Physics 150 Practice Hour Exam I

You will have one hour to complete this exam. There are two sections to this exam.

Section I: The first section is a set of twelve multiple choice or short answer questions. Answer all twelve questions. Each question is worth five points. Write your answers carefully in the blanks in front of the questions. If a letter is written and an answer is circled, the written letter will be the answer graded. No partial credit is given in this section. The maximum number of points you can earn in this section is 50 points, so if you miss one or two questions, you will still earn full credit.

Section II: The second section of the exam consists of three (3) problems, of which you are to complete two (2). Each of these problems is worth 25 points, for a total of 50 points. You must indicate clearly which one of the problems you are **not** answering in this section, for example by leaving it blank or by crossing it out if you've started to work it but changed your mind. If you do not indicate which problem you are not doing, two will be graded at random.

Section	Max Points	Score
I	50	
II	50	
TOTAL		

- You may have a sheet of your own handwritten notes that is **one side** of an $8\frac{1}{2}" \times 11"$ sheet of paper.
- You may use a calculator, though you may not share one with someone else in the class. Make sure that your batteries are fresh. **Use of a smartphone calculator app is not allowed.**
- You should be sure to give units when it is relevant.
- You should be sure to use the correct number of significant figures.
- You should solve each problem in formula form before "plugging in" numbers to ensure maximum credit.
- You should show **only** the relevant mathematics in the correct step-by-step logical order on the problem pages in Section II. You should show all work. Correct numerical answers with incorrect reasoning will not earn full credit.
- The answers to the problems in Section II may be given in formula form or numerically as you prefer. All known or given quantities must be given clearly, with proper units.
- You should use well drawn pictures whenever they are relevant; they help you to think and the grader to understand your thinking.
- If you are struggling with a problem in Section II, it will help your grade to explain your thinking in words, even if you cannot get a complete answer. Partial credit will be given for partial solutions.
- If you run low on time on the multiple choice section, it will help your grade to eliminate obviously incorrect answers and then make an educated guess. Do not leave any multiple choice questions unanswered.
- As a general test-taking rule, you should **never** change an answer you have written unless you are **absolutely certain** that it is incorrect.

_____ 1. One second is 10^9 nanoseconds. The speed of light (3×10^8 m/s) in m/ns is

(A) less than 10^{-2} m/ns.
(B) at least 10^{-2} m/ns but less than 10^{-1} m/ns.
(C) at least 10^{-1} m/ns but less than 10 m/ns.
(D) 10 m/ns or greater.

_____ 2. The angle θ between the vectors $\mathbf{A} = \mathbf{i} + 2\mathbf{j} + 2\mathbf{k}$ and $\mathbf{B} = 3\mathbf{i} - 4\mathbf{j}$ is

(X) less than 10°
(F) at least 10° but less than 25°
(G) at least 25° but less than 45°
(H) at least 45° but less than 65°
(I) 65° or greater

_____ 3. A golf ball is hit at an angle of 53.1° and rises to a maximum height of 50 m. How high will the ball rise if the initial velocity is tripled? (Ignore air resistance.)

(J) less than 50 m.
(K) at least 50 m but less than 87 m.
(L) at least 87 m but less than 200 m.
(M) 200 m or greater.

_____ 4. A particle moves so that its position as a function of time is $x(t) = At^2 - Bt^3$, with $A = 7.0\ m/s^2$ and $B = 4.0\ m/s^3$. Its velocity at time $t = 1$ is

(N) less than -4 m/s.
(O) at least -4 m/s but less than 0 m/s.
(P) at least 0 m/s but less than 4 m/s.
(E) 4 m/s or greater.

_____ 5. A highway on-ramp has radius $R = 50\ m$. What is the maximum possible speed for a car to travel on this on-ramp if the maximum possible acceleration is 5.78 m/s^2?

(Q) less than 5 m/s.
(R) at least 5 m/s but less than 10 m/s.
(S) at least 10 m/s but less than 20 m/s.
(U) 20 m/s or greater.

_____ 6. A boy throws a rock horizontally with an initial speed of 20 m/s over the edge of a cliff. If air resistance is negligible and the rock has downward speed of 40 m/s just before it strikes the ground at the bottom of the cliff, the height of the cliff is

(T) less than 50 m.
(W) at least 50 m but less than 100 m.
(X) at least 100 m but less than 200 m.
(Z) 200 m or greater.

_____ 7. In the previous question, the cliff overlooks a level plain. How far from its initial horizontal position does the rock hit the horizontal plain?

(Z) less than 10 m.
(Y) at least 10 m but less than 50 m.
(W) at least 50 m but less than 100 m.
(E) 100 m or greater.

_____ 8. A 100-gram mass is moving so that its velocity makes a 45° angle with its acceleration. Which of the following statements is true?

(U) The mass is speeding up.
(S) The mass is slowing down.
(R) The mass's speed is instantaneously constant.
(Q) More information is needed to determine the answer.

_____ 9. You are skiing down a very steep hill that is inclined at 30° to the horizontal. (It's a 58% grade!) If friction and air resistance are both negligible, each second your speed increases by

(P) less than 1 m/s.
(O) at least 1 m/s but less than 2 m/s.
(N) at least 2 m/s but less than 3 m/s.
(T) 3 m/s or more.

_____ 10. A 10-kg mass hangs by a light cord below a 20-kg mass. An upward force is applied to the 20-kg mass, and both masses accelerate upwards with an acceleration of 3 m/s^2. The tension in the cord connecting the upward accelerating masses is

(M) less than 80 N.
(L) at least 80 N but less than 100 N.
(K) at least 100 N but less than 150 N.
(J) 150 N or greater.

_____ 11. A 2.6-kg mass has a 10 m/s initial speed. A non-constant net force then acts on the mass, doing -30 J of work. Afterwards, the kinetic energy of the mass is

(H) less than 10 J.
(G) at least 10 J, but less than 30 J.
(F) at least 30 J but less than 50 J.
(X) 50 J or greater.

_____ 12. A 2.6-kg mass has 3 J of kinetic energy. The speed of the mass is

(D) less than 1 m/s.
(C) at least 1 m/s, but less than 2 m/s.
(B) at least 2 m/s but less than 4 m/s.
(A) 4 m/s or greater.

Problem 1: Motion in One Dimension

A police officer is sitting at the side of the road when a speeding car passes her. She immediately floors her patrol car and catches up with the speeder after they have each traveled a distance of $d = 1350\ m$. **Assume that the speeder is moving at a constant speed and the police car is moving at a constant acceleration of** $a = 3.00\ \text{m/s}^2$.

(1) Sketch a graph of the velocity versus time for both the speeder and the police officer on the same graph.

(2) How much time did it take the police officer to catch up with the speeder?

$t =$ _____

(3) What is the speeder's speed when caught?

$v =$ _____

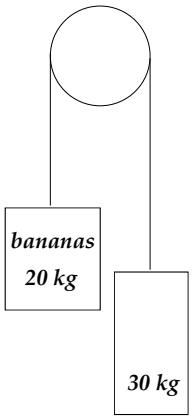
(4) What is the police officer's speed as she catches up with the speeder?

$v =$ _____

(5) What is the police officer's average speed from rest to when she catches up with the speeder?

$v_{\text{avg}} =$ _____

Problem 2: Newton's Laws



A 20.0 kg load of bananas hangs from one end of a rope that passes over a small, frictionless pulley. A 30.0 kg counterweight is suspended from the other end of the rope, as shown in the figure. The system is released from rest.

(1) Draw two free-body diagrams, one for the load of bananas and one for the counterweight.

(2) What is the magnitude of the upward acceleration of the load of bananas?

$a =$ _____

(3) What is the tension in the rope while the load is moving?

$T =$ _____

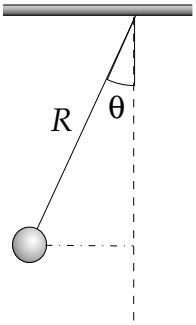
(4) If you held your hand under the 30.0 kg counterweight and the system wasn't moving, what would the tension in the rope be?

$T =$ _____

(5) If you held your hand under the 30.0 kg counterweight and the system wasn't moving, what would the normal force from your hand on the 30.0 kg counterweight be?

$n =$ _____

Problem 3: Work & Energy



A 3.0 kg mass is attached to the ceiling by a rope of length $R = 2.4\ m$. The mass is held so that the rope makes an angle of $\theta = 60^\circ$ with the vertical and released from rest.

(1) How far does the mass drop vertically from its initial point to its lowest point?

$y_i - y_f$ = _____

(2) How much work does gravity do on the mass between its release and its lowest point?

W_{grav} = _____

(3) What is the mass's initial kinetic energy?

K_i = _____

(4) What is the mass's final speed? (At the lowest point.)

v_f = _____

(5) How much work is done by the tension in the rope? ***Explain your answer.***

W_{tension} = _____