1. The horizontal and vertical components of a projectile's velocity are:
   a. directly proportional  
   b. inversely proportional  
   c. independent of each other  
   d. equal

2. The horizontal acceleration (x-direction) of a projectile after it is fired is:
   a. dependent on vertical acceleration  
   b. directly proportional to acceleration due to gravity  
   c. constant  
   d. zero

3. An orange is dropped at the same time a bullet is shot from a gun. Which of the following is true?
   a. The acceleration due to gravity is greater for the orange because the orange is heavier.
   b. Gravity acts less on the bullet than on the orange because the bullet is moving faster.
   c. The horizontal (x-direction) velocities will be the same.
   d. The two objects will hit the ground at the same time.

4. Impulse equals ________.
   a. instantaneous momentum  
   b. mass times velocity  
   c. the difference in the final and initial momenta  
   d. the sum of forces acting on a body

5. On a force-time graph, the area under the graph is a measure of ________.
   a. force  
   b. impulse  
   c. mass  
   d. momentum

6. An air bag is effective because it ________ the amount of force by increasing the time interval over which the impulse is applied.
   a. balances  
   b. decreases  
   c. eliminates  
   d. increases

7. A 40 kg ice skater glides with a speed of 2.0 m/s toward a 10.0 kg sled at rest on the ice. The ice skater reaches the sled, holds on to it, and then continues to slide in the same direction. What is the speed of the ice-skater and the sled after they collide?
   a. 0.4 m/s  
   b. 0.8 m/s  
   c. 1.6 m/s  
   d. 3.2 m/s

8. What is the difference in momentum between a 50.0 kg runner moving at a speed of 3.00 m/s and a 3000 kg truck moving at a speed of 1.00 m/s?
   a. 1275 kg m/s  
   b. 2550 kg m/s  
   c. 2850 kg m/s  
   d. 2950 kg m/s

9. A force of 16 N exerted against a non-moving rock with an impulse of 0.8 kg m/s causes the rock to fly off the ground with a speed of 4.0 m/s. What is the mass of the rock?
   a. 0.2 kg  
   b. 0.8 kg  
   c. 1.6 kg  
   d. 4.0 kg

10. Two people carry identical 40.0 N boxes up a ramp. The ramp is 2.00 m long and rests on a platform that is 1.00 m high. One person walks up the ramp in 2.00 sec, and the other person walks up the ramp in 4.00 sec. What is the difference in power the two people use to carry the boxes up the ramp? 
    a. 5.00 W  
    b. 10.0 W  
    c. 20.0 W  
    d. 40.0 W
11. A 4 N soccer ball sits motionless on a field. A player’s foot exerts a force of 5 N on the ball for a distance of 0.1 m, and the ball rolls a distance of 1 m. How much kinetic energy does the ball gain from the player?
   a. 0.5 J  
   b. 0.9 J  
   c. 9 J  
   d. 50 J

12. A bicyclist increases her speed from 4.0 m/s to 6.0 m/s. The combined mass of the bicyclist and the bicycle is 55 kg. How much work did the bicyclist do in increasing her speed?
   a. 11 J  
   b. 28 J  
   c. 55 J  
   d. 550 J

13. You drop a 0.06 kg ball from a height of 1.0 m above a hard, flat surface. The ball strikes the surface and transfers 0.14 J of its energy to the floor. It then bounces back upward. How much kinetic energy does the ball have just after it bounces off the flat surface?
   a. 0.20 J  
   b. 0.59 J  
   c. 0.45 J  
   d. 0.73 J

14. You move a 2.5 kg book from a shelf that is 1.2 m above the ground to a shelf that is 2.6 m above the ground. What is the change in the book’s gravitational potential energy?
   a. 1.4 J  
   b. 0.59 J  
   c. 3.5 J  
   d. 34 J

15. What is the value of the spring constant of a spring with an elastic potential energy of 8.67 J when it is stretched 247 mm? = 247 m.
   a. 70.2 N/m  
   b. 71.1 N/m  
   c. 142 N/m  
   d. 284 N/m

16. A spring with a constant of 350 N/m pulls a door closed. How much work is done as the spring pulls the door at a constant velocity from an 85 cm stretch to a 5.0 cm stretch?
   a. 112 Nm  
   b. 130 J  
   c. 224 Nm  
   d. 1.12 x 10^3 J

17. If the external world does work on a system, the ______.
   a. amount of work done on the system has a negative value  
   b. energy of the system decreases  
   c. energy of the system increases  
   d. external world becomes warmer

18. Work is done on an object when a constant force is exerted on the object causing the object to be displaced ______.
   a. opposite the direction of the force  
   b. at an angle to the force  
   c. perpendicular to the force  
   d. in the direction of the force

19. In which of the following situations is no work done on a book?
   a. carrying the book down the hall  
   b. dropping the book  
   c. picking up the book  
   d. pushing the book across the desk

20. In which of the following situations is work done on a rock by gravity?
   a. carrying the rock across the yard  
   b. dropping the rock  
   c. picking up the rock  
   d. pushing the rock across the driveway

21. One definition of ______ is "work done per unit time."
   a. efficiency  
   b. ideal mechanical advantage  
   c. mechanical advantage  
   d. power
General Physics: Final Prep – Group Workfest: Multiple Choice

22. The time it takes for a wave to complete one wave cycle is the wave’s _____.
   a. amplitude  
   b. period  
   c. wavelength  
   d. frequency

23. The distance from the trough of a wave to the adjacent trough is the _____.
   a. amplitude  
   b. period  
   c. wavelength  
   d. speed

24. The number of times a wave cycle repeats each second is the _____ of the wave.
   a. period  
   b. frequency  
   c. velocity  
   d. wavelength

25. The bending of waves at the boundary of two different media is known as _____.
   a. refraction  
   b. reflection  
   c. incidence  
   d. diffraction

26. The _____ is a line drawn at a right angle to a barrier.
   a. normal  
   b. ray  
   c. node  
   d. wave front

27. How does sound travel from its source to your ear?
   a. By changes in air pressure  
   b. By vibrations in wires or strings  
   c. By electromagnetic waves  
   d. By infrared waves

28. Paulo is listening to classical music in the speakers installed in his pool. A note with a frequency of 327 Hz reaches his ears while he is under water. What is the wavelength of the sound that reaches Paulo’s ears? Use 1493 m/s for the speed of sound in water.
   a. 2.19 nm  
   b. 4.88 x 10^-5 m  
   c. 2.19 x 10^-1 m  
   d. 4.57 m

29. The horn of a car attracts the attention of a stationary observer. If the car is approaching the observer at 60.0 km/hr and the horn has a frequency of 512 Hz, what is the frequency of the sound perceived by the observer?
   a. Greater than 512 Hz  
   b. Less than 512 Hz  
   c. 512 Hz  
   d. The observer does not hear any sound

30. A ray of light strikes a plane mirror at an angle of 23 degrees to the normal. What is the angle between the reflected ray and the mirror?
   a. 23 degrees  
   b. 46 degrees  
   c. 67 degrees  
   d. 134 degrees

For each statement below, mark true (A) or false (B). If false, fill in the blank on the bubble sheet with a word to replace the italicized part to make the statement true.

31. A – true  B – false: An object has kinetic energy because of its motion.

32. A – true  B – false: If several forces act on a system, the product of the work done by each force equals the work done on the system.

33. A – true  B – false: One way to calculate power is to multiply force by velocity.
General Physics: Final Prep – Group Workfest: Multiple Choice

34. A – true  B – false: The work-energy theorem states that the work done on a system is equal to the change in kinetic energy of the system.

35. A – true  B – false: When two-dimensional waves are reflected at boundaries, the angles of incidence and reflection are equal.

36. A – true  B – false: The force experienced by a spring is directly proportional to the displacement of the spring.

37. A – true  B – false: The period of a wave is determined by the medium through which the wave moves.

38. A – true  B – false: When a wave crosses a boundary, some energy is transferred and some is reflected.
General Physics: Final Prep – Group Workfest: Free Response

1. A remote-control car with a constant velocity drives off the top of a wall that is 10.0 m high and lands 4.60 m from the base of the wall.
   a. How long is the car in the air?
   \[ \Delta t = \sqrt{\frac{2 \Delta y}{a}} = \sqrt{\frac{2(10.0 \text{ m})}{(9.8 \text{ m/s}^2)}} = 2.041 \text{ s} \]
   \[ \Delta t = \sqrt{\frac{2 \cdot 10.0}{9.8}} = 2.041 \text{ s} \]
   \[ \Delta t = 2.041 \text{ s} \]

   b. What is the car's velocity before it drives off the top of the wall?
   \[ V = \frac{\Delta x}{\Delta t} = \frac{4.60 \text{ m}}{1.43 \text{ s}} = 3.22 \text{ m/s} \]
   \[ V = 3.22 \text{ m/s} \]

   c. What is the car's vertical velocity at impact?
   \[ v_f^2 = v_i^2 + 2a \Delta y = 2(9.8 \text{ m/s}^2)(10 \text{ m}) = 196 \text{ m}^2/\text{s}^2 \]
   \[ v_f = \sqrt{196} = 14 \text{ m/s} \]

   d. How far from the base of the wall would the remote-control car have landed if it had been subject to acceleration due to gravity on the Moon (1.7 m/s²)?
   \[ \Delta y = \frac{1}{2} a \Delta t^2 = \frac{1}{2} (1.7 \text{ m/s}^2)(3.43 \text{ s})^2 = 11.765 \text{ m} \]
   \[ \Delta t = 3.43 \text{ s} \]

2. A 300 g bird flying along at 6.0 m/s sees a 10 g insect heading straight toward it with a speed of 30 m/s. The bird opens its mouth wide and enjoys a nice lunch. What is the bird's speed immediately after swallowing?
   \[ (.300 \text{ kg})(6 \text{ m/s}) + (.010 \text{ kg})(-30 \text{ m/s}) = (.310 \text{ kg})(v_f) \]
   \[ 1.8 - .3 = .310 v_f \]
   \[ 5.8310 = v_f = 4.84 \text{ m/s} \]

3. As a 15,000 kg jet lands on an aircraft carrier, its tail hook snags a cable to slow it down. The cable is attached to a spring with spring constant 60,000 N/m. If the spring stretches 30 m to stop the plane, what was the plane’s landing speed?
   \[ \Delta E_{\text{total}} = 0 = \Delta E_K + \Delta E_{el} \]
   \[ E_K = \frac{1}{2}mv^2 \]
   \[ E_{el} = \frac{1}{2} k \Delta x^2 = \frac{1}{2} (60,000 \text{ N/m})(30 \text{ m})^2 = 2.7 \times 10^7 \text{ J} \]
   \[ v^2 = 3600 \text{ m}^2/\text{s}^2 \]
   \[ v = 60 \text{ m/s} \]

4. A spring that is stretched 23.0 cm from its equilibrium point experiences a force of 103 N. What is the spring constant? How much energy is stored in the spring?
   \[ F = k \Delta x \]
   \[ k = \frac{F}{\Delta x} = 103 \text{ N} / .23 \text{ m} = 448 \text{ N/m} \]
   \[ E_{el} = \frac{1}{2} k \Delta x^2 = \frac{1}{2} (448 \text{ N/m})(.23 \text{ m})^2 = 11.8 \text{ J} \]

5. A box sits on a platform supported by a compressed spring. The box has a mass of 1.0 kg. When the spring is released, it transfers 4.9 J of energy to the box, and the box flies upward. What maximum height will the box reach?
   \[ \Delta E_{\text{total}} = 0 = \Delta E_K + \Delta E_{el} \]
   \[ \Delta E_{el} = \Delta E_K = 4.9 \text{ J} = \frac{1}{2}mv^2 \]
   \[ v^2 = 9.8 \text{ m/s}^2 \]
   \[ v = 3.13 \text{ m/s} \]
   \[ \Delta y = \frac{1}{2} \cdot 9.8 \text{ m/s}^2 = 4.9 \text{ m} \]

   \[ v_f^2 = v_i^2 + 2a \Delta y \]
   \[ v_f = \sqrt{3.13^2 + 2(-9.8 \text{ m/s}^2)(4.9 \text{ m})} = 0 \text{ m/s} \]
6. A wave with a frequency of 1.1 Hz travels through deep water at a speed of 5.7 m/s. When the wave enters shallow water, its speed slows to 3.2 m/s. What is the wavelength of the wave in the shallow water?

\[ v = f \lambda \]

\[ \lambda = \frac{v}{f} = \frac{3.2 \text{ m/s}}{1.1 \text{ Hz}} = \boxed{2.91 \text{ m}} \]
Group Work - Multiple Choice

1. A B C D E
2. A B C D E
3. A B C D E
4. A B C D E
5. A B C D E
6. A B C D E
7. A B C D E
8. A B C D E
9. A B C D E
10. A B C D E
11. A B C D E
12. A B C D E
13. A B C D E
14. A B C D E
15. A B C D E
16. A B C D E
17. A B C D E
18. A B C D E
19. A B C D E
20. A B C D E
21. A B C D E
22. A B C D E
23. A B C D E
24. A B C D E
25. A B C D E
26. A B C D E
27. A B C D E
28. A B C D E
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30. A B C D E
31. A B C D E
32. A B C D E
33. A B C D E
34. A B C D E
35. A B C D E
36. A B C D E
37. A B C D E
38. A B C D E
39. A B C D E
40. A B C D E

- Sum
- Total Energy
- Speed

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