1. A particle with an initial velocity of 50 m/s slows at a constant acceleration to 20 m/s over a distance of 105 m. How long does it take for the particle to slow down?

(A) 2 s

(B) 3 s

(C) 4 s

(D) 5 s

(E) 6 s

2. A projectile reaches its maximum height in approximately 1.8 seconds. It has a horizontal velocity of 24 m/s. At what speed is it launched?

(A) 17 m/s

(B) 30 m/s

(C) 45 m/s

(D) 52 m/s

(E) 60 m/s

3. A 2 kg object moving at 10 m/s in a circle with a radius of 5 m, is accelerating at:

(A) 2 m/s2

(B) 20 m/s2

(C) 40 m/s2

(D) 50 m/s2

(E) 60 m/s2

4. A man dangles a 10 kg mass from the end of a rope. If he steps on an elevator while still holding the rope, and the elevator accelerates downward at 3 m/s2, the tension in the rope will be:

(A) 0 N

(B) 30 N

(C) 70 N

(D) 100 N

(E) 200 N

5. A 54.9 kg crate is pulled across a level floor with a force of 219 N. The force acts at an angle of 30º up from the horizontal. The kinetic coefficient of friction is 0.267. What is the acceleration of the crate?

(A) 5 m/s2

(B) 4 m/s2

(C) 1.37 m/s2

(D) 2 m/s2

(E) 3.39 m/s2

6. A gun shoots a bullet at 221 m/s at an angle of 57.3º above the horizontal. The bullet embeds into a tree at the same height as it left the muzzle. Neglecting air resistance, determine the bullet's time of flight in seconds.

(A) 20 s

(B) 21 s

(C) 22 s

(D) 25 s

(E) 38 s

7. A 20.3 kg child is sitting on a merry-go-round with a radius of 5.69 m. The time it takes the merry-go-round to make one revolution is 4.94 s. Find the centripetal acceleration of the child.

(A) 13 m/s2

(B) 4.5 m/s2

(C) 16 m/s2

(D) 7.3 m/s2

(E) 9.2 m/s2

8. A girl runs straight off a cliff with a horizontal velocity of 2.29 m/s and falls for 2.48 s before landing on the ground. What is the horizontal component of her velocity just before she reaches the ground?

(A) 0.4 m/s

(B) 2 m/s

(C) 4.8 m/s

(D) 2.29 m/s

(E) 3.99 m/s

9. A boy pushes a 5 kg cart in a circle, starting at 0.5 m/s and accelerating to 3 m/s. How much work was done on the cart?

(A) 40.5 J

(B) 0 J

(C) 49 J

(D) 25.5 J

(E) 21.9 J

10. In 0.5 s, a hammer drives a 30 cm nail into a piece of wood. If the frictional force between the nail and the wood is 200 N, approximately how much work is done by the hammer?

(A) 30 J

(B) 60 J

(C) 120 J

(D) 600 J

(E) 900 J

11. A 7.54 kg block rests over a hole in a table. A 22.4 g bullet is shot straight up into the block. The bullet and block rise 0.941 m above the table. What speed did the bullet have just before hitting the block?

(A) 1670 m/s

(B) 1500 m/s

(C) 1220 m/s

(D) 1249 m/s

(E) 1450 m/s

12. A mass of 7 kg is raised through a vertical distance of 30 m. If the gravitational acceleration is 9.8 m/s2, then the potential energy gained by the mass is

(A) 2210 J

(B) 2420 J

(C) 2882 J

(D) 2810 J

(E) 2058 J

13. Which of the following could be accomplished with the least average force?

(A) Accelerating a 2 kg ball from 0 m/s to 9 m/s in half a second

(B) Accelerating a 6 kg ball from 0 m/s to 6 m/s in one second

(C) Accelerating a 9 kg ball from 0 m/s to 8 m/s in two seconds

(D) Accelerating a 10 kg ball from 0 m/s to 7 m/s in two seconds

(E) Accelerating a 10 kg ball from 0 m/s to 7 m/s in one seconds

14. What minimum force F is required to lift the mass?



(A) 15 N

(B) 20 N

(C) 30 N

(D) 60 N

(E) 98 N

15. If ten ocean waves wash into shore each minute, what is the period of each wave?

(A) 0.167 s

(B) 6 s

(C) 10 s

(D) 60 s

(E) 120 s

16. Which of the following could be the absolute pressure inside the chest cavity of a person who is inhaling?

(A) -0.2 atm

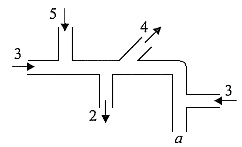
(B) 0.9 atm

(C) 1 atm

(D) 1.1 atm

(E) 10 atm

17. The numbers below represent the volume flow rate (cm3/s) of an ideal fluid into and out of the pipe shown. What is the flow rate at the end marked a?



(A) 3 cm3/s out of the pipe

(B) 5 cm3/s out of the pipe

(C) 2 cm3/s into the pipe

(D) 6 cm3/s into the pipe

(E) 9 cm3/s into the pipe

18. An 10 kg object is dropped from a height of 100 meters. How much gravitational potential energy has it lost when its speed is 30 m/s? (Ignore air resistance.)

(A) 320 J

(B) 320 J

(C) 2600 kJ

(D) 4500 kJ

(E) 4500 J

19. A 50 g stone is tied to the end of a string and whirled in a horizontal circle of radius 2 m at 20 m/s. Ignoring the force of gravity, determine the tension in the string.

(A) 5 N

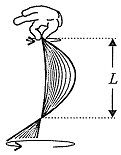
(B) 10 N

(C) 100 N

(D) 500 N

(E) 240 N

20. A person dangles a rope and makes small circular motions with his hands. The rope takes on the shape as shown. L is the distance between the first two nodes. If L is 1 m, and the rope makes one revolution in 0.5 seconds, what is the velocity of the wave?



(A) 0.5 m/s

(B) 1 m/s

(C) 2.5 m/s

(D) 4 m/s

(E) 5 m/s

21. A 50 N horizontal force is applied to a 5 kg crate, and it slides along a horizontal floor with an acceleration of 8 m/s2. What is the magnitude of the force of kinetic friction acting on the crate?

(A) 0 N

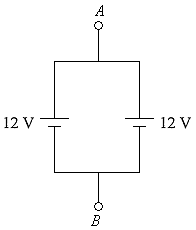
(B) 10 N

(C) 50 N

(D) 40 N

(E) 100 N

22. What is the voltage between points *A* and *B*?



(A) 0 V

(B) 6 V

(C) 12 V

(D) 24 V

(E) 32 V

23. Two positive charges each equal to Q = 10-10 coulomb are fixed and at rest, separated by a distance d = 2 cm. Find the net electrostatic force on a charge q = -10-9 coulomb that is placed at a distance 0.5d from each of the charges Q.

(A) 45×10-19 N

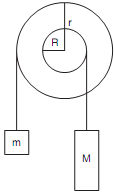
(B) 4.5×10-10 N

(C) 9.0×10-10 N

(D) 1.8×10-10 N

(E) 0 N

24. If *R* = 1.5 m, *r* = 0.5 m, and *M* = 1 kg, *m* equals



(A) kg

(B) 1 kg

(C) kg

(D) 2 kg

(E) 3 kg

25. The force necessary to compress a multiradial spring is given by *F* = 30*x*–4*x*2, where *F* is in N and *x* is in m. When stretched 3 m, the spring’s change in potential energy is

(A) 30 J

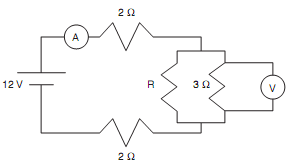
(B) 88 J

(C) 99 J

(D) 135 J

(E) 199 J

26. If the ammeter in the below illustration reads 2 A, resistor *R* has a value of



(A) 2 Ω

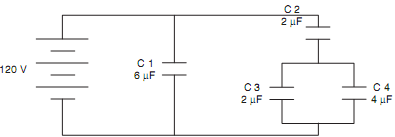
(B) 4 Ω

(C) 6 Ω

(D) 8 Ω

(E) 10 Ω

27. The charge storied in the 6 µF capacitor *C*1 is nearest to



(A) 300 µC

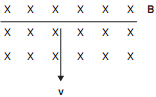
(B) 550 µC

(C) 600 µC

(D) 750 µC

(E) 900 µC

28. A wire of length 0.2 m moves through a constant magnetic field at a 90° angle and velocity of 0.2 m/s as shown. The 0.5 T magnetic field is directed into the paper. The current induced in the wire is directed



(A) Into the page.

(B) Out of the page.

(C) To the left.

(D) To the right.

(E) Clockwise.

29. A sample of radioactive material has a half-life of 60 years. After how many years will of the original substance remain?

(A) 60 years

(B) 120 years

(C) 180 years

(D) 240 years

(E) 300 years

30. The robotics model now lifts a 3 kg mass through a height of 0.5 m in 1 second. The power developed is

(A) 5 W

(B) 10 W

(C) 15 W

(D) 20 W

(E) 25 W