

Common Exam 3 Phys 105

Fall 2008

Physics 105 Formula Sheet:

$$W = mg \quad g = 9.8 \text{ m/s}^2 \quad \text{centi}=c=0.01 \quad \text{kilo}=k=1,000 \quad \text{mega}=M=1,000,000$$

$$\text{For constant } a: \quad v = v_o + at \quad x - x_o = v_o t + \frac{1}{2}at^2 \quad v^2 - v_o^2 = 2a \cdot (x - x_o) \quad x - x_o = \frac{1}{2}(v + v_o)t$$

$$F_{\text{net}} = ma \quad \Sigma \mathbf{F} = m\mathbf{a} \quad F_{\text{st,max}} = \mu_s N \quad F_k = \mu_k N$$

$$\text{Work: } W = \vec{F} \cdot \vec{d} = |\vec{F}| |\vec{d}| \cos \theta_{F,d}, \quad W_{\text{grav}} = -mg \cdot (y - y_o), \quad W_{\text{spring}} = -\frac{1}{2}k(x^2 - x_o^2), \quad W_{\text{frict}} = -F_k d,$$

$$\text{Work-Energy Theorem: } W_{\text{tot}} = K_f - K_i$$

$$\text{Kinetic Energy: } K = \frac{1}{2}mv^2, \quad \text{Power: } P = W/\Delta t = \mathbf{F} \cdot \mathbf{v}$$

$$\text{Potential Energy for gravity } U_g = mg \cdot (y - y_o), \quad \Delta U_g = -W_g$$

$$\text{Potential Energy for spring: } F = -kx, \quad U_s = \frac{1}{2}kx^2, \quad \Delta U_s = -W_s$$

$$\text{Mechanical Energy: } E_m = U + K.$$

Conservation of mechanical energy: $\Delta E_m = \Delta U + \Delta K = 0$ if conservative forces are the only forces that do work on the system.

$$\text{Work done by non-conservative forces: } W_{\text{nc}} = E_{m,f} - E_{m,i}$$

$$\textbf{Vectors: Components: } a_x = a \cdot \cos(\theta) \quad a_y = a \cdot \sin(\theta) \quad \mathbf{a} = a_x \mathbf{i} + a_y \mathbf{j} \quad |\mathbf{a}| = \sqrt{a_x^2 + a_y^2} \quad \theta = \tan^{-1}(a_y/a_x)$$

$$\text{Addition: } \mathbf{a} + \mathbf{b} = \mathbf{c} \quad \text{implies } c_x = a_x + b_x, \quad c_y = a_y + b_y$$

$$\text{Dot product: } \mathbf{a} \cdot \mathbf{b} = a \cdot b \cdot \cos(\phi) = a_x b_x + a_y b_y + a_z b_z \quad \text{unit vectors: } \mathbf{i} \cdot \mathbf{i} = \mathbf{j} \cdot \mathbf{j} = \mathbf{k} \cdot \mathbf{k} = 1; \quad \mathbf{i} \cdot \mathbf{j} = \mathbf{i} \cdot \mathbf{k} = \mathbf{j} \cdot \mathbf{k} = 0$$

As a student at NJIT I will conduct myself in a professional manner and will comply with the provisions of the NJIT Academic Honor Code. I also understand that I must subscribe to the following pledge: On my honor, I pledge that I _____ have not violated the provisions of the NJIT Academic Honor Code.

Multiple Choice: (15 questions, 1pt. each) Identify the letter of the choice that best answers the question.

- _____ 1. I drop a 60-g golf ball from 2.0 m high. It rebounds to 1.5 m. How much energy is lost?
- 1.0 J
 - 0.88 J
 - 0.50 J
 - 0.29 J
 - 1.1 J
- _____ 2. A Hooke's law spring is compressed 12.0 cm from equilibrium and the potential energy stored is 72.0 J. What is the spring constant in this case?
- 1 000 N/m
 - No answer is correct.
 - 5 000 N/m
 - 10 000 N/m
 - 1 200 N/m
- _____ 3. A 7.00-kg bowling ball falls from a 2.00-m shelf. Just before hitting the floor, what will be its kinetic energy? ($g = 9.80 \text{ m/s}^2$ and assume air resistance is negligible)
- 19.6 J
 - 14.0 J
 - 156 J
 - 137 J
 - 29.4 J
- _____ 4. A parachutist of mass 50.0 kg jumps out of an airplane at a height of 1 000 m. The parachute deploys, and she lands on the ground with a speed of 5.0 m/s. How much energy was lost to air friction during this jump?
- 489 000 J
 - 49 400 J
 - 198 000 J
 - 98 700 J
 - 534 000 J
- _____ 5. If both mass and velocity of a ball are tripled, the kinetic energy is increased by a factor of:
- 81.
 - 9.
 - 6.
 - 3.
 - 27.

- _____ 6. An amount of work equal to 1.5 J is required to compress the spring in a spring-gun. What is the "launch speed" of a 15-g marble?
- 15 m/s
 - 14 m/s
 - 18 m/s
 - 23 m/s
 - 21 m/s
- _____ 7. A worker pushes a wheelbarrow with a force of 40 N over a level distance of 6.0 m. If a frictional force of 24 N acts on the wheelbarrow in a direction opposite to that of the worker, what net work is done on the wheelbarrow?
- 216 J
 - 96 J
 - 75 J
 - 144 J
 - 240 J
- _____ 8. Old Faithful geyser in Yellowstone Park shoots water hourly to a height of 40 m. With what velocity does the water leave the ground?
- 20 m/s
 - 7.0 m/s
 - 28 m/s
 - 14 m/s
 - 34 m/s
- _____ 9. A professional skier reaches a speed of 56 m/s on a 30° ski slope. Ignoring friction, what was the minimum distance along the slope the skier would have had to travel, starting from rest?
- 720 m
 - 110 m
 - 160 m
 - 640 m
 - 320 m
- _____ 10. The SI units for k , the spring constant, are equivalent to:
- J.
 - J/N.
 - kg/s².
 - kg/s.
 - None of the above.

- _____ 11. When an object is dropped from a tower, what is the effect of the air resistance as it falls?
- does positive work
 - increases the object's kinetic energy
 - increases the object's potential energy
 - increases the total energy of the object
 - None of the above choices are valid.
- _____ 12. A very light cart holding a 300-N box is moved at constant velocity across a 15-m level surface. What is the net work done in the process?
- zero
 - 20 J
 - 4500 J
 - 1/20 J
 - 2 000 J
- _____ 13. A horizontal force of 100 N is applied to move a 45-kg cart across a 9.0-m level surface. What work is done by the 100-N force?
- 900 J
 - 405 J
 - 4 500 J
 - 5600 J
 - 500 J
- _____ 14. Preston pushes a wheelbarrow weighing 500 N to the top of a 50.0-m ramp, inclined at 20.0° with the horizontal, and leaves it. Tamara accidentally bumps the wheelbarrow. It slides back down the ramp, during which an 80.0-N frictional force acts on it over the 50.0 m. What is the wheelbarrow's kinetic energy at the bottom at of the ramp? ($g = 9.8 \text{ m/s}^2$)
- 13 100 J
 - 8 150 J
 - 14 300 J
 - 4 550 J
 - 6 550 J
- _____ 15. I use a rope 2.00 m long to swing a 10.0-kg weight around my head. The tension in the rope is 20.0 N. In half a revolution how much work is done by the rope on the weight?
- 126 J
 - 40.0 J
 - 251 J
 - 0
 - None of the above.