201 Practice Exam

1) Vector **A** has a magnitude of 20m and makes an angle of 30° above the positive x axis. Vector **B** has a magnitude of 15m and is oriented 60° to the left of the y axis. Find the magnitude and direction of 2**A**+**B**
   a. 30m, 4°
   b. 35m, 52°
   c. 58m, 167°
   d. 63m, 232°

2) If the contraction of the left ventricle in a human heart lasts 250 mili-seconds and the speed of blood flow in the aorta (the outflow artery) is 0.8 m/s after the contraction ends, what is the average acceleration of a blood cell as it leaves the heart?
   a. 310 m/s^2
   b. 31 m/s^2
   c. 3.2 m/s^2
   d. 0.32 m/s^2

3) A projectile is fired from the ground at an angle of 60 degrees above the horizontal with an initial speed of 30 m/s. What is the magnitude and direction (relative to the horizontal) of the projectile's velocity at its maximum height?
   a. 15 m/s, 0°
   b. 0 m/s, 0°
   c. 15 m/s, 60°
   d. 0 m/s, 0°

4) A box rests on a frozen pond (assume it to be frictionless and horizontal). If a fisherman applies a horizontal force with a magnitude 48N to the box and produces an acceleration of 3 m/s^2, what is the box's mass?
   a. Not enough information given.
   b. 144 kg
   c. 0.0625 kg
   d. 16 kg

5) Two boxes connected by a rope are pulled across a horizontal floor. There is friction between the floor and the boxes. Which way would the force due to friction point in each of the box's free-body diagrams?
   a. Opposite the direction of movement.
   b. In the same direction as the movement.
   c. Perpendicular to the direction of movement.
   d. The friction between the two boxes will cancel, leaving no net friction.

6) A table with a weight equivalent to 800N is slid across a floor with friction. The pushing force has a magnitude of 100N. If the table moves with constant speed, the friction force must be…
   a. 100N
   b. Greater than 100N but less than 800N
   c. 800N
   d. Greater than 800N

7) A surgeon is using material from a donated heart to repair a patient's damaged aorta and needs to know the elastic characteristics of the material. Testing showed a 16cm strip of the material stretches 3.74cm when 1.5N of pulling force is exerted on it. What is the force constant of the material?
   a. 9.375 N/m
   b. 40 N/m
   c. 2.5 N/m
   d. 10.66 N/m

8) A fishing weight of mass 0.2kg is tied to a fishing line that is 0.5m long. The weight is then whirled in a vertical circle. The fishing line will break if its tension exceeds 100N. At what speed will the string break?
   a. 256 m/s
   b. 27 m/s
   c. 4 m/s
   d. 16 m/s

9) You throw a 20N rock into the air from the ground and notice that when it is 15m high, it is traveling upwards at 25 m/s. Use the work-energy theorem to find the maximum height of the rock.
   a. 30.3m
   b. 46.8m
   c. 25m
   d. 93.6m

10) A 1.5kg brick is sliding along a rough horizontal surface at 13 m/s. If the brick stops in 4.8s, how much mechanical energy is lost and what happens to the lost energy?
   a. 9.7J
   b. 39J
   c. 127J
   d. 19.4J

11) A 70kg person walks at a steady pace of 5km/h on a treadmill with a 5% grade (this means the vertical distance is only 5% of the horizontal distance). Walking on a flat surface requires 300W of power. Assuming the metabolic power required is equal to the combined amount of walking on a flat surface and the rate of work of the climb, how much power is required?
    a. 300W
    b. 315W
    c. 350W
    d. 370W

12) Two figure skaters, one weighing 625N and the other 725N, push off against each other on frictionless ice. If the heavier skater travels at 1.5 m/s, how fast will the lighter one travel?
    a. 0.37 m/s
    b. 1.5 m/s
    c. 1.74 m/s
    d. 3.89 m/s

13) On an air track, a 400g puck (1) moving to the right at 2 m/s collides elastically with a 500g puck (2) moving in the opposite direction at 3 m/s. Find the velocity of each puck after the collision.
    a. v_1= -1.44 m/s , v_2= 1.44 m/s
    b. v_1= -1.44 m/s , v_2= 3.55 m/s
    c. v_1= -2 m/s , v_2= 3m/s
    d. v_1= -3.55 m/s , v_2= 1.44 m/s

14) Three odd-shaped blocks of chocolate have the following masses and center-of-mass coordinates:
    a. 0.3kg, (0.2, 0.3)
    b. 0.4kg, (0.1, -0.4)
    c. 0.2kg, (-0.3, 0.6)

    Find the coordinates of the center-of-mass of the whole system.
    d. (-0.0444, 0.0556)
    e. (0.0444, 0.0556)
    f. (0.0444, -0.0556)
    g. (-0.0444, -0.0556)

15) If a wheel 212cm in diameter takes 2.25s for each revolution, find its period and angular speed (in rad/s).
    a. 2.25s, 2.79 rad/s
    b. 1.25, 2.79 rad/s
    c. 2.25s, 5.58 rad/s

d. 1.25s, 5.58 rad/s

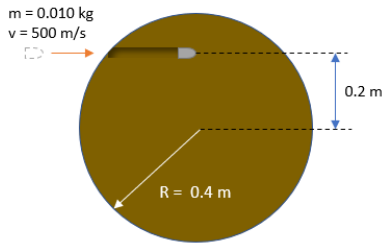
16) A car is traveling at a constant speed on the highway. Its tires have diameter of 61cm and are rolling without slipping or sliding. If the angular speed of the tires is 50 rad/s, what is the speed of the car in SI units?

a. 2.3 m/s
b. 9.8 m/s
c. 15.3 m/s
d. 19.2 m/s

17) A 4N and 10N force act on an object. The moment arm of the 4N force is 0.2m. If the 10N force produces five times the torque of the 4N force, what is its moment arm?

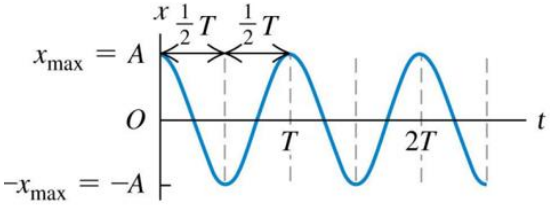
a. 0.4m
b. 0.7m
c. 1.3m
d. 1.7m

18) A unform 2kg solid disk of radius R=0.4m is free to rotate on a frictionless horizontal axle through its center. The disk is initially at rest, and then a 10g bullet traveling at 500 m/s is fired into it as shown. If the bullet embeds itself in the disk at a vertical distance of 0.2m above the axle, what will be the angular velocity of the disk?



a. 4.1 rad/s
b. 6.2 rad/s
c. 9.3 rad/s
d. 12 rad/s

19) Using the graph provided, at which of the following times does the object have the *most negative acceleration* a_x?



a. t = T/4
b. t = T/2
c. t = 3T/4
d. t = T

20) A pendulum on earth swings with angular frequency ω. On an unknown planet, it swings with angular frequency $\omega/2$. The acceleration due to gravity on this planet is…
a. 4g
b. 2g
c. g/2
d. g/4

21) If you double the wavelength λ of a wave on a string, what happens to the wave speed v and the wave frequency f?
a. v is doubled and f is doubled
b. v is doubled and f is unchanged
c. v is unchanged and f is doubled
d. v is unchanged and f is halved

22) The sound intensity is measured to be 30 dB at a distance of 50m from a point source that emits sound waves uniformly in all directions. At what distance from this same source is the sound intensity level 50 dB?
a. 5m
b. 10m
c. 50m
d. 100m

23) A train is moving due west at a constant speed of 24 m/s. You are due west of the train, traveling due east toward the train with a constant speed of 16 m/s. The train whistle is emitting sound waves with a frequency of 600 Hz. The speed of sound in air is 344 m/s. What frequency of the sound do you hear?
a. 535Hz

b. 615Hz
c. 675Hz
d. 587Hz

24) A small circular hole 6mm in diameter is cut in the side of a large water tank. The top of the tank is open to the air. The water is escaping from the hole at a speed of 10 m/s. How far below the water surface is the hole?
   a. 25m
   b. 7.3m
   c. 2.3m
   d. 5.1m

25) When the temperature of the piece of metal is increase and the metal expands, will the gap between the ends become…

   a. Narrower
   b. Wider
   c. Unchanged
   d. Not enough information given

26) The blood plays an important role in removing heat from the body by brining it to the surface where it radiates away. Assume the temperature of the bottom layer of skin is 37C and the temperature of the outer surface is 30C. Also assume the average thickness of the skin to be 0.75mm. Assume body surface-area of $2m^2$ and a net heat loss of 75W while at rest. Using these assumptions, what is the thermal conductivity of this assumed person's skin?

   a. 4E-3 W/(m*K)
   b. 2E-2 W/(m*K)
   c. 1E+4 W/(m*K)
   d. 4 W/(m*K)

27) How many molecules are in 3.2 moles of Iron? (N_A = 6.022E+23, Molar Mass = 55.8 g/mol)
   a. 1.927E+24
   b. 6.022E+23
   c. 178.56
   d. 3.36E+25

28) If 5g of liquid helium is converted into a gas at standard temperature and pressure, what is the length of the side of a cube that would contain the gas? (The density of liquid helium is 0.125 g/cm^3)
    a. 0.1m
    b. 0.7m
    c. 0.3m
    d. 1.2m

29) Compute the change in entropy of 1kg of ice at 0C when it melts and converts to liquid water. (L_f = 3.34E3 J/kg)
    a. 1527 J/K
    b. 1220 J/K
    c. 1823 J/K
    d. 348 J/K

30) A Carnot engine has an efficiency of 59% and performs 2.5E+4 J of work in each cycle. How much heat does the engine extract from its heat source in each cycle?
    a. 4 KJ
    b. 42 J
    c. 42 KJ
    d. 4 J