

Fall 2007

Please write your CID \_\_\_\_\_

## Physics 105 Exam 1

Hess & Colton

**3 hour time limit.**

Constants:  $g = 9.80 \text{ m/s}^2$

Keep four significant digits throughout your calculations; do not round up to less than four. When data is given, assume it has at least four significant digits. For example “15 meters” means 15.00 meters.

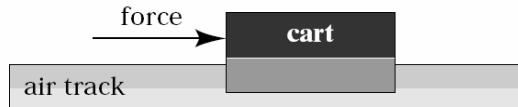
The problems are labeled with a question mark in brackets; [1?] means the answer goes in bubble sheet #1.

You are **encouraged to write your work and full answers on the exam pages** (but of course also record your final answers on the bubble sheet).

Make sure your calculator is in DEGREES, not radians.

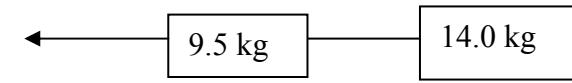
→ Write your CID above upper right corner. Did you do this \_\_\_\_\_? You won’t get your exam back without writing your CID.

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A constant force is exerted for a short length of time on a cart that is initially at rest on an air track. This force gives the cart a certain final speed. The same force is exerted for the same length of time on another cart, also initially at rest, that has four times the mass of the first one. The final speed of the heavier cart is [1?] \_\_\_\_\_.  
1) one-fourth 2) four times 3) half 4) double 5) the same as \_\_\_\_\_ that of the lighter cart.

If instead you replace the phrase “length of time” by “**distance**”, the final speed of the heavier cart is [2?] \_\_\_\_\_.  
1) one-fourth 2) four times 3) half 4) double 5) the same as \_\_\_\_\_ that of the lighter cart.



What is the tension in the rope connecting the two boxes if the tension in the rope pulling the group to the left is 75 N? (There is no friction.) [3?] \_\_\_\_\_.  
(a) less than 38.4 N (b) 38.4 – 41.4 N (c) 41.4 - 44.4 N (d) 44.4-47.4  
(e) 47.4 – 50.4 N (f) more than 50.4 N.

You are a passenger in a car and not wearing your seat belt. Without increasing or decreasing its speed, the car makes a sharp left turn, and you find yourself colliding with the right-hand door. Which is the correct analysis of the situation according to Newton's laws? [4?] \_\_\_\_\_

- 1) Before and after the collision with the door, there is a rightward force pushing you into the door.
- 2) Starting at the time of collision with the door, the door exerts a leftward force on you.
- 3) Both of the above
- 4) Neither of the above

A car can go from 0 to 60 mph (26.82 m/s) in 8.11 seconds. If the car has a mass of 1318 kg, with what force is it pushing backwards on the road during this time? (assume no air friction) [5?] \_\_\_\_\_ (a) less than 3600 N (b) 3600 – 3900 (c) 3900 – 4200 (d) 4200 – 4500 (e) 4500-4800 (f) more than 4800 N.

Consider a horse pulling a buggy at constant velocity. The following are pairs of forces.

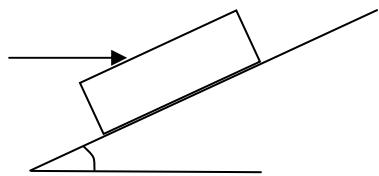
- I. The horse pulling on the buggy, and the buggy pulling back on the horse.
- II. The horse pulling on the buggy, and the ground pushing the horse forward.
- III. The horse pushing down on the ground, and the ground pushing up on the horse.
- IV. Gravity pulling down on the horse, and the ground pushing up on the horse.
- V. Gravity pulling down on the horse, and the horse pulling up on the Earth.

Which of the force pairs constitute ones that **must always** be equal and opposite **according to Newton's 3<sup>rd</sup> Law?** [6?] \_\_\_\_\_

- |                  |                          |
|------------------|--------------------------|
| 1) I only        | 6) I, III, IV, and V     |
| 2) I and II      | 7) III and IV only       |
| 3) I and III     | 8) III and V only        |
| 4) I, III, and V | 9) I, II, III, IV, and V |
| 5) I, IV, and V  |                          |



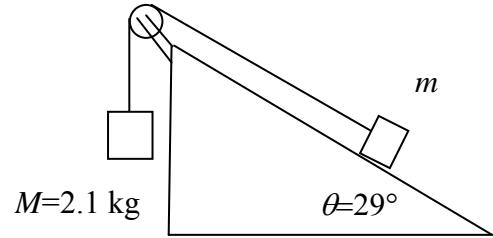
A horizontal force of 27.0 N is applied to a 3.5 kg block that is on a 33° slope as shown. There is no friction. What is the normal force? [7?] \_\_\_\_\_  
(a) less than 44 N (b) 44 - 45 N (c) 45 – 46 N (d) 46 - 47 N (e) 47 – 48 N  
(f) 49 – 50 N (g) 50 – 51 N (h) more than 51 N.



A weightlifter is holding a barbell at rest on a large scale, and a first reading of the scale is taken. The weightlifter begins to lift the barbell, initially accelerating it upward from rest, and ends up holding it motionless above his head. The scale always reads a force that is [8?] \_\_\_\_\_ 1) the weight of the barbells 2) the weight of the man 3) the combined weight of the barbells and the man 4) the normal force on the man. During the process, the reading on the scale will [9?] \_\_\_\_\_

- 1) always be the same as the first reading
- 2) be more than, then less than, then the same as the first reading
- 3) be less than, then more than, then the same as the first reading
- 4) always be more than the first reading

If there is no friction, how large does  $m$  need to be in order for it not to be pulled up the ramp? [10?] \_\_\_\_ kg. (a) less than 3.8 kg (b) 3.8 – 4.1 (c) 4.1 – 4.4 (d) 4.4 – 4.7 (e) 4.7 – 5.0 (f) more than 5.0 kg.



If there is friction, with  $\mu_s = 0.2$  and  $\mu_k = 0.1$ , how small can  $m$  be and still not be pulled up the ramp? [11?] \_\_\_\_ (a) 2.7 – 2.9 kg (b) 2.9 – 3.1 (c) 3.1 – 3.3 (d) 3.3 – 3.5 (e) 3.5 – 3.7 (f) more than 3.7 kg.

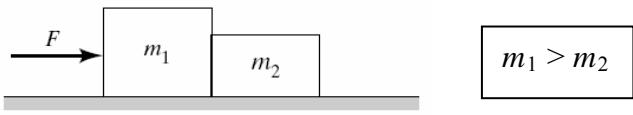
You have a hanging spring with  $k = 14 \text{ N/m}$ . You add a 1.5 kg mass to the spring and let the spring slowly stretch out so that the mass hangs without moving. What is the force the spring is applying to the mass? [12?] \_\_\_\_ N. (a) 14.2 – 14.4 N (b) 14.4 – 14.6 (c) 14.6 – 14.8 (d) 14.8 – 15.0 (e) 15.0 – 15.2 (f) more than 15.2 N.

Now you give the mass a quick push downward, so that it travels 0.22 m further down before stopping and turning around. What was the force the spring was applying to the mass, at its lowest point? [13?] \_\_\_\_ (a) 9 – 11 N (b) 11 – 13 (c) 13 – 15 (d) 15 – 17 (e) 17 – 19 (f) 19 – 21 (g) 21 – 23 (h) 23 – 25 (i) more than 25 N.

Two blocks ( $m_1 > m_2$ ) sitting on a frictionless table are pushed from the left by a horizontal force, as shown.

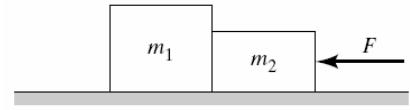
They accelerate to the right. How does the magnitude of the force of  $m_1$  on  $m_2$  compare with the magnitude of the force of  $m_2$  on  $m_1$ ? [14?] \_\_\_\_\_

- 1) the force of  $m_1$  on  $m_2$  is larger 2) the force of  $m_2$  on  $m_1$  is larger 3) they are equal.



How does the magnitude of the force of  $m_1$  on  $m_2$  compare between the two pictures shown (the same force  $F$  pushing on the left vs. pushing on the right)? [15?] \_\_\_\_\_

- 1) It is larger when  $F$  is pushing on  $m_1$ , from the left. 2) It is larger when  $F$  is pushing on  $m_2$ , from the right. 3) It is the same for both situations.



A car of mass 700 kg going 12 m/s goes up a hill that is 4 m high, and at the same time the engine does 50000 J of work to help the car up the hill. The car's speed at the top of the hill is [16?] \_\_\_\_\_

- (a) 14 – 14.5 m/s (b) 14.5 – 15 (c) 15 – 15.5 (d) 15.5 – 16 (e) 16 – 16.5 (f) 16.5 – 17 (g) 17 – 17.5 (h) 17.5 – 18 (i) more than 18 m/s.

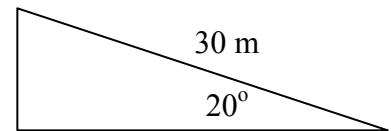
Three skaters approach a drop-off going the same speed. One simply goes forward off the edge into the air (like a projectile), one rolls down an inclined plane, and one goes down a curved ramp, all without friction, and all going down the same vertical distance. Just before they reach the bottom, the one with the highest speed is the one that [17?] \_\_\_\_\_. 1) went forward into the air 2) went down the inclined plane 3) went down the curved ramp 4) neither... same for all.

A 500 kg stone is pulled up a greased ramp (there is still friction) at constant speed, angled  $20^\circ$  above horizontal, to build a pyramid. If the stone is slowly pulled 30 meters in 800 seconds up the incline by a force of 1720N from ropes directed along the incline, the work done by the rope pullers is [18?] \_\_\_\_\_

- (a) less than 50000 N (b) 50000 – 51000 (c) 51000 – 52000 (d) 52000 – 53000 (e) 53000 – 54000 (f) more than 54000 N.

The power provided by the rope pullers is [19?] \_\_\_\_\_

- (a) Less than 52 W (b) 52 – 56 (c) 56 – 60 (d) 60 – 64 (e) 64 – 68 (f) 68 – 72 (g) more than 72 W.



If there is no significant velocity, the work done against friction must have been [20?] \_\_\_\_\_

- (a) less than 400 kJ (b) 400 – 420 (c) 420 – 440 (d) 440 – 460 (e) 460 – 480 (f) 480 – 500 (g) 500 – 520 (h) 520 – 540 (i) more than 540 kJ.

In the electrical force between a nucleus and an electron, the work done in moving the electron in the space around the nucleus depends only on the initial and final distances between the nucleus and the electron. This electrical force is [21?]\_\_\_\_ 1) conservative 2) nonconservative 3) depends on the time it takes.

Tarzan, mass 80 kg, is jogging at 1 m/s when he hears a lion behind him. He runs even faster and at the end of 20m is now going 3 m/s. Over the 20 m of distance he did [22?]\_\_\_\_ (a) less than 295 J (b) 295 – 305 (c) 305 – 315 (d) 315 – 325 (e) 325 – 335 (f) more than 335 J of work.

Still going 3 m/s, he now grabs a vine of length 4 m and swings over a river, and if he hangs on until he stops in his swing, he will be at an angle from the vertical of [23?]\_\_\_\_ (a) 23 – 24 degrees (b) 24 – 25 (c) 25 – 26 (d) 26 – 27 (e) 27 – 28 (f) 28 – 29 (g) 29 – 30 (h) 30 – 31 (i) more than 31 degrees.

If instead he lets go of the vine while he is 0.25 m off the ground, his speed when he lets go will be [24?]\_\_\_\_ (a) less than 1.4 m/s (b) 1.4 – 1.5 (c) 1.5 – 1.6 (d) 1.6 – 1.7 (e) 1.7 – 1.8 (f) 1.8 – 1.9 (g) more than 1.9 m/s

You move a load of bricks of mass 28 kg slowly so it never gets significant velocity. First you move the bricks to a new floor that is 4 m above you, and the work you did on the bricks was [25?]\_\_\_\_ (a) less than 950 J (b) 950 – 1000 (c) 1000 – 1050 (d) 1050 – 1100 (e) 1100 – 1150 (f) more than 1150 J.

You now carry the bricks across the floor a distance of 2 m, and the work you did on the bricks was [26?]\_\_\_\_ (a) less than -500 J (b) -500 to -300 (c) -300 to -100 (d) -100 to 100 (e) 100 to 300 (f) 300 to 500 (g) more than 500 J.

A skydiver is falling , and opens his parachute, and slows down. Which is greatest on the man right after he opens the chute: [27?]\_\_\_\_ 1) force of gravity 2) force of chute 3) they are the same. He now is falling at a constant speed. Which is greatest on the man now? [28?]\_\_\_\_ 1) force of gravity 2) force of chute 3) they are the same.