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Physics 1313 Examination 1

Prof. T.E. Coan

Please PRINT your name so that we can read it.

Name: _____

Some useful equations and other information.

$v = v_0 + at$ $\quad v^2 = v_0^2 + 2ax$ $\quad x = v_0 t + \frac{1}{2}at^2$

$\bar{v} = (v + v_0)/2$ $\quad \vec{F}_n = m\vec{a}_n$ $\quad \vec{F}_{12} = -\vec{F}_{21}$

$g = 9.8\,\mathrm{m/s^2}$ $\quad 1\,\mathrm{N} = 1\,\mathrm{kg\text{-}m/s^2}$

$a_c = v^2/r$

BOX your final answers!

5 pts. Two children, David and Caroline, are playing on a diving board 2 meters above the surface of a pool. They decide to have a contest to see who can land in the pool first. David runs off the board with some horizontal velocity while Caroline merely steps of the board, with no initial horizontal or vertical velocity. Who, if anyone, lands in the pool first? Circle your answer.

- David lands in the pool first;
- Caroline lands in the pool first;
- David and Caroline land in the pool simultaneously.

5 pts. You are walking North and then gradually stop. What is the direction of your acceleration? Circle your answer.

- Your acceleration is towards the East;
- Your acceleration is towards the South
- Your acceleration is towards the North.

5 pts. You are sitting on the shore of a lake and notice that a sailboat is moving at a *constant* velocity directly east. What, if anything, can you say about the magnitude of the *net* force F_N on the sailboat? Circle your answer.

- You cannot say anything about F_N.
- You can say that $F_N = 0$.
- F_N is increasing with time.

5 pts. You drop a 2 kg book and a 5 kg tire jack both from shoulder height. Which, if any, strikes the ground first? Ignore any effects of air resistance. Circle your answer.

- The book lands first;
- The tire jack lands first;
- The book and the jack land simultaneously.

5 pts. You are at a party and have had a bit too much alcohol to drink. You decide to throw your empty beer bottle into a trash can 10 meters away from you. You throw the bottle slightly upwards and it arcs towards the can. You miss and the bottle hits the floor. What can you say about the *vertical* velocity $\vec{V_y}$ of the bottle? Circle your answer.

- $\vec{V_y} = 0$ m/s at the very top of the arc-like trajectory;
- $\vec{V_y}$ was at no time zero;
- $\vec{V_y} = 0$ m/s just as the bottle crashes into the floor.

5 pts. You and your space alien sister own identical copies of the 1313 physics text. You live here on Earth and she lives on some planet where the local acceleration due to gravity is three times larger than Earth's. You each drop this book from rest and somehow measure the distance each book has fallen after 2 seconds. What can you say about the distances the books have fallen? Circle your answer.

- Both books fall the same distance;
- The space alien book falls 9 times farther than your book;
- The space alien book falls 3 times farther than your book.

5 pts. You push a stalled car directly northwards with some force. Your friend also pushes your car, simultaneously, with a force of the same magnitude but towards the West. Which way does the stalled car accelerate? Circle your answer.

- The car moves in a southerly direction;
- The car moves towards the east;
- The car moves in a direction towards the North West.

5 pts. The acceleration on the surface of the Moon is about 1/6 the value of what it is here on Earth. You throw a rock on the moon and it lands $10\,m$ in front of you. What can you say, if anything, about the acceleration of the rock after it leaves your hand? Circle your answer.

- The acceleration of the rock is a maximum just before it strikes the "ground";
- The acceleration of the rock is constant;
- The acceleration of the rock is a minimum just before it strikes the "ground".

Q1. 20 pts. total. You and your true love decide its time to get "serious". You both decide to go bungee jumping. Your true love jumps horizontally from a tall platform with a horizontal velocity $V_H = 5\,\mathrm{m/s}$. You merely step from the platform with no initial velocity and begin your fall.

(a) 10 pts. When the horizontal distance H your true love has traveled is $H = 10\,\mathrm{m}$, what is your vertical displacement y?

(b) 10 pts. Again, when the horizontal distance H your true love has traveled is $H = 10\,\mathrm{m}$, what is the magnitude of your true love's *vertical* velocity v_y?

Q2. 20 pts. total. You have become saturated with political hucksterism and empty rhetoric. You decide that some heckling and rotten fruit throwing will raise the level of political discourse in the 1996 Presidential campaign. Your least favorite presidential candidate is speaking a distance of 15 m in front of you. You throw a piece of rather ripe produce with mass $m = 0.2\,\mathrm{kg}$ towards him.

(a) 10 pts. Assume that you provide some uniform horizontal acceleration a_H to the fruit while actually throwing it, but that the horizontal acceleration is zero once the fruit leaves your hand. Further assume that the fruit is accelerated through a horizontal distance of $s = 1.0\,\mathrm{m}$ after starting from rest. If the fruit leaves your hand with a speed $v = 18\,\mathrm{m/s}$, what was its horizontal acceleration a_H? Remember to specify units.

(b) 5 pts. What is the magnitude of the horizontal force F_H exerted on the fruit during the throwing motion? (**If** you leave part a blank, use $a = 20\,\mathrm{m/s^2}$.)

(c) 5 pts. What is the weight W of the fruit?

Q3. 20 pts. total. You have purchased tickets on a roller coaster at the local county fair. This roller coaster has a looped section whereby you travel in a vertical circle. This circle has a radius of $r = 10\,\text{m}$.

(a) 10 pts. If the magnitude of your velocity is $v = 15{,}\text{m/s}$ as you travel around this vertical loop, what is your net acceleration $\vec{a}$ when you are traveling around the loop? Remember to give the direction for $\vec{a}$.

(b) 5 pts. What would be your trajectory if, just as you arrive at the very top of the loop, the coaster track were to break and the roller coaster cart were to go sailing off into the air? Sketch what its trajectory would be. No great artistic value is necessary to make this sketch. Just be clear.

(c) 5 pts. Suppose that for some reason you wanted to *double* your centripetal acceleration as you went around the loop. How would you do it? Would you double your speed, double your radius, halve your speed, halve your radius, etc.