1. A particle starts from rest and accelerates for 4 seconds at 10 m/s2. What is its displacement from its initial position?

(A) 16 m

(B) 40 m

(C) 80 m

(D) 120 m

(E) 150 m

2. A particle moving at 10 m/s reverses its direction to move at 10 m/s in the opposite direction. If its acceleration is -10 m/s2, what is the total distance that it travels?

(A) 0 m

(B) 5 m

(C) 10 m

(D) 20 m

(E) 50 m

3. A 4 kg block experiences a net force of 80 N in the direction of its movement for 2 seconds. What is its change in velocity?

(A) 10 m/s

(B) 20 m/s

(C) 40 m/s

(D) 80 m/s

(E) 100 m/s

4. A 156.34 kg block rests on a flat board. One end of the board is slowly lifted until the block begins to slide. If the block begins to slide when the board is at an angle of 30° with the horizontal, what is the coefficient of static friction between the block and the board?

(A) 0.1

(B) 0.6

(C) 1

(D) 2

(E) 3

5. If two springs (k = 400 N/m) are placed parallel to each other, what is the spring constant of the two spring system?

(A) 100 N/m

(B) 200 N/m

(C) 400 N/m

(D) 800 N/m

(E) 1000 N/m

6. A crate slides down a ramp with an acceleration of 0.636 m/s2 when the ramp makes an angle of 28.8º to the horizontal. At what angle would the crate slide with constant velocity?

(A) 45º

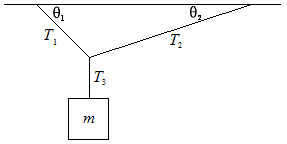
(B) 30º

(C) 60º

(D) 21.6º

(E) 25.4º

7. Which of the following must be true of magnitudes of the tensions given in the diagram?



(A) T1 > T2

(B) T2 >T1

(C) T1 = T2

(D) T1 + T2 = T3

(E) T1 - T2 = T3

8. A 15 kg mass pulled along a frictionless surface by a horizontal force of 100 N will have what acceleration?

(A) 10 m/s2

(B) 4.9 m/s2

(C) 15 m/s2

(D) 7.63 m/s2

(E) 6.67 m/s2

9. A wrecking ball pendulum of length 8.77 m is released from rest at an angle of 18.5º from the vertical. What is the maximum speed of the pendulum?

(A) 1.4 m/s

(B) 4.08 m/s

(C) 4.80 m/s

(D) 2.98 m/s

(E) 3.99 m/s

10. A 2 kg ball and an 8 kg ball are placed on separate springs, each with the same spring constant. The springs are compressed by the same distance and released. Which of the following is true about the maximum heights reached by the balls?

(A) The 2 kg ball will go four times as high.

(B) The 2 kg ball will go twice as high.

(C) The balls will reach equal maximum heights.

(D) The 8 kg ball will go four times as high.

(E) The 16 kg ball will go four times as high.

11. A forklift lifts a 500 kg box 4 m in the air in 100 s. What is the minimum power required by the forklift?

(A) 0

(B) 2102 W

(C) 2104 W

(D) 2106 W

(E) 2108 W

12. A mass of 4 kg is raised through a vertical distance of 40 m. If the gravitational acceleration is 9.8 m/s2, then the potential energy gained by the mass is

(A) 1150 J

(B) 1230 J

(C) 1178 J

(D) 1450 J

(E) 1568 J

13. A 1 kg lump of clay moving through space at 2 m/s collides with a second 1 kg lump of clay at rest. If the lumps stick together what is their final velocity?

(A) 0.5 m/s

(B) 1 m/s

(C) 2 m/s

(D) 4 m/s

(E) 6 m/s

14. You connect two capacitors *C*1 = 15 pF and *C*2 = 30 pF in series across a 1.5 V battery. The potential difference across capacitor *C*1 is approximately

(A) 0.50 V

(B) 0.8 V

(C) 1 V

(D) 0.33 V

(E) 0.67 V

15. Substance *X* has a half-life of 12 hours. How much of a 400 g sample remains after 2 days?

(A) 25 g

(B) 50 g

(C) 100 g

(D) 200 g

(E) 400 g

16. A rigid container holds air (density 1.3 kg/m3) at 0°C. If the temperature is increased to 273°C, what is the new density of the air?

(A) 0.65 kg/m3

(B) 1.3 kg/m3

(C) 2.6 kg/m3

(D) 3.9 kg/m3

(E) 4.5 kg/m3

17. A 25 kg object has an apparent weight of 200 N when placed in a fluid with a specific gravity of 0.6. What is the specific gravity of the object?

(A) 1.2

(B) 2.0

(C) 3.0

(D) 12

(E) 15

18. A 2.5 kg stone is dropped from a height of 4 m. What is its momentum on impact? (Ignore air resistance.)

(A) 6 kg∙m/s

(B) 9 kg∙m/s

(C) 17.5 kg∙m/s

(D) 20.5 kg∙m/s

(E) 22.5 kg∙m/s

19. An object whose specific gravity is 2 weighs 200 N less when it is weighed while totally submerged in water than when it is weighed in air. What is the weight of this object in air?

(A) 100 N

(B) 200 N

(C) 400 N

(D) 500 N

(E) 600 N

20. Sound emanating from a particular source travels in all directions. This sound is measured at 20 dB by an observer standing 40 m away. In order to decrease the intensity level to 10 dB, approximately how far from the source must the observer be?

(A) 80 m

(B) 126 m

(C) 160 m

(D) 400 m

(E) 500 m

21. An interstellar gas circles the core of earth’s galaxy. If the wavelength of the light reflecting off the gas coming toward the earth is 499 nm, and the wavelength of light reflecting off the gas moving away from earth is 501 nm, what is the speed of the gas?

(A) 4.1l04 m/s

(B) 1.8l05 m/s

(C) 6l05 m/s

(D) 1.5l011 m/s

(E) 4l011 m/s

22. A capacitor, *C*1 = 5 µF, is charged up to 8 V. It is then connected to a second uncharged capacitor *C*2 = 2.5 µF. The charge on *C*1 after the system has come to equilibrium is

(A) 26.7 µC

(B) 13.3 µC

(C) 20.0 µC

(D) 40.0 µC

(E) 6.67 µC

23. A capacitor is made with two strips of metal foil, each 2.5 cm wide by 50 cm long, with a 0.7 µm thick strip of paper (*k* = 3.7) sandwiched between them. The capacitor is rolled up to save space. What is the capacitance of this device? (The permittivity of free space ε0 = 8.85×10–12 F/m.)

(A) 43 nF

(B) 0.16 µF

(C) 2 µF

(D) 0.58 µF

(E) 7.3 µF

24. The capacitance of a parallel-plate capacitor is 24 µF when the plates are separated by a material of dielectric constant 2. If this material is removed, leaving air between the plates, and the separation between the plates is tripled, the capacitance is

(A) 2 µF

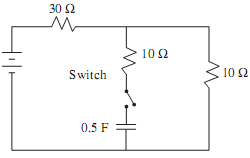
(B) 16 µF

(C) 36 µF

(D) 4 µF

(E) 8 µF

25. In the circuit shown below, the 0.5 F capacitor is initially uncharged. The switch is closed at time *t* = 0. What is the time constant (the time for the capacitor to charge to 63% of its maximum charge) for the charging of this capacitor?



(A) 5 s

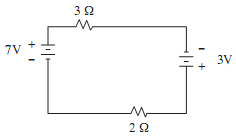
(B) 10 s

(C) 20 s

(D) 30 s

(E) 40 s

26. In the circuit shown below, what is the current through the 3 Ω resistor?



(A) 0 A

(B) 0.5 A

(C) 1 A

(D) 1.5 A

(E) 2 A

27. The space between the inner wire of radius *a* = 1 mm of a co-axial cable and the conducting shield of radius *b* = 8 mm is made of nylon (*k* = 4.2). A potential difference of 20 V is maintained between the wire and the shield. The energy stored per meter of the cable is

(A) 1.12 nJ/m

(B) 20.5 nJ/m

(C) 22.5 nJ/m

(D) 5.36 nJ/m

(E) 2.68 nJ/m

28. A beam of electrons has speed 107 m/s. It is desired to use the magnetic field of the Earth,

5 ×10−5 T, to bend the electron beam into a circle. What will be the radius of this circle?

(A) 1 nm

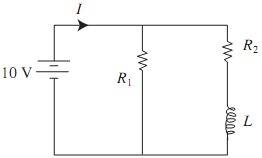
(B) 1 µm

(C) 1 mm

(D) 1 m

(E) 1 km

29. If the two equal resistors *R*1 and *R*2 are connected in parallel to a 10 V battery with no other circuit components, the current provided by the battery is *I*. In the circuit shown below, an inductor of inductance *L* is included in series with *R*2. What is the current through *R*2 after the circuit has been connected for a long time?



(A) 0

(B) 0.25*I*

(C) 0.5*I*

(D) *I*

(E)

30. A cannon is mounted on a truck that moves forward at a speed of 5 m/s. The operator wants to launch a ball from a cannon so the ball goes as far as possible before hitting the level surface. The muzzle velocity of the cannon is 50 m/s. What angle from the horizontal should the operator point the cannon?

(A) 5

(B) 41

(C) 45

(D) 49

(E) 85