. The test also has a set of free-form questions worth 12 points, for which fully worked solutions are required. The total possible number of points is 28.

Multiple-choice questions:

- Please choose the best answer.
- Blank or incorrect answers are worth zero points.
- Multiple answers for the same question result in zero points for that question.

Free-form Questions: To be awarded maximum credit, you must provide fully worked solutions to all parts of the free-form questions. In addition to showing your work, please put your answer(s) for each part in the boxes provided. You can use the back-side of the sheets and the blank pages at the end for your rough work which will not be graded or taken into account.

When the invigilators declare the test ended, **stop any writing or filling of circles** on the answer sheet immediately. Please put your answer sheet **inside your test paper** and have the paper ready for an invigilator to pick up.

Possibly helpful information for this test:
$\pi = 3.14159$ is the ratio of the circumference to the diameter of a circle
πr^2 is the area of a circle of radius r
$4\pi r^2$ is the surface area of a sphere of radius r
$\frac{4}{3}\pi r^3$ is the volume of a sphere of radius r
$g = 9.80$ m/s^2 is the acceleration due to gravity near the Earth's surface.
Common Prefixes: k = "kilo-" = 10^3 c = "centi-" = 10^{-2} m = "milli-" = 10^{-3}
μ = "micro-" = 10^{-6} n = "nano-" = 10^{-9}

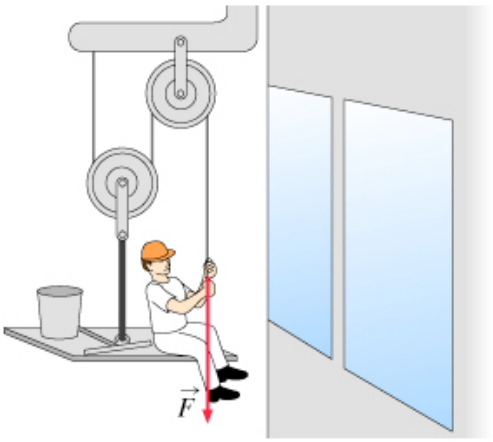
Coefficients of friction

Materials	Static μ_s	Kinetic μ_k	Rolling μ_r
Rubber on concrete	1.00	0.80	0.02
Wood on snow	0.12	0.06	

MULTIPLE CHOICE (16 points total)

1. A 75 kg package of food and medical supplies is dropped from an airplane. The package is shaped like a sphere of radius 18 cm. Estimate terminal speed of this package. Do **not** neglect air resistance for this problem.
   A. 1.7 m/s
   B. 85 m/s
   C. 120 m/s
   D. 170 m/s
   E. 300 m/s

2. A window washer of mass M is sitting on a platform suspended by a system of cables and pulleys as shown . He is pulling on the cable with a force of magnitude F. The cables and pulleys are ideal (massless and frictionless), and the platform has mass, m. What is the magnitude of the minimum force F that allows the window washer to move upward.
   A. $\frac{Mg}{3}$
   B. $(2M+m)g$
   C. $3(M+m)g$
   D. $\frac{Mg}{3}+mg$
   E. $\frac{(M+m)g}{3}$



Problems 3 and 4 both refer to the following situation:

Two cars, both of mass m, collide and stick together. Prior to the collision, one car had been traveling North at speed $2v$, while the second was traveling East at speed v. Neglect horizontal outside forces on the cars, such as friction from the road on the cars.

3. Immediately after the collision, what is the speed of the joined cars?

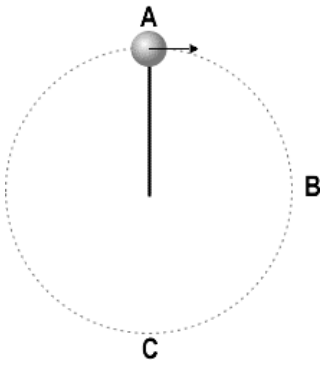
A. v B. $2v$ C. $\frac{3}{2}v$ D. $\sqrt{\frac{3}{2}}v$ E. $\frac{\sqrt{5}}{2}v$

4. What is the ratio, K_f/K_i, of the final to initial kinetic energy of the system just after and before the collision?

A. 1 B. $1/2$ C. $1/4$ D. $3/4$ E. $\sqrt{5}/4$

5. In each of the four elevators in the tower of the Physics building is mounted a spring scale with a 0.750 kg mass hanging from it. As preparation for the 4th Practicals Session, you were advised to take a ride on the elevator and observe the reading on the spring scale. Assume that when the elevator was stationary, you observed the reading on the spring scale to be 7.35 N. You then pressed the "B" button to go down to the basement, and just before reaching the basement, as the elevator was slowing down, you observed the reading on the spring scale to be 8.35 N. What was the acceleration of the elevator at the moment you made this second observation?
   A. 11.1 m/s^2, down
   B. 1.33 m/s^2, down
   C. 1.33 m/s^2, up
   D. 11.1 m/s^2, up
   E. Something is wrong with the data; the reading on the spring scale should have been less than or equal to 7.35 N.

6. A massive ball on a massless string is moving in a vertical circle as shown. Air resistance is negligible. Three points A, B and C on the circle are shown. At which of the three points is the magnitude of the tangential acceleration of the ball, a_t, the largest?
   A. A
   B. B
   C. C
   D. The tangential acceleration has the same non-zero magnitude at all 3 points.
   E. The tangential acceleration is zero at all 3 points.

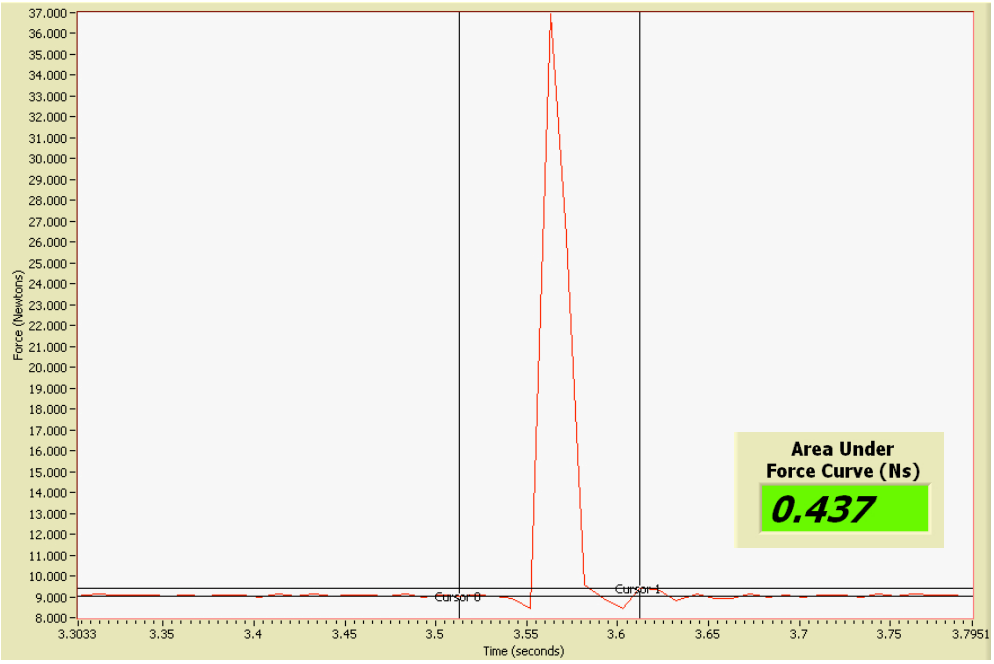


7. A concrete highway curve of radius 70.0 m is banked at a 15° angle. What is the magnitude of the force of static friction on a 1500 kg rubber-tired car traveling at 23 m/s around this curve without slipping?
    A. 7100 N
    B. 11,000 N
    C. 14,000 N
    D. 15,000 N
    E. 20,000 N

8. You drop a rock from the observation deck of the CN tower. Neglect air resistance. Which one of the following four statements most correct?
    A. The kinetic energy of the rock increases by equal amounts in equal time intervals as it falls.
    B. The kinetic energy of the rock increases by equal amounts in equal distances as it falls.
    C. Both A and B are true.
    D. Neither A nor B are true.

FREE-FORM IN TWO UNRELATED PARTS (12 points total)
Clearly show your reasoning and work as some part marks may be awarded. Write your final answers in the boxes provided.

PART A
In Practicals students rolled a 0.505 kg cart along a low-friction track, and measured its speed with a Motion Sensor. According to the computer, just before the cart collided with the bumper of a fixed Force Sensor, its speed was 45.5 cm/s. The cart then collided with the bumper on the Force Sensor, and reversed its direction. Shown is a plot of force versus time as measured by the Force Sensor. The area under the curve, as measured between the cursors which are marked with vertical lines, is 0.437 N s. From this information, predict the speed of the cart immediately after the collision. [Please express your final answer in the box provided in cm/s to 3 significant figures.]



$v_f =$

PART B

It's a winter Saturday and you're pulling a friend along a level, snow-covered road on a wooden sled. The rope pulls on the sled at a 25° angle above the horizontal. The mass of the sled, with your friend on it, is 45 kg. With what force must you pull on the rope in order to walk forward at a steady speed of 1.3 m/s? [Please express your final answer in the box provided in N to 2 significant figures.]

$F =$

ROUGH WORK (not marked)