Name_____

Physics 100 Midterm I (10/12/01)

speed $= \frac{\text{distance}}{\text{time}}$; time $= \frac{\text{distance}}{\text{speed}}$; distance = speed × time

$h = \frac{1}{2}gt^2 \quad t = \sqrt{2h/g} \quad g = 10\frac{m}{s^2}$ 1 lb = 4.5 Newtons

Work $= F \cdot d_{\|}$; $K.E. = \frac{1}{2}mv^2$; grav. $P.E. = mgh$ weight $= mg$ Power$= \frac{\text{energy}}{\text{time}}$

$F_{\text{grav}} = G\frac{m_1 m_2}{d^2}$, $G = 6.7 \times 10^{-11}\frac{Nm^2}{kg^2}$, $g_{Earth} = G\frac{M_{Earth}}{R^2_{Earth}}$

$F_{\text{elec}} = k\frac{q_1 q_2}{d^2}$, $k = 9 \times 10^9 \frac{Nm^2}{coul^2}$

momentum $= m\vec{v}$; ang. momentum $= rmv = I\omega$ moment of inertia $= I = mr^2$

frequency $= \frac{1}{\text{period}}$ wave speed = frequency × wavelength

Answer all Questions.

1. Konishiki, the famous Sumo wrestler from Hawaii weighs 615 pounds. What is his mass?

   a) 615 kg
   b) 61.5 kg
   c) 2767 N
   d) 277 kg

2. Suppose you are on a space ship, far from the Earth and the influence of Earth's (or any other object's) gravity. What statement about your *weight* and *mass* is correct?

   a) Both your mass and your weight stay the same.
   b) Both your mass and your weight decrease.
   c) Your mass stays the same and your weight decreases.
   d) Your weight stays the same and your mass decreases.

3. A 70 kg astronaut is orbiting the Earth in a space shuttle. The shuttle circles the Earth with a constant speed. What statement is correct?

   a) Her acceleration has value g and is pointed straight upwards.
   b) Since her speed is constant, she is not accelerating.
   c) Her acceleration has value g and is pointed straight ahead.
   d) Her acceleration has value g and is pointed straight downwards.

4. A ball is thrown straight up with an initial upward speed of 20 m/s. What is its acceleration at the highest point in its trajectory?

   a) 20 m/s^2, upward.
   b) 20 m/s^2, downward.
   c) 10 m/s^2, upward.
   d) 10 m/s^2, downward.
   e) 0.0

5. If the same ball was thrown upward with twice the initial speed, i.e. 40 m/s, how does its maximum height change?

   a) $2\times$ higher
   b) $3\times$ higher
   c) $4\times$ higher
   d) $8\times$ higher
   e) None of the above.

6. A 90 kg student climbs 30 flights of stairs to the roof of a bulding. Each flight of stairs has a vertical rise of 3 m. How much work does he do?

   a) 0 *joules*
   b) 81×10^2 *joules*
   c) 81×10^3 *joules*
   d) 81×10^4 *joules*.

7. Another 90 kg student runs for 4000 meters over level ground. How much work does he do?

   a) 360 *joules*
   b) 36×10^2 *joules*
   c) 0 *joules*
   d) 36×10^3 *joules*
   e) 36×10^4 *joules*.

8. Why is it easier to maintain your balance on a bicycle that is moving that one that is standing still?

   a) no difference, it only seems that way.
   b) conservation of momentum.
   c) conservation of angular momentum.
   d) conservation of energy.

9. Why does a trapeze artist goes into a tuck when he wants to make a number of flips?

   a) This helps him avoid dizziness.
   b) This conserves momentum.
   c) This reduces his moment of inertia
   and increases his angular velocity.
   d) Only for appearances and nothing to do with physics.

10. Newton's second law states $\vec{F} = m\vec{a}$: i.e. the acceleration of an object is proportional to the applied force; the direction of the acceleration is the same as the direction of the force. This law applies equally well for *any direction* of the applied force. What symmetry is this?

    a) rotational symmetry

    b) time-translation symmetry

    c) space-translation symmetry

    d) force-acceleration symmetry

11. What conservation law does *space-translation* symmetry imply?

    a) conservation of angular momentum

    b) conservation of energy

    c) conservation of momentum

    d) none of the above

12. Newtons third law says that every force has an equal and opposite "reaction" force. Right now, the Earth's gravity is pulling you downward with a force equal to your weight. What is the reaction force to this?

    a) The upward force your chair exerts on you.

    b) A force between the floor and your chair.

    c) A force you exert on the Earth, pulling it upwards.

    d) All of the above.

    e) None of the above.

13. The graph at the right illustrates the output of two sources of sound. Where does the sound of the two sources interfere *destructively*?

    a) t_2

    b) t_1 and t_2

    c) t_2 and t_3

    d) t_1 and t_3

    e) t_1, t_2 and t_3

14. Suppose a physics 100 teacher makes a deal with the University President such that he gets paid \$1 for his 1^{st} class, \$2 for his 2^{nd}, \$4 for his 3^{rd}, \$8 for his 4^{th}, etc. How much should he be paid for his 41^{st} class?

    a) \$80.

    b) (about) \$ 1 thousand.

    c) (about) \$ 1 million.

    d) (about) \$ 1 billion.

    e) (about) \$ 1 trillion.

15. A 90 kg UH warrior quarterback dives toward the goal line with a speed of 4 m/s. A 120 kg BYU linebacker tries to stop him by diving directly at him with a speed of 2.5 m/s. They collide in mid-air right over the goal line and the BYU player hangs on to the UH guy. Which of the following happens immediately after the collision?

    a) The players travel at a speed of 0.28 m/s in the same direction as the BYU player was initially moving.

    b) The players travel at a speed of 2.5 m/s in the same direction as the BYU player was initially moving.

    c) The players travel at a speed of 4.0 m/s in the same direction as the UH player was initially moving.

    d) The players travel at a speed of 0.28 m/s in the same direction as the UH player was initially moving.

16. What of the following features are common for gravitational and electrical forces?

    a) They are both always repulsive.

    b) They are both always attractive.

    c) They both have an inverse-square-law distance behaviour.

    d) They are the same strength.

17. The planet Mars has a mass of 6.6×10^{23} kg and a radius of 3.4×10^{6} m. What is the acceleration due to gravity on the surface of Mars?

a) 0.0 m/s^2.

b) 1.3 m/s^2.

c) 1.7 m/s^2.

d) 3.8 m/s^2.

e) 10 m/s^2.

18. The speed of light is $v = 3 \times 10^8\ m/s$, and the Sun is $d = 1.5 \times 10^{11}\ m$ from the Earth. How long does it take light to travel from the Sun to the Earth?

a) 4.5×10^8 seconds

b) 5000 seconds

c) 500 seconds

d) 50 seconds

e) 5×10^{-3} seconds.

19. Suppose I roll a disk, a hoop, and a solid ball, all with the same mass and radius down an inclined plane. Which one gets to the bottom fastest?

a) The hoop.

b) The disk.

c) The ball.

d) They all get there at the same time.

20. Suppose you are standing next to a road and a loud speeding car passes by. What statement best describes the frequency of the sound you hear?

a) The frequency stays constant.

b) The frequency is higher when the car is approaching and abruptly gets lower when it is going away from you.

c) The frequency is lower when the car is approaching and abruptly gets higher when it is going away from you.

d) The frequency is lower when the car is approaching and slowly gets higher as it passes by.