8 Oct 2015

Physics 1307 Examination 2

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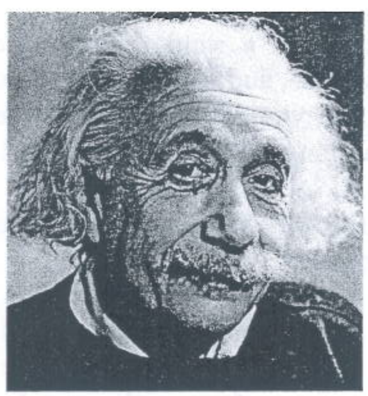
Fall 2015

Please PRINT your name so that we can read it.

Name: Solutions

BOX your final answers.

SHOW work for maximum credit.



Al says ....Be Smokin' Smart!

* Note for Q1: In circular motion, force points toward the center of this circle. Since it is somewhat ambiguous whether this means it is "always changing" or "points in a constant direction" both (b) and (c) were accepted.

Q1 2 pts You take a seat on a carousel at some Spring Break location (East Dallas for me). The carousel rotates at a steady rate and your chair traces out a circle as you go around and around. If your chair has a constant speed, what can you say, if anything, about the net force acting on you? Circle the one best answer.

a) The net force is zero since the speed is constant.
b) The net force is not zero and its direction constantly changes.
c) The net force is not zero and points in a constant direction
d) None of the above answers is correct.

Q2 2 pts You throw 2 identical tennis balls from a third-story apartment balcony in a completely horizontal direction, one at a time. The second time you throw the ball its initial speed is *twice* as great as the initial speed of the first. What can you say about the subsequent motion of the two balls? Ignore air friction. Circle the single best answer.

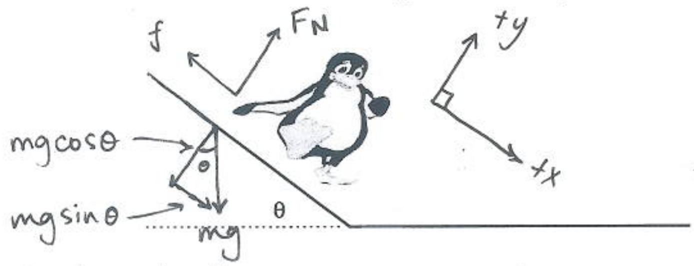
a) The second ball is in the air for twice as long as the first.
b) The first ball is in the air for twice as long as the second.
c) Both balls are in the air for the same amount of time.
d) None of the above answers is correct.

Q3 2 pts You are gazing out a window and notice that a stationary shopping cart, after a short while, suddenly begins to coast slowly along the street. What, if anything, can you say about the force or forces acting on this cart while you were watching it? Circle the single best answer.

a) You need to know the direction of the car's motion to say anything about possible forces that were or are present.
b) Since you do not know whether or not the car's speed is constant, you cannot say anything about whether any net force acted on the car.

c) There must have been some net force acting on the car while you were watching it.
d) None of the above answers is correct.

Q4 10 pts A penguin of mass m slides with *constant* velocity of 1.4 m/s down an icy incline. The incline slopes above the horizontal at $\theta = 20.0°$. See the figure. At the bottom, the penguin slides on a horizontal patch of ice. The coefficient μ of (kinetic) friction is the same for the incline and the horizontal patch. What is the coefficient of friction μ? Recall that the magnitude of the frictional force acting on an object is the coefficient of friction times the normal force acting on that object. Box that answer.



constant velocity, so $a = 0$, $\Sigma F = 0$:

$$\Sigma F_x = mg\sin\theta - f = mg\sin\theta - \mu_k F_N = 0$$

$$\longrightarrow mg\sin\theta = \mu_k F_N$$

$$\Sigma F_y = F_N - mg\cos\theta = 0 \longrightarrow F_N = mg\cos\theta$$

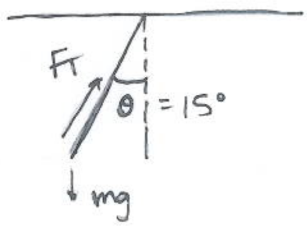
$$mg\sin\theta = \mu_k \cdot mg\cos\theta$$

$$\rightarrow \mu_k = \frac{\sin\theta}{\cos\theta} = \tan\theta = \tan(20°)$$

$$\boxed{\mu_k = 0.36}$$

Q5 10 pts A subway train rounds an unbanked circular curve at 67 km/hr. A passenger hanging on a strap notices that an adjacent unused strap makes an angle of 15° to the vertical. What is the radius of the turn? **Hint:** Think what the tension in the strap must be and what the forces involved are. Be sure to box your answer.

circular motion: $\sum F = ma = \frac{mv^2}{r}$



$\sum F_y = F_T \cos\theta - mg = 0 \rightarrow F_T = \frac{mg}{\cos\theta}$ ①

$\sum F_x = F_T \sin\theta = \frac{mv^2}{r}$ ②

plug ① into ②: $\frac{mg}{\cos\theta} \cdot \sin\theta = \frac{mv^2}{r}$

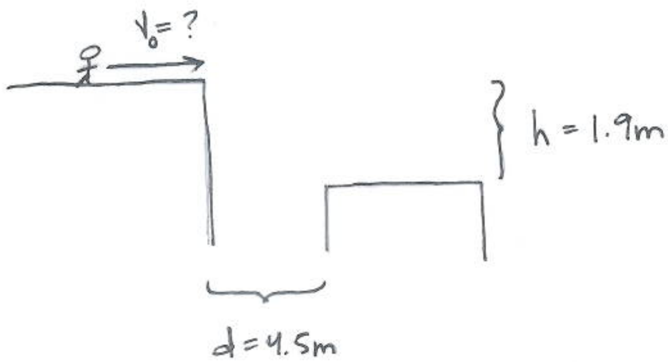
$\rightarrow g\tan\theta = \frac{v^2}{r}$, $r = \frac{v^2}{g\tan\theta}$

convert v: $v = 67 \frac{\text{km}}{\text{hr}} \cdot \frac{1000\text{ m}}{\text{km}} \cdot \frac{1\text{ hr}}{3600\text{ s}} = 18.611\text{ m/s}$

$r = \frac{(18.611\text{ m/s})^2}{(9.8\text{ m/s}^2)\tan(15)}$

$r = 131.91\text{ m}$

Q6 10 pts In a chase scene, a diamond thief is supposed to run right off a flat roof and land on another roof a distance $h = 1.9\,\text{m}$ lower. If the gap d between buildings is $4.5\,\text{m}$ wide, how fast must she run? Label her speed v and box your answer. **Hint:** Use symbols before grinding away with numbers.



y direction

$\Delta y = 1.9\ \text{m}$

$V_{oy} = 0\ \text{m/s}$

$a_y = -g$

$y_f = y_0 + V_{oy}t + \frac{1}{2}at^2$

$-1.9\,\text{m} = -\frac{1}{2}(9.8\,\text{m/s}^2)\,t^2$

$\rightarrow t = \sqrt{\dfrac{2(1.9\,\text{m})}{9.8\,\text{m/s}^2}}$

$= 0.623\ \text{s}$

x direction

$\Delta x = 4.5\ \text{m}$

$V_{ox} = ?$

$a_x = 0$

$t = 0.623\ \text{s}$

$\Delta x = V_{ox}t$

$V_{ox} = \dfrac{\Delta x}{t} = \dfrac{4.5\,\text{m}}{0.623\,\text{s}}$

$\rightarrow \boxed{V = 7.22\ \text{m/s}}$

Q7 10 pts A luge and its rider, with a total mass $m = 85\,\text{kg}$, emerges from a downhill track with an initial speed of $v_0 = 37\,\text{m/s}$. A force slows them to a stop with a constant acceleration of *magnitude* $a = 2\,\text{m/s}^2$. What distance d do they travel while slowing to a stop? Box your answer.

$$V^2 = V_0^2 + 2a\underbrace{\Delta X}_{d}, \quad d = \frac{V^2 - V_0^2}{2a} = \frac{0 - (37\,m/s)^2}{2(-2\,m/s^2)}$$

$$\boxed{d = 342.25\,m}$$

Alternative solution:

$W = F\Delta X = ma\Delta X$ (no need to integrate $W = \int F dx$ here because F is constant)

$\Delta KE = \frac{1}{2}m(V_f^2 - V_i^2) = -\frac{1}{2}mV_i^2$

$W = \Delta KE$

$\cancel{m}a\Delta X = -\frac{1}{2}\cancel{m}V_i^2$ (a is negative, so the negatives cancel)

$\Delta X = \frac{1}{2}\frac{V_i^2}{a}$ → notice that this is the same equation we got from using kinematics above!

$= \frac{(37\,m/s)^2}{2(2\,m/s^2)}$

$= 342.25\,m$

Extra credit. 1 pt. Identify the author of the following quotation.

"Never argue with a fool, onlookers may not be able to tell the difference."

- Jimmy Fallon;
- James Baldwin;
- Mark Twain;
- Emily Dickinson;
- Homer Simpson;
- Mary Shelley.