

Quiz 6, Physics 2a, Nov 5 2010

**Double check that you bubble in your code number correctly.
If there's a mistake, your score will be lowered –as a penalty.**

VERSION A

1. A 10 kg watermelon will be launched, straight up like a rocket, using a spring gun. The spring is compressed $4m$, which requires a force of $400N$, and is then locked in place. The watermelon is then put inside. Someone then pulls the trigger and up the watermelon goes. The inside of the spring gun is coated with teflon, so the average friction force between the watermelon and the inside of the spring gun is $50N$.
 - Call point A where the watermelon rests on the compressed spring, before the launch.
 - Point B , after the launch, is where the watermelon is at the top of the gun, just after the spring uncompresses.
 - Call point C where the watermelon reaches its highest point in the air (apogee).How much energy was stored in the compressed spring, before the trigger was pulled?
 - (a) 400J
 - (b) 800J
 - (c) 1600J
 - (d) 100J
2. Same setup. What is $E_B - E_A$, the difference in total energy of the watermelon at points B and A ?
 - (a) 0
 - (b) $100J$
 - (c) $-100J$
 - (d) $-200J$.
3. Same setup. What is the approximate kinetic energy of the watermelon at point B ?
 - (a) 200J
 - (b) 400J
 - (c) 600J
 - (d) 100J
4. Same setup. Approximately how high does the watermelon go after it loses contact with the spring, in other words what is $y_C - y_B$?
 - (a) 1m
 - (b) 2m
 - (c) 5m
 - (d) 10m.

5. Consider a loop-the-loop track, with negligible friction. The loop has radius R . The car's weight is $w = mg$. Suppose that, at the instant where the car is at the top of the loop, the normal force between car and track is twice the weight, $N = 2w$.

What is the velocity of the car at the top of the loop?

- (a) \sqrt{gR}
- (b) $\sqrt{2gR}$
- (c) $\sqrt{3gR}$
- (d) $\sqrt{gR/2}$.

6. Same setup. Before going into the loop-the-loop, the car was initially at rest at height h above the ground. The car then rolled frictionlessly down the track and into the loop-the-loop. Using the information given above, find h .

- (a) $\frac{3}{2}R$
- (b) $\frac{5}{2}R$
- (c) $\frac{7}{2}R$
- (d) $\frac{9}{2}R$.

7. A $2kg$ block is forced against a horizontal spring of negligible mass, compressing the spring a distance of $1m$. The spring constant is $200N/m$. When released, the block slides on a frictionless, horizontal surface and then up an incline with slope 30° .

What is the velocity of the block after released, while it is sliding on the frictionless, horizontal surface?

- (a) $10m/s$
- (b) $20m/s$
- (c) $30m/s$
- (d) $40m/s$.

8. Same setup. What is the approximate maximum vertical height h that the block reaches up the frictionless ramp?

- (a) $2m$
- (b) $3m$
- (c) $4m$
- (d) $5m$.

9. Same setup, but now suppose that the ramp has a non-zero coefficient of kinetic friction, μ_k (the horizontal surface is still frictionless). Accounting for this friction,

now the block only slides half as high up the ramp, as compared to when the ramp was frictionless.

What is the force of friction while the block slides up the ramp?

- (a) 10N
- (b) 12N
- (c) 14N
- (d) 18N

10. A pendulum consists of a light string of length $L = 5m$, attached at the top to the ceiling and at the bottom to a bob of weight $10N$. The pendulum is pulled out to an initial angle θ_0 with respect to vertical, and is then released (it's at rest when at θ_0). Take θ_0 with $\sin \theta_0 = \frac{4}{5}$.

What is the tension in the string at the point where the weight has reached the bottom, $\theta = 0$?

- (a) 2N
- (b) 8N
- (c) 18N
- (d) 20N