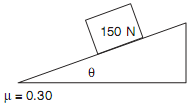
1. A 150 N box sits motionless on an inclined plane, as shown below. What is the angle of the incline?



(A) = 17

(B) = 11

(C) = 41

(D) = 30

(E) = 45

2. A 2.0 kg cart is given a shove up a long, smooth 30° incline. If the cart is traveling 8 m/s after the shove, how much time elapses until the block returns to its initial position?

(A) 1.6 s

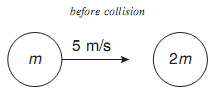
(B) 3.2 s

(C) 4 s

(D) 6 s

(E) 8 s

3. Two balls, of mass m and 2*m*, collide and stick together. The combined balls are at rest after the collision. If the ball of mass *m* was moving 5 m/s to the right before the collision, what was the velocity of the ball of mass 2*m* before the collision?



(A) 2.5 m/s to the right

(B) 2.5 m/s to the left

(C) 10 m/s to the right

(D) 10 m/s to the left

(E) 1.7 m/s to the left

4. Two identical balls of mass *m* = 1 kg are moving towards each other, as shown below. What is the initial kinetic energy of the system consisting of the two balls?



(A) 0 joules

(B) 1 joules

(C) 12 joules

(D) 18 joules

(E) 36 joules

5. To increase the diameter of an aluminum ring from 50 mm to 50.1 mm, the temperature of the ring must increase by 80°C. What temperature change would be necessary to increase the diameter of an aluminum ring from 100 mm to 100.1 mm?

(A) 20°C

(B) 40°C

(C) 80°C

(D) 110°C

(E) 160°C

6. In a closed pipe ﬁlled with air, a 384 Hz tuning fork resonates when the pipe is 22 cm long, this tuning fork does not resonate for any smaller pipes. For which of these closed pipe lengths will this tuning fork also resonate?

(A) 11 cm

(B) 44 cm

(C) 66 cm

(D) 88 cm

(E) 384 cm

7. Two automobiles are 150 kilometers apart and traveling toward each other. One automobile is moving at 60 km/h and the other is moving at 40 km/h mph. In how many hours will they meet?

(A) 2.5

(B) 2

(C) 1.75

(D) 1.5

(E) 1.25

8. The coordinate of a particle in meters is given by *x*(*t*) = 16*t*−3*t*3, where the time *t* is in seconds. The particle is momentarily at rest at *t* =

(A) 0.75 s

(B) 1.3 s

(C) 5.3 s

(D) 7.3 s

(E) 9.3 s

9. A vector of magnitude 20 is added to a vector of magnitude 25. The magnitude of this sum might be:

(A) 0

(B) 3

(C) 12

(D) 47

(E) 50

10. The speed of a 4 N hockey puck, sliding across a level ice surface, decreases at the rate of 0.61 m/s2. The coefficient of kinetic friction between the puck and ice is:

(A) 0.062

(B) 0.41

(C) 0.62

(D) 1.2

(E) 9.8

11. A 24 N horizontal force is applied to a 40 N block initially at rest on a rough horizontal surface. If the coefficients of friction are *μs* = 0.5 and *μk* = 0.4, the magnitude of the frictional force on the block is:

(A) 8 N

(B) 12 N

(C) 16 N

(D) 20 N

(E) 400 N

12. An object of mass 1 g is whirled in a horizontal circle of radius 0.5 m at a constant speed of 2 m/s. The work done on the object during one revolution is:

(A) 0

(B) 1 J

(C) 2 J

(D) 4 J

(E) 16 J

13. At the same instant that a 0.5 kg ball is dropped from 25 m above Earth, a second ball, with a mass of 0.25 kg, is thrown straight upward from Earth’s surface with an initial speed of 15 m/s.

They move along nearby lines and pass without colliding. At the end of 2 s the velocity of the center of mass of the two-ball system is:

(A) 11 m/s, down

(B) 11 m/s, up

(C) 15 m/s, down

(D) 15 m/s, up

(E) 20 m/s, down

14. A thin-walled hollow tube rolls without sliding along the floor. The ratio of its translational kinetic energy to its rotational kinetic energy (about an axis through its center of mass) is:

(A) 1

(B) 2

(C) 3

(D) 0.5

(E) 0.2

15. To measure moderately low pressures oil with a density of 8.5×102 kg/m3 is used in place of mercury in a barometer. A change in the height of the oil column of 1 mm indicates a change in pressure of about:

(A) 1.2×10−7 Pa

(B) 1.2×10−5 Pa

(C) 0.85 Pa

(D) 1.2 Pa

(E) 8.3 Pa

16. An object attached to one end of a spring makes 20 complete oscillations in 10 s. Its period is:

(A) 2 Hz

(B) 10 s

(C) 0.5 Hz

(D) 2 s

(E) 0.5 s

17. A sound wave has a wavelength of 3 m. The distance from a compression center to the adjacent rarefaction center is:

(A) 0.75m

(B) 4.5m

(C) 3.5m

(D) 2.5m

(E) 1.5m

18. It is known that 28 g of a certain ideal gas occupy 22.4 liters at standard conditions (0C, 1 atm). The volume occupied by 42 g of this gas at standard conditions is:

(A) 14.9 liters

(B) 22.4 liters

(C) 33.6 liters

(D) 42 liters

(E) 72 liters

19. An ideal gas occupies 12 liters at 293 K and 1 atm (76 cm *Hg*). Its temperature is now raised to 373 K and its pressure increased to 215 cm *Hg*. The new volume is:

(A) 0.2 liters

(B) 5.4 liters

(C) 13.6 liters

(D) 20.8 liters

(E) 28 liters

20. A wire contains a steady current of 2 A. The number of electrons that pass a cross section in 2 s is:

(A) 2

(B) 4

(C) 6.3×1018

(D) 1.3×1019

(E) 2.5×1019

21. A spherical shell has an inner radius of 3.7 cm and an outer radius of 4.5 cm. If charge is distributed uniformly throughout the shell with a volume density of 6.1×10−4 C/m3 the total charge is:

(A) 1.0×10−7 C

(B) 1.3×10−7 C

(C) 2.0×10−7 C

(D) 2.3×10−7 C

(E) 4.0×10−7 C

22. A particle with a charge of 5.5×10−8 C is ﬁxed at the origin. A particle with a charge of −2.3×10−8 C is moved from *x* = 3.5 cm on the *x* axis to *y* = 4.3 cm on the *y* axis. The change in potential energy of the two-particle system is:

(A) 3.1×10−3 J

(B) −3.1×10−3 J

(C) 6.0×10−5 J

(D) −6.0×10−5 J

(E) 0

23. Two identical particles, each with charge *q*, are placed on the *x* axis, one at the origin and the other at *x* = 5 cm. A third particle, with charge −*q*, is placed on the *x* axis so the potential energy of the three-particle system is the same as the potential energy at inﬁnite separation. Its *x* coordinate is:

(A) 13 cm

(B) 2.5 cm

(C) 7.5 cm

(D) 10 cm

(E) -5 cm

24. To charge a 1 F capacitor with 2 C requires a potential diﬀerence of:

(A) 2 V

(B) 3 V

(C) 4 V

(D) 5 V

(E) 6 V

25. A total resistance of 3 Ω is to be produced by combining an unknown resistor *R* with a 12 Ω resistor. What is the value of *R* and how is it to be connected to the 12 Ω resistor?

(A) 4 Ω, parallel

(B) 4 Ω, series

(C) 2.4 Ω, paralle

(D) 2.4Ω, series

(E) 9 Ω, series

26. A 2 T uniform magnetic ﬁeld makes an angle of 30 with the *z* axis. The magnetic ﬂux through a 3 m2 portion of the *xy* plane is:

(A) 2 Wb

(B) 3 Wb

(C) 5.2 Wb

(D) 6 Wb

(E) 12 Wb

27. An *LC* circuit consists of a 1 µF capacitor and a 4 mH inductor. Its oscillation frequency is approximately:

(A) 0.025 Hz

(B) 25 Hz

(C) 60 Hz

(D) 2500 Hz

(E) 15800 Hz

28. An electron is in a one-dimensional trap with zero potential energy in the interior and inﬁnite potential energy at the walls. The ratio of the energy for *n* = 3 to that for *n* = 1 is:

(A)

(B)

(C) 3

(D) 9

(E) 1

29. Bromine, with atomic mass 79.942*u*, is composed of nearly equal amounts of two isotopes, one of which contains 79 nucleons per atom. The mass number of the other isotope is:

(A) 78

(B) 79

(C) 80

(D) 81

(E) 82

30. The interplaner distance in a crystal is 2.8×10–8 m. The value of maximum wavelength which can be diffracted

(A) 2.8×10–8 m

(B) 5.6×10–8 m

(C) 1.4×10–8 m

(D) 7.6×10–8 m

(E) 9.6×10–8 m