1. A particle starts from rest and accelerates at 10 m/s2. How long does it take for the particle to reach a velocity of 45 m/s?

(A) 2 s

(B) 3 s

(C) 4.5 s

(D) 45 s

(E) 60 s

2. An object is dropped from a height *h* and strikes the ground with a velocity *v*. If the object is dropped from a height of 2*h*, which of the following represents its velocity when it strikes the ground?

(A) *v*

(B) 1.4*v*

(C) 2*v*

(D) 4*v*

(E) 8*v*

3. Light is incident on a piece of glass in air at an angle of 37º from the normal. If the index of refraction of the glass is 1.5, the angle that the refracted ray makes with the normal is approximately

(A) 23.6°

(B) 21.8°

(C) 13.8°

(D) 41.8°

(E) 56.4°

4. A wire of length *L* and resistance *R* is cut into 4 equal pieces. If the 4 pieces are now twisted together to make a wire of length , what is the new resistance of the shorter wire combination?

(A)

(B)

(C) *R*

(D) 4*R*

(E) 16*R*

5. A man holds one end of a 30 cm spring in each hand. If he applies a 100 N force to each end of the spring, by how much does he shorten the spring? (k = 1000 N/m)

(A) 5 cm

(B) 10 cm

(C) 20 cm

(D) 30 cm

(E) 50 cm

6. A bullet with a mass of 22.1 g strikes a fixed block at a speed of 254 m/s. The bullet stops after penetrating 5.94 cm into the block. What is the magnitude of the average net force acting on the bullet?

(A) 11000 N

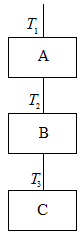
(B) 12100 N

(C) 14432 N

(D) 10000 N

(E) 12002 N

7. Boxes *A*, *B*, and *C* each have a mass of 10 kg. If the boxes are lifted at a constant velocity, what is the tension *T*2?



(A) 100 N

(B) 200 N

(C) 250 N

(D) 300 N

(E) 400 N

8. A ball was thrown straight up at 20.8 m/s then caught at the same place it was released. How many seconds was it in the air?

(A) 0.75 s

(B) 1 s

(C) 3.8 s

(D) 4.5 s

(E) 4.24 s

9. Water flows over a set of falls at the rate of 2.09×106 kg/s. If the water falls 44.6 m, what is the power dissipated by the falling water?

(A) 140 MW

(B) 800 MW

(C) 400 MW

(D) 123 MW

(E) 913 MW

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 car moving at a constant velocity of 20 m/s applies a net frictional force to the road of 1000 N in order to maintain its velocity. What is the minimum power of the engine?

(A) 1000 W

(B) 2000 W

(C) 10000 W

(D) 20000 W

(E) 25000 W

12. If an engine does 760 J of work in 8 seconds, its average power is

(A) 55 W

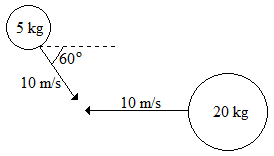
(B) 35 W

(C) 75 W

(D) 95 W

(E) 99 W

13. Two masses in space move toward each other and collide. Assume no rotational motion occurs before or after the collision. If the two masses stick together after colliding, what is the final horizontal velocity of the masses?



(A) 0

(B) 5 m/s to the left

(C) 7 m/s to the left

(D) 9 m/s to the left

(E) 12 m/s to the left

14. A frictionless ramp is 7 m high and 21 m long. How much force is required to push a 150 kg box up the ramp?

(A) 100 N

(B) 300 N

(C) 500 N

(D) 1500 N

(E) 2200 N

15. If 12 g of substance *X* remain from an original sample of 384 g, and substance *X* has a half-life of 10 hours, how much time has passed?

(A) 20 hours

(B) 50 hours

(C) 30 hours

(D) 40 hours

(E) 60 hours

16. What is the weight of 1 liter of water?

(A) 1 kg

(B) 10 kg

(C) 100 kg

(D) 1000 kg

(E) 10000 kg

17. A crane lifts 50 kg 50 m in 10 seconds. It develops a power of

(A) 50 W

(B) 250 W

(C) 750 W

(D) 2500 W

(E) 4500 W

18. An object slides down a 2 meter long ramp that makes an angle of 60° with the horizontal. The mass of the object is 2 kg, and the coefficient of kinetic friction between the object and the ramp is 0.3. Calculate the work done by the normal force on the object.

(A) 3 J

(B) 6 J

(C) 9 J

(D) 12 J

(E) 0 J

19. At the ocean surface, the pressure equals 1 atm (approximately 100,000 pascals). At approximately what depth is the total pressure equal to 2 atm? (Note: Seawater has specific gravity 1.025.)

(A) 1 m

(B) 2 m

(C) 5 m

(D) 0.25

(E) 10 m

20. A source creates a sound that is observed at 200 W/m2. If the intensity level of the observed sound decreases by 20 decibels, what is the decrease in observed intensity?

(A) 2 W/m2

(B) 20 W/m2

(C) 100 W/m2

(D) 198 W/m2

(E) 300 W/m2

21. A force of 1 dyne will cause an object of mass 1 gram to accelerate at 1 cm/s2; therefore, 1 dyne is equal to *x* newtons. What is *x*?

(A) l02

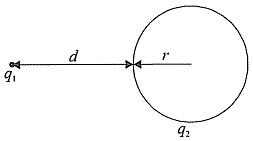
(B) l05

(C) l0-4

(D) l04

(E) l0-5

22. Inside a vacuum chamber, a point charge q1 is separated by a distance d from the surface of a hollow sphere with a radius *r* and made from a conducting material. The sphere has a charge q2. What is the electric field strength a distance 0.5r from the center of the sphere? (Note: k is the Coulomb’s law constant.)



(A) Zero, there is no electric field anywhere inside the sphere.

(B)

(C)

(D)

(E)

23. Find the magnitude of the electrostatic force between a +3 µC point charge and a -10 µC point charge if they are separated by 100 cm of empty space. (Note: Coulomb’s constant *k* is 9×109 N·m2/C2.)

(A) 0.027 N

(B) 0.27 N

(C) 2.7 N

(D) 27 N

(E) 270 N

24. 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

25. In an aquarium, light traveling through water (*n* = 1.3) is incident upon the glass container (*n* = 1.5) at an angle of 36 from the normal. What is the angle of transmission in the glass?

(A) The light will not enter the glass because of total internal reflection.

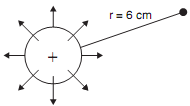
(B) 31

(C) 36

(D) 41

(E) 52

26. A certain charge radiates an electric field of +8×10–7 N/C at a distance of 6 cm. The charge is



(A) +12×10–20 C

(B) +21×10–20 C

(C) +32×10–20 C

(D) +36×10–20 C

(E) +48×10–20 C

27. Two identical nonconducting spheres having charges of –12 nC and +8 nC are touched together and then separated. The final charge on each is

(A) –2 nC

(B) nC

(C) +2 nC

(D) +4 nC

(E) +48 nC

28. Tripling the distance between two electric charges changes the force between them by a factor of

(A)

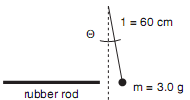
(B)

(C)

(D) 3

(E) 9

29. A 3 g plastic sphere hangs on the end of a 60 cm string. When a charged rubber rod is brought near it, the sphere is deflected 6 cm from its original position. The magnitude of the electric force on the sphere is



(A) 3×10–4 N

(B) 3×10–3 N

(C) 3×10–2 N

(D) 3×10–1 N

(E) 3 N

30. Three charges, +5 nC, +4 nC, and –3 nC, are placed at points *A*, *B* and *C*, respectively, in an a straight line as shown. The force exerted on the charge at point *C* is



(A) -2.7×10–9 N

(B) -9×10–9 N

(C) -16×10–7 N

(D) +2.7×10–7 N

(E) +9×10–7 N