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

(A) 16 m/s

(B) 20 m/s

(C) 30 m/s

(D) 40 m/s

(E) 45 m/s

2. A particle moving at 5 m/s reverses its direction in 1 s to move at 5 m/s in the opposite direction. If its acceleration is constant, what is its displacement at 0.5 seconds?

(A) 0 m

(B) 1.25 m

(C) 2.5 m

(D) 5 m

(E) 10 m

3. A 5 kg block moves at a constant velocity of 10 m/s. What is the net force on the block?

(A) 0 N

(B) 0.5 N

(C) 2 N

(D) 50 N

(E) 55 N

4. The following experiment takes place on the moon. A 2 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. A spring (k = 400 N/m) is cut in half to make two new springs. What is the spring constant of each of the new springs?

(A) 100 N/m

(B) 200 N/m

(C) 400 N/m

(D) 800 N/m

(E) 1000 N/m

6. An airplane with a mass of 12007 kg pulls a glider with a mass of 6809 kg. The airplane's propellers provide a net force of 35313 N. What is the glider's acceleration?

(A) 1.00 m/s2

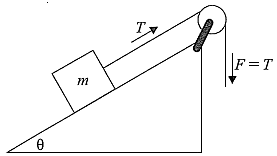
(B) 2.55 m/s2

(C) 1.30 m/s2

(D) 2.00 m/s2

(E) 1.88 m/s2

7. The plane below is frictionless and inclined at a 30° angle. The mass m is 6 kg. If the mass is accelerated up the plane at 2 m/s2, what is the tension T in the rope?



(A) 30 N

(B) 36 N

(C) 42 N

(D) 72 N

(E) 100 N

8. An object acted on by three forces moves with constant velocity. One force acting on the object is in the positive *x* direction and has a magnitude of 6.5 N, a second force has a magnitude of 4.4 N and points in the negative *y* direction. Find the magnitude of the third force acting on the object.

(A) 7.9 N

(B) 2.2 N

(C) 12.2 N

(D) 36 N

(E) 42 N

9. A 0.7 kg object is suspended from a spring with *k* = 19 N/m. The mass is pulled 0.494 m downward from its equilibrium position and allowed to oscillate. What is the maximum kinentic energy of the object?

(A) 4.21 J

(B) 611.3 J

(C) 1.288 J

(D) 14.0 J

(E) 2.318 J

10. A 2 kg ball is thrown upwards with a speed of 40 m/s. At what height will the ball be when its kinetic energy is equal its potential energy?

(A) 20 m

(B) 40 m

(C) 60 m

(D) 80 m

(E) 100 m

11. A forklift holds a 500 kg box 4 m in the air for 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. The maximum amount of work that can be done by a 40 kW machine in 11 seconds is

(A) 150 kJ

(B) 230 kJ

(C) 178 kJ

(D) 450 kJ

(E) 440 kJ

13. A 2 kg block moves 12 m/s. What is its momentum?

(A) 6 kg m/s

(B) 12 kg m/s

(C) 24 kg m/s

(D) 144 kg m/s

(E) 256 kg m/s

14. A 10 kg box accelerates down a frictionless ramp at 5 m/s2. If the block reaches a velocity of 10 m/s at the bottom of the ramp, what is the mechanical advantage of the ramp?

(A) 1:1

(B) 2:1

(C) 5:1

(D) 10:1

(E) 12:1

15. Substance *X* has a half-life of 30 min. If 10 g remain after 2 hours, what was the original amount?

(A) 20 g

(B) 40 g

(C) 80 g

(D) 160 g

(E) 320 g

16. A forklift has a maximum power of 4103 W. When operating at maximum power, it is capable of lifting 100 waterjugs to a height of 1 meter in 10 seconds. How long will it require to lift 100 of the same size jugs filled with alcohol? (Note: Alcohol has a specific gravity of 0.8.)

(A) 8 s

(B) 10 s

(C) 11.25 s

(D) 12 s

(E) 15 s

17. Ice has a specific gravity of 0.9. What percentage of an iceberg is above the water?

(A) 10%

(B) 45%

(C) 90%

(D) 100%

(E) 0%

18. After accelerating uniformly from rest at a rate of 2 m/s2 for 4.5 seconds, an object with mass 2 kg collides head-on with another object of mass 1 kg initially at rest. After the completely inelastic collision, what is the common velocity of the two objects?

(A) 5 m/s

(B) 3 m/s

(C) 8 m/s

(D) 18 m/s

(E) 6 m/s

19. An object is weighed in air, and it is also weighed while totally submerged in water. If it weighs 100 N less when submerged, find the volume of the object. (The density of water is 1000 kg/m3.)

(A) 0.004 m3

(B) 1.000 m3

(C) 0.002 m3

(D) 0.005 m3

(E) 0.001 m3

20. 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

21. An observer moves at 0.1 the speed of sound toward a stationary sound source. If the source emits sound waves with a wavelength, what is the approximate wavelength perceived by the observer?

(A) 

(B) 

(C) 

(D) 

(E) 

22. You make a homemade capacitor out of two flat circular metal plates, each of radius 5 cm, and hold them a distance of 1 cm apart. You then connect each plate to the terminals of a 6 V battery. What would be the capacitance of your capacitor?

(A) 4×10–12 F

(B) 7×10–12 F

(C) 2.2×10–12 F

(D) 2.2×10–10 F

(E) 7×10–10 F

23. What is the force on a 1 C charge moving at 1 m/s perpendicular to a magnetic field with a strength of 1 tesla?

(A) 0 N

(B) 1 N

(C) 2 N

(D) 3 N

(E) 4 N

24. Two charged metal plates are placed one meter apart creating a constant electric field between them. A one coulomb charged particle is placed in the space between them. The particle experiences a force of 100 newtons due to the electric field. What is the potential difference between the plates?

(A) 1 V

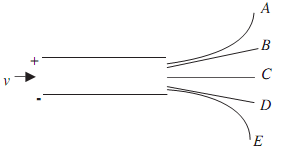
(B) 10 V

(C) 20 V

(D) 50 V

(E) 100 V

25. An electron moving at constant velocity enters the region between two charged plates, as shown below. Which of the paths below correctly shows the electron’s trajectory after leaving the region between the charged plates?



(A) *A*

(B) *B*

(C) *C*

(D) *D*

(E) *E*

26. Two isolated particles, *A* and *B*, are 4 m apart. Particle *A* has a net charge of 2*Q*, and *B* has a net charge of *Q*. The ratio of the magnitude of the electric force on *A* to that on *B* is

(A) 4:1

(B) 2:1

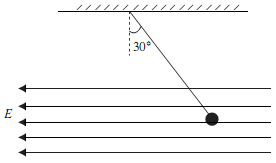
(C) 1:1

(D) 1:2

(E) 1:4

27. A uniform electric field points to the left. A small metal ball charged to -2 mC hangs at a 30 angle from a string of negligible mass, as shown below. The tension in the string is measured to be 0.1 N. What is the magnitude of the electric field?

(sin30 = 0.50; cos30 = 0.87; tan30 = 0.58).



(A) 25 N/C

(B) 50 N/C

(C) 2500 N/C

(D) 5000 N/C

(E) 10000 N/C

28. You attach a 30 pF capacitor across a 1.5 V battery. How much energy is stored in the capacitor?

(A) 3.4×10–8 J

(B) 4.5×10–11 J

(C) 6.7×10–11 J

(D) 3.4×10–11 J

(E) 4.5×10–8 J

29. A 2 µF capacitor has a potential difference of 5000 V. The work done in charging it was

(A) 2.5 J

(B) 5 J

(C) 25 J

(D) 5 mJ

(E) 0.5 kJ

30. A 2 µF capacitor is connected directly to a battery. When the capacitor is fully charged, it stores 600 µC of charge. An experimenter replaces the 2 µF capacitor with three 18 µF capacitors in series connected to the same battery. Once the capacitors are fully charged, what charge is stored on each capacitor?

(A) 100 µC

(B) 200 µC

(C) 600 µC

(D) 1200 µC

(E) 1800 µC