

Physics 221

Quiz 7, Form: A

Name: _____

Date: _____

1. State the energy principle for a particle in words.

2. State the energy principle for a particle using an equation.

3. What chapter of the book should you have read this week?
 - (a) 2
 - (b) 3
 - (c) 4
 - (d) 5
 - (e) 6

Questions 4-7: The great HPU basketball player, Issa Konare, throws a basketball straight upward into the air. It rises and falls back to his hand. During the catch, his hands are displaced downward a few cm as the ball slows down.

4. As the ball rises from his hand to its peak, the work done by gravity on the ball is
 - (a) positive
 - (b) negative
 - (c) zero

5. As the ball falls from its peak to the floor, the work done by gravity on the ball is
 - (a) positive
 - (b) negative
 - (c) zero

6. During the throw while the ball is in his hands and moving upward, the work done by him on the ball is
 - (a) positive
 - (b) negative
 - (c) zero

7. During the catch while the ball is in his hands and is moving downward, the work done by him on the ball is
 - (a) positive
 - (b) negative
 - (c) zero

8. If a force, \vec{F} , on a particle has a component opposite in direction to the displacement, $\Delta\vec{r}$, through which the force acts, then the work done on the particle by the force is
- (a) positive.
 - (b) negative.
 - (c) zero.
 - (d) none of the above because it depends on what other forces are doing work.
9. If a force, \vec{F} , on a particle has a component in the same direction as the displacement, $\Delta\vec{r}$, through which the force acts, then the work done on the particle by the force is
- (a) positive.
 - (b) negative.
 - (c) zero.
 - (d) none of the above because it depends on what other forces are doing work.
10. If the *total* work on a particle is positive during some displacement of the particle from point i to point f , the energy of the particle at point f is
- (a) greater than its energy at point i .
 - (b) less than its energy at point i .
 - (c) equal to the kinetic energy at point i .
11. If the *total* work on a particle is negative during some displacement of the particle from point i to point f , the energy of the particle at point f is
- (a) greater than its energy at point i .
 - (b) less than its energy at point i .
 - (c) equal to the kinetic energy at point i .
12. You set up a pendulum using a ball tied to a string in the lab. At first, the pendulum hangs vertically. You then pull it back 40° and release it from rest. As it swings, the work done on the pendulum ball by the force of the string is zero during any interval. Why?
13. The total work done by external forces on a proton is 1.39×10^{-10} J in order to increase its speed from $0.9c$. What will be its final speed? The mass of a proton is 1.7×10^{-27} kg.

The force of thruster A on a 2000-kg space probe is $\langle 2e6, -1e6, 9e5 \rangle$ N as the probe undergoes a displacement along a straight line from position $\vec{r}_i = \langle 0, 1, -1 \rangle$ m to position $\vec{r}_f = \langle 2, 4, 0 \rangle$ m. At its initial position, its speed is 100 m/s, and at its final position its speed is 150 m/s. Model the probe as a point particle.

14. What is the displacement of the probe during this interval?

15. What is the work done by the force of thruster A during this interval?

16. There must be other thrusters firing because the total work, which is the change in the energy of the probe, is not equal to the work done by thruster A. Thus, how much work did other forces do on the space probe?

Answer Key for Exam A

1. The total work done on a particle is equal to its change in energy.

2. $W = \Delta E$

3. (c)

8. (b)

4. (b)

9. (a)

5. (a)

10. (a)

6. (a)

7. (b)

11. (b)

12. The force of the string on the ball is always perpendicular to a small displacement of the ball $d\vec{r}$; therefore, the work done by the string is zero ($\vec{F} \cdot d\vec{r} = 0$).

$$13. W = \Delta E = \frac{mc^2}{\sqrt{1-v_f^2/c^2}} - \frac{mc^2}{\sqrt{1-v_i^2/c^2}}$$
$$1.39 \times 10^{-10} = \Delta E = \frac{1.7 \times 10^{-27} c^2}{\sqrt{1-v_f^2/c^2}} - \frac{1.7 \times 10^{-27} c^2}{\sqrt{1-0.9^2}}$$
$$v_f = 0.95c = 2.85 \times 10^8 \text{ m/s}$$

14. $\Delta \vec{r} = \vec{r}_f - \vec{r}_i$

$$\Delta \vec{r} = \langle 2, 3, 1 \rangle \text{ m}$$

15. $W = \vec{F} \cdot \Delta \vec{r}$

$$W_A = -9 \times 10^6 \text{ J}$$

16. $W_{\text{other}} = \Delta E - W_A = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 - W_A$

$$W_{\text{other}} = 12.5 \times 10^6 - -9 \times 10^6 = 21.5 \times 10^6 \text{ J}$$