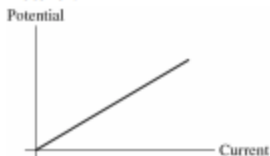


Semester Two Final Exam

- 1) Jill does twice as much work as Jack does and in half the time. Jill's power output is
 - A) one-fourth as much as Jack's power output.
 - B) the same as Jack's power output.
 - C) twice Jack's power output.
 - D) one-half as much as Jack's power output.
 - E) four times Jack's power output.
- 2) An organ pipe open at both ends has a length of 0.80 m. If the velocity of sound in air is 340 m/s, what is the frequency of the third harmonic of this pipe?
 - A) 850 Hz
 - B) 213 Hz
 - C) 425 Hz
 - D) 638 Hz
- 3) If we double the frequency of a system undergoing simple harmonic motion, which of the following statements about that system are true? (There could be more than one correct choice.)
 - A) The amplitude is doubled.
 - B) The angular frequency is doubled.
 - C) The period is doubled.
 - D) The angular frequency is reduced to one-half of what it was.
 - E) The period is reduced to one-half of what it was.
- 4) If a guitar string has a fundamental frequency of 500 Hz, which one of the following frequencies can set the string into resonant vibration?
 - A) 750 Hz
 - B) 250 Hz
 - C) 1750 Hz
 - D) 1500 Hz
- 5) A 0.140-kg baseball is thrown with a velocity of 22.1 m/s. It is struck by the bat with an average force of 5000 N, which results in a velocity of 37.0 m/s in the opposite direction from the original velocity. How long were the bat and ball in contact?
 - A) 3.96×10^{-3} s
 - B) 2.83×10^{-2} s
 - C) 1.65×10^{-3} s
 - D) 1.18×10^{-2} s
- 6) You throw a baseball straight up. Compare the sign of the work done by gravity while the ball goes up with the sign of the work done by gravity while it goes down.
 - A) The work is positive on the way up and positive on the way down.
 - B) The work is positive on the way up and negative on the way down.
 - C) The work is negative on the way up and on the way down because gravity is always downward.
 - D) The work is negative on the way up and positive on the way down.
- 7) A child pulls on a wagon with a force of 75 N. If the wagon moves a total of 42 m in 2.9 min, what is the average power delivered by the child?
 - A) 24 W
 - B) 27 W
 - C) 18 W
 - D) 22 W
- 8) A spaceship is traveling to the Moon. At what point is it beyond the pull of Earth's gravitational field?
 - A) when it gets above the atmosphere
 - B) when it is half-way there
 - C) when it is closer to the Moon than it is to Earth
 - D) It is never beyond the pull of Earth's gravitational field.

- 9) In many cartoon shows, a character runs off a cliff, realizes his predicament, and lets out a scream. He continues to scream as he falls. If the physical situation is portrayed correctly, from the vantage point of an observer at the *foot* of the cliff, the pitch of the scream as he falls should be
- lower than the original pitch and constant.
 - higher than the original pitch and constant.
 - lower than the original pitch and decreasing as he falls.
 - higher than the original pitch and increasing as he falls.
 - It is impossible to predict.
- 10) Two small objects, with masses m and M , are originally a distance r apart, and the magnitude of the gravitational force on each one is F . The masses are changed to $2m$ and $2M$, and the distance is changed to $4r$. What is the magnitude of the new gravitational force?
- $4F$
 - $F/16$
 - $F/4$
 - $F/2$
 - $16F$
- 11) The period of a simple pendulum that is 1.00 m long on another planet is 1.50 s. What is the gravitational acceleration on this planet if the mass of the pendulum bob is 1.5 kg?
- 21.0 m/s^2
 - 16.3 m/s^2
 - 19.3 m/s^2
 - 17.5 m/s^2
- 12) When the current through a resistor is increased by a factor of 4, the power dissipated by the resistor
- increases by a factor of 16.
 - increases by a factor of 4.
 - decreases by a factor of 4.
 - increases by a factor of 2.
 - decreases by a factor of 16.
- 13) A heavy stone and a light stone are released from rest in such away that they both have the same amount of gravitational potential energy just as they are released. Air resistance is negligibly small. Which of the following statements about these stones are correct? (There could be more than one correct choice.)
- The initial height of the light stone is greater than the initial height of the heavy stone.
 - The stones both have the same kinetic energy just as they reach the ground.
 - The stones both have the same speed just as they reach the ground.
 - The stones must have been released from the same height.
 - Just as it reaches the ground, the light stone is traveling faster than the heavy stone.

- 14) For the graph shown in the figure, what physical quantity does the slope of the graph represent for ohmic material?



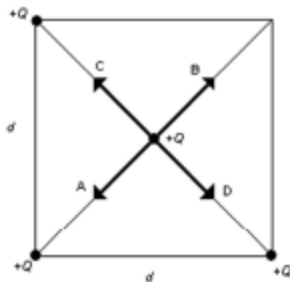
- power
 - $1/(\text{resistivity})$
 - $1/(\text{resistance})$
 - resistivity
 - resistance
- 15) Crests of an ocean wave pass a pier every 13.0 s. If the waves are moving at 5.6 m/s, what is the wavelength of the ocean waves?
- 37 m
 - 62 m
 - 84 m
 - 73 m

- 16) Two cyclists who weigh the same and have identical bicycles ride up the same mountain, both starting at the same time. Joe rides straight up the mountain, and Bob rides up the longer road that has a lower grade. Joe gets to the top before Bob. Ignoring friction and wind resistance, which one of the following statements is true?
- The amount of work done by Joe is equal to the amount of work done by Bob, but the average power exerted by Joe is greater than that of Bob.
 - The average power exerted by Bob and Joe was the same, but Joe exerted more work in getting there.
 - Bob and Joe exerted the same amount of work, and the average power of each cyclist was also the same.
 - The amount of work done by Joe is greater than the amount of work done by Bob, and the average power exerted by Joe is greater than that of Bob.
- 17) Two pure tones are sounded together and a particular beat frequency is heard. What happens to the beat frequency if the frequency of one of the tones is increased?
- It increases.
 - It decreases.
 - It does not change.
 - It could either increase or decrease.
- 18) Grandfather clocks are designed so they can be adjusted by moving the weight at the bottom of the pendulum up or down. Suppose you have a grandfather clock at home that runs fast. Which of the following adjustments of the weight would make it more accurate? (There could be more than one correct choice.)
- Remove some mass from the weight.
 - Raise the weight.
 - Add more mass to the weight.
 - Decrease the amplitude of swing by a small amount.
 - Lower the weight.
- 19) Swimmers at a water park have a choice of two frictionless water slides, as shown in the figure. Although both slides drop over the same height h , slide 1 is straight while slide 2 is curved, dropping quickly at first and then leveling out. How does the speed v_1 of a swimmer reaching the bottom of slide 1 compare with v_2 , the speed of a swimmer reaching the end of slide 2?







- $v_1 > v_2$
 - $v_1 < v_2$
 - $v_1 = v_2$
 - The heavier swimmer will have a greater speed than the lighter swimmer, no matter which slide he uses.
 - No simple relationship exists between v_1 and v_2 .
- 20) A truck has four times the mass of a car and is moving with twice the speed of the car. If K_t and K_c refer to the kinetic energies of truck and car respectively, it is correct to say that
- $K_t = 2K_c$.
 - $K_t = \frac{1}{2}K_c$.
 - $K_t = 4K_c$.
 - $K_t = K_c$.
 - $K_t = 16K_c$.

- 21) When unequal resistors are connected in series across an ideal battery,
- A) the potential difference across each is the same.
 - B) the equivalent resistance of the circuit is equal to the average of all the resistances.
 - C) the same power is dissipated in each one.
 - D) the equivalent resistance of the circuit is less than that of the smallest resistor.
 - E) the current flowing in each is the same.
- 22) Consider a pipe of length L that is open at one end and closed at the other end. What are the wavelengths of the three lowest-pitch tones produced by this pipe?
- A) $4L, 4L/3, 4L/5$ B) $2L, L, 2L/3$ C) $4L, 2L, L$ D) $2L, L, L/2$
- 23) Three equal charges $+Q$ are at three of the corners of a square of side d . A fourth charge $+Q$ of equal magnitude is at the center of the square as shown in the figure. Which one of the arrows shown represents the net force acting on the charge at the center of the square?



- A) A B) B C) C D) D
- 24) A rubber ball bounces off of a wall with an initial speed v and reverses its direction so its speed is v right after the bounce. As a result of this bounce, which of the following quantities of the ball are conserved? (There could be more than one correct choice.)
- A) both the momentum and the kinetic energy of the ball
 - B) the momentum of the ball
 - C) the kinetic energy of the ball
 - D) None of the above quantities are conserved.
- 25) You are standing on a skateboard, initially at rest. A friend throws a very heavy ball towards you. You have two choices about what to do with the ball: either catch the ball or deflect it back toward your friend with the same speed as it was originally thrown. Which choice should you make in order to maximize your speed on the skateboard?
- A) Catch the ball.
 - B) Deflect the ball back.
 - C) Your final speed on the skateboard will be the same regardless whether you catch the ball or deflect the ball.

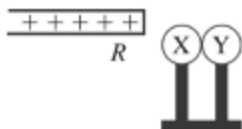
- 26) Two point charges, Q_1 and Q_2 , are separated by a distance R . If the magnitudes of both charges are doubled and their separation is also doubled, what happens to the electrical force that each charge exerts on the other one?
- It is reduced by a factor of $\sqrt{2}$.
 - It remains the same.
 - It increases by a factor of 4.
 - It increases by a factor of 2.
 - It increases by a factor of $\sqrt{2}$.
- 27) A 60.6-kg bungee jumper jumps off a bridge and undergoes simple harmonic motion. If the period of oscillation is 11.2 s, what is the spring constant (force constant) of the bungee cord?
- 22.9 N/m
 - 19.1 N/m
 - 30.6 N/m
- 28) A rocket explodes into two fragments, one 25 times heavier than the other. The magnitude of the momentum change of the lighter fragment is
- The same as the momentum change of the heavier fragment.
 - 1/25 as great as the momentum change of the heavier fragment.
 - 25 times as great as the momentum change of the heavier fragment.
 - 1/4 as great as the momentum change of the heavier fragment.
 - 5 times as great as the momentum change of the heavier fragment.
- 29) Shown below are the velocity and acceleration vectors for an object in several different types of motion. In which case is the object's velocity changing while its speed is not changing?
- 
 - 
 - 
 - 
- 30) When a rigid object rotates about a fixed axis, what is true about all the points in the object? (There could be more than one correct choice.)
- They all have the same radial acceleration.
 - They all have the same tangential acceleration.
 - They all have the same angular acceleration.
 - They all have the same tangential speed.
 - They all have the same angular speed.

- 31) Two simple pendulums, A and B, are each 3.0 m long, and the period of pendulum A is T . Pendulum A is twice as heavy as pendulum B. What is the period of pendulum B?

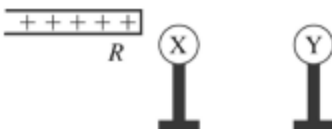
A) $T\sqrt{2}$ B) $T/2$ C) $T/\sqrt{2}$ D) T E) $2T$

32)

(a)



(b)



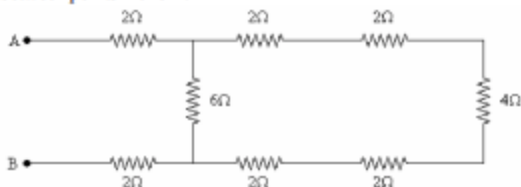
- X and Y are two initially uncharged metal spheres on insulating stands, and they are in contact with each other. A positively charged rod R is brought close to X as shown in part (a) of the figure. Sphere Y is now moved away from X, as shown in part (b). What are the final charge states of X and Y?

- A) X is negative and Y is positive.
B) Both X and Y are negative.
C) X is positive and Y is neutral.
D) Both X and Y are neutral.
E) X is neutral and Y is positive.
- 33) Two children, Ahmed and Jacques, ride on a merry-go-round. Ahmed is at a greater distance from the axis of rotation than Jacques. Which of the following are true statements? (There could be more than one correct choice.)
- A) Jacques and Ahmed have the same angular speed.
B) Jacques and Ahmed have the same tangential speed.
C) Ahmed has a greater tangential speed than Jacques.
D) Jacques has a greater angular speed than Ahmed.
E) Jacques has a smaller angular speed than Ahmed.
- 34) A plastic rod is charged up by rubbing a wool cloth, and brought to an initially neutral metallic sphere that is insulated from ground. It is allowed to touch the sphere for a few seconds, and then is separated from the sphere by a small distance. After the rod is separated, the rod
- A) feels no force due to the sphere.
B) is attracted to the sphere.
C) is repelled by the sphere.
- 35) A 1200-kg car moving at 6.2 m/s suddenly collides with a stationary car of mass 1500 kg. If the two vehicles lock together, what is their combined velocity immediately after the collision?
- A) 2.2 m/s B) 3.5 m/s C) 2.8 m/s D) 4.9 m/s
- 36) In a resonating pipe that is open at one end and closed at the other end, there
- A) are displacement antinodes at each end.
B) is a displacement node at the closed end and a displacement antinode at the open end.
C) is a displacement node at the open end and a displacement antinode at the closed end.
D) are displacement nodes at each end.
- 37) An electronic component with a $17\text{-}\Omega$ resistor is rated for use at power levels not exceeding 11 W. How much current can safely flow through the component?
- A) 0.80 A B) 0.20 A C) 1.55 A D) 187 A

- 38) A negatively-charged plastic rod is brought close to (but does not touch) a neutral metal sphere that is connected to ground. After waiting a few seconds, the ground connection is removed (without touching the sphere), and after that the rod is also removed. The sphere is now
 A) neutral. B) negatively charged. C) positively charged.
- 39) Satellite A has twice the mass of satellite B, and moves at the same orbital distance from Earth as satellite B. Compare the speeds of the two satellites.
 A) The speed of B is four times the speed of A.
 B) The speed of B is twice the speed of A.
 C) The speed of B is equal to the speed of A.
 D) The speed of B is one-half the speed of A.
 E) The speed of B is one-fourth the speed of A.
- 40) A 1000-kg car is moving at 30 m/s around a horizontal unbanked curve whose diameter is 0.20 km. What is the magnitude of the friction force required to keep the car from sliding?
 A) 300 N B) 9000 N C) 3000 N D) 900 N E) 9800 N
- 41) On a horizontal frictionless air table, a puck runs into an ideal horizontal spring that is fastened to the table. The puck compresses the spring by 15 cm before coming to rest. During the compression process, which quantities are conserved?
 A) only the kinetic energy of the puck
 B) the momentum and the kinetic energy of the puck
 C) only the momentum of the puck
 D) only the mechanical energy (kinetic plus potential) of the puck
 E) the momentum and the mechanical energy of the puck
- 42) Two tiny particles carrying like charges of the same magnitude are 8.0 mm apart. If the electric force on one of them is 3.0 N, what is the magnitude of the charge on each of these particles? ($k = 1/4\pi\epsilon_0 = 9.0 \times 10^9 \text{ N} \cdot \text{m}^2/\text{C}^2$)
 A) $4.2 \times 10^2 \text{ C}$ B) $1.5 \times 10^{-7} \text{ C}$ C) $1.5 \times 10^{-1} \text{ C}$ D) $1.5 \times 10^{-4} \text{ C}$
- 43) A proton and an electron are released from rest, with only the electrostatic force acting. Which of the following statements must be true about them as they move toward each other? (There could be more than one correct choice.)
 A) Their electric potential energy keeps decreasing.
 B) Their electric potential energy keeps increasing.
 C) Their kinetic energy keeps decreasing.
 D) Their acceleration keeps decreasing.
 E) Their kinetic energy keeps increasing.
- 44) A 5-kg ball collides inelastically head-on with a 10-kg ball, which is initially stationary. Which of the following statements is true? (There could be more than one correct choice.)
 A) The magnitude of the change of velocity the 5-kg ball experiences is equal to that of the 10-kg ball.
 B) The magnitude of the change of velocity the 5-kg ball experiences is less than that of the 10-kg ball.
 C) Both balls lose all their momentum since the collision is inelastic.
 D) The magnitude of the change of velocity the 5-kg ball experiences is greater than that of the 10-kg ball.
 E) The magnitude of the change of the momentum of the 5-kg ball is equal to the magnitude of the change of momentum of the 10-kg ball.
- 45) A small glass bead has been charged to 3.0 nC. What is the strength of the electric field 2.0 cm from the center of the bead? ($k = 1/4\pi\epsilon_0 = 8.99 \times 10^9 \text{ N} \cdot \text{m}^2/\text{C}^2$)
 A) $6.7 \times 10^4 \text{ N/C}$ B) $2.0 \times 10^{-4} \text{ N/C}$ C) $1.3 \times 10^3 \text{ N/C}$ D) $1.3 \times 10^{-6} \text{ N/C}$

- 46) Identical forces act for the same length of time on two different objects. The magnitude of the change in momentum of the lighter object is
- larger than the magnitude of the change in momentum of the larger mass.
 - exactly equal to the magnitude of the change in momentum of the larger mass.
 - smaller than the magnitude of the change in momentum of the larger mass, but not zero.
 - zero.
 - There is not enough information to answer the question.
- 47) What characteristics of a sound wave are related to the "pitch" of a musical note? (There could be more than one correct choice.)
- wavelength
 - period
 - frequency
 - amplitude
- 48) The lowest tone to resonate in pipe of length L that is open at both ends is 200 Hz. Which one of the following frequencies will *not* resonate in the same pipe?
- 600 Hz
 - 400 Hz
 - 800 Hz
 - 200 Hz
 - 900 Hz
- 49) At a certain instant, a compact disc is rotating at 210 rpm. What is its angular speed in rad/s?
- 660 rad/s
 - 22 rad/s
 - 11 rad/s
 - 45 rad/s
 - 69 rad/s
- 50) A 331-kg car moving at 15.7 m/s in the $+x$ direction hits from behind a second car moving at 12.5 m/s in the same direction. If the second car has a mass of 284 kg and a speed of 18.3 m/s right after the collision, what is the velocity of the first car after this sudden collision?
- 10.7 m/s
 - 8.94 m/s
 - 10.7 m/s
 - 20.7 m/s
- 51) You are making a circular turn in your car on a horizontal road when you hit a big patch of ice, causing the force of friction between the tires and the road to become zero. While the car is on the ice, it
- moves along a straight-line path away from the center of the circle.
 - continues to follow a circular path, but with a radius larger than the original radius.
 - moves along a straight-line path toward the center of the circle.
 - moves along a path that is neither straight nor circular.
 - moves along a straight-line path in its original direction.
- 52) A small car meshes with a large truck in a head-on collision. Which of the following statements concerning the momentum during the collision are correct? (There could be more than one correct choice.)
- The momentum of the car-truck system is conserved, but the momentum of each one separately is not conserved.
 - The momentum of the car is conserved.
 - The momentum of the car and the momentum of the truck are each conserved.
 - The car and the truck must undergo the same change in speed.
 - The momentum of the truck is conserved.
- 53) A car goes around a circular curve on a horizontal road at constant speed. What is the direction of the friction force on the car due to the road?
- perpendicular to the curve outward
 - perpendicular to the curve inward
 - tangent to the curve opposite to the direction of the car's motion
 - tangent to the curve in the forward direction
 - There is no friction on the car because its speed is constant.

- 54) A number of resistors are connected across points A and B as shown in the figure. What is the equivalent resistance between points A and B?



- A) 12 Ω B) 4 Ω C) 10 Ω D) 6 Ω E) 8 Ω
- 55) The captain of a spaceship orbiting planet X discovers that to remain in orbit at 295 km from the planet's center, she needs to maintain a speed of 61 m/s. What is the mass of planet X? ($G = 6.67 \times 10^{-11} \text{ N} \cdot \text{m}^2/\text{kg}^2$)
- A) $2.7 \times 10^{17} \text{ kg}$ B) $2.7 \times 10^{14} \text{ kg}$ C) $1.6 \times 10^{16} \text{ kg}$ D) $1.6 \times 10^{19} \text{ kg}$
- 56) What is the gravitational force acting on a 65-kg person due to another 65-kg person standing 5.0 m away? We can model each person as a small sphere. ($G = 6.67 \times 10^{-11} \text{ N} \cdot \text{m}^2/\text{kg}^2$)
- A) $1.7 \times 10^{-10} \text{ N}$ B) $5.6 \times 10^{-8} \text{ N}$ C) $1.7 \times 10^3 \text{ N}$ D) $1.1 \times 10^{-8} \text{ N}$ E) $8.7 \times 10^{-10} \text{ N}$
- 57) When you drop a pebble from height H , it reaches the ground with speed V if there is no air resistance. From what height should you drop it so it will reach the ground with twice speed?
- A) $\sqrt{2}H$ B) $8H$ C) $16H$ D) $2H$ E) $4H$
- 58) If a string fixed at both ends resonates in its fundamental mode with a frequency of 150 Hz, at which of the following frequencies will it *not* resonate? (There could be more than one correct choice.)
- A) 300 Hz B) 600 Hz C) 450 Hz D) 75 Hz E) 500 Hz
- 59) A traveler pulls on a suitcase strap at an angle 36° above the horizontal. If 851 J of work are done by the strap while moving the suitcase a horizontal distance of 15 m, what is the tension in the strap?
- A) 79 N B) 70 N C) 85 N D) 57 N
- 60) Two tiny beads are 25 cm apart with no other charges or fields present. Bead A carries $10 \mu\text{C}$ of charge and bead B carries $1 \mu\text{C}$. Which one of the following statements is true about the magnitudes of the electric forces on these beads?
- A) The force on A is 100 times the force on B.
 B) The force on B is 10 times the force on A.
 C) The force on B is 100 times the force on A.
 D) The force on A is exactly equal to the force on B.
 E) The force on A is 10 times the force on B.
- 61) A pipe of length L that is open at both ends is resonating at its fundamental frequency. Which statement about the sound is correct?
- A) The wavelength is L and there is a displacement node at the pipe's midpoint.
 B) The wavelength is $2L$ and there is a displacement antinode at the pipe's midpoint.
 C) The wavelength is $2L$ and there is a displacement node at the pipe's midpoint.
 D) The wavelength is L and there is a displacement antinode at the pipe's midpoint.

62) A 1000-kg car experiences a net force of 9500 N while slowing down from 30 m/s to 16.6 m/s. How far does it travel while slowing down?

A) 39 m

B) 36 m

C) 33 m

D) 30 m