FIRST YEAR PHYSICS

JANUARY, 2013

Directions: For each question or statement fill in the appropriate space on the answer sheet. Use the letter preceding the word, phrase, or quantity which best completes or answers the question. Each of the 25 questions is worth 4 points. *Use:* ***g =10 m/s²***

1. *Elvis has left the building*. In an effort to dodge the paparazzi, he walks 6 blocks West and then walks 8 blocks South. What is the magnitude of his displacement?
(A) zero (B) 6 blocks (C) 8 blocks (D) 10 blocks (E) 14 blocks

2. Which of the following pairs of velocity and speed combinations is accurate for an athlete who completes one complete lap around an typical 400-m track in a race?

	Average Velocity	***Average Speed***
(A)	Zero	Zero
(B)	Zero	> 0
(C)	Zero	< 0
(D)	> 0	> 0
(E)	< 0	< 0

3. Which of the following, if any, presents an *impossible* situation? An object which, over a given non-zero period of time, has
(A) zero average speed and zero average velocity.
(B) zero average speed and non-zero average velocity.
(C) non-zero average speed and zero average velocity.
(D) non-zero average speed and non-zero average velocity.
(E) All of the above are possible.

4. A tennis ball is thrown straight upward during a serve. Which of the following is true about its velocity and acceleration after it leaves the hand, but before it reaches maximum height?
(A) Velocity is positive, acceleration is negative.
(B) Velocity is positive, acceleration is zero.
(C) Velocity is negative, acceleration is negative.
(D) Velocity is negative, acceleration is zero.
(E) Velocity is positive, acceleration is positive.

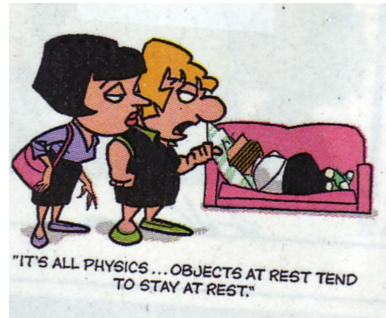
5. In what ways can you accelerate your car during your lunchtime escape to Burger King™ ? Choose only one.
(A) You speed up. (B) You slow down. (C) You turn. (D) A and B ONLY. (E) A and B and C.

6. A cannonball is shot with a muzzle speed of 100 m/s and an angle of 60^o above the horizontal. Which of the following correctly represents the initial velocity components?

	Initial Horizontal Velocity (m/s)	***Initial Vertical Velocity (m/s)***
(A)	0	0
(B)	50	87
(C)	87	50
(D)	100	0
(E)	0	100

7. Mark Sanchez throws a football at 40 m/s at an angle of 30^o above the horizontal. How long is the ball in the air until a defensive end makes an interception assuming he catches the football at the same height that Sanchez released it?
(A) 1 sec (B) 2 sec (C) 3 sec (D) 4 sec (E) 5 sec

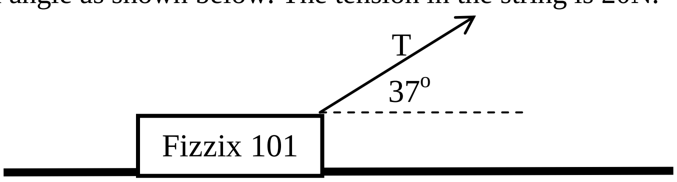
8. The cartoon shown below, *Lockhorns* ©2002, is a reference to which of the following?
(A) Law of Universal Gravitation (B) Newton's 1st Law (C) Newton's 2nd Law
(D) Newton's 3rd Law (E) Law of Conservation of Energy



9. The Avengers™ are out playing a friendly game of softball against their archenemies, *Loki & His Army of Bad Guys*. Loki pitches the ball and the Incredible Hulk whacks the 0.2-kg ball with a force of 500,000,000 N. What force does the ball exert on Hulk's 2-kg bat while they are in contact, just before the ball goes into orbit?

(A) $\frac{1}{500{,}000{,}000} N$ (B) $\frac{1}{250{,}000{,}000} N$ (C) 250,000,000 N (D) 500,000,000 N (E) 2,500,000,000 N

Use the following info for #10 & #11: A 3-kg Physics text book is being pulled at constant horizontal velocity by a string attached at an angle as shown below. The tension in the string is 20N.



10. How much force opposes the motion?
(A) 0 (B) 12-N (C) 16-N (D) 20-N (E) Not Enough Information to Answer

11. What is the net Normal force exerted on the book by the surface?
(A) 14-N (B) 18-N (C) 30-N (D) 42-N (E) 46-N

12. The gravitational force between the ***AMS*** (***A***lien ***M***other ***S***hip) and earth has a magnitude of ***F*** while maintaining a circular orbit of radius ***R*** around the earth. If the ***AMS*** moves closer so that its new orbital radius is half of its original, then the gravitational force would be
(A) 4***F*** (B) 2***F*** (C) ***F*** (D) ***F***/2 (E) ***F***/4

13. Warming up for his big confrontation with Goliath, David whirls a 2-kg rock in a vertical circle of radius 1-m keeping the speed of the rock at a constant 5 m/s. What is the tension in the sling at the top of the circle?
(A) 30 N (B) 40 N (C) 50 N (D) 60 N (E) 70 N

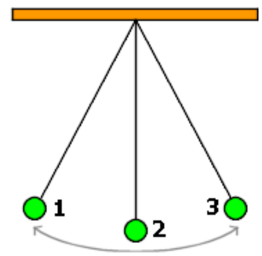
14. The gravitational force between Object ***A*** and Object ***B*** is 20-N. If the mass of Object ***A*** and Object ***B*** are *both* doubled and the distance between them is also doubled, what will the new gravitational force be between them?
(A) 5 N (B) 10 N (C) 20 N (D) 40 N (E) 80 N

15. When a planet of mass ***m*** orbits a sun of mass ***M*** at orbital radius ***R***, the period of the orbit may be represented by

(A) $2\pi R$ (B) $\frac{v^2}{R}$ (C) $2\pi\sqrt{\frac{R^3}{GM}}$ (D) $2\pi\sqrt{\frac{R}{G}}$ (E) $\frac{MR^2}{2}$

16. A certain amount of work ***W*** is completed by a uniform force ***F***. Maximum power is expended when
(A) ***W*** is done over a long period of time.
(B) ***W*** is done over a short period of time.
(C) ***W*** is done against gravity.
(D) ***W*** is done by gravity.
(E) ***W*** is done in the absence of friction.

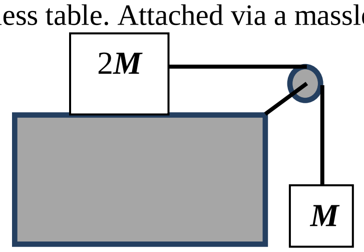
17. A pendulum, as shown to the side, oscillates between points 1, 2, and 3, and so on. Which of the following statements about a complete cycle is accurate?



(A) Maximum KE occurs at points 1 and 3.
(B) Maximum KE occurs at point 2.
(C) Maximum PE occurs at point 2.
(D) Maximum KE and maximum PE are equal and occur at the same position.
(E) Maximum total mechanical energy occurs at only point 2.

18. During a Physics Lab Field Trip, a large heavy ball is dropped from rest from the top of the *Leaning Tower of Pizza*. The Tower height is ***H.*** It takes 4 seconds for the ball to reach the ground. How far from the top of the Tower was the ball 2 seconds after release? Ignore air resistance.
(A) H/8 (B) H/4 (C) H/2 (D) 3H/4 (E) 5H/6

Use the following information for #19 & #20: A mass of 2***M*** sits on a frictionless table. Attached via a massless rope over a massless and frictionless pulley is a suspended mass of ***M***.



19. When released from rest, what is the acceleration of M?
(A) ***g*** (B) ***g***/5 (C) ***g***/3 (D) ***g***/2 (E) Zero

20. What is the tension in the string connected to the suspended block while the system is in motion?
(A) mg (B) mg/3 (C) 2mg/3 (D) 4mg/3 (E) Zero

21. With what maximum speed can a car of mass ***m*** travel around a circular unbanked Interstate Highway ramp of radius ***r*** without slipping if the coefficient of static friction is $\boldsymbol{\mu_s}$ and the coefficient of kinetic friction is $\boldsymbol{\mu_k}$?

(A) $\sqrt{\mu_k gr}$ (B) $\sqrt{\mu_s gr}$ (C) $\sqrt{\mu_k mgr}$ (D) $\sqrt{\mu_s mgr}$ (E) $\sqrt{\frac{\mu_s g}{r}}$

22. Five unknown ancient coins salvaged from a sunken ship in the Passaic River are tested by dropping all five into a graduated cylinder containing 20.20 *mL* of water. The volume of the water *increased* to 22.05 *mL*. A single coin has a mass of 0.99 grams. What metal was used to forge these coins?
$D_{Aluminum}$ = 2.7 g/*mL* , D_{Zinc} = 7.1 g/*mL* , D_{Copper} = 9.0 g/*mL* , D_{Silver} = 10.0 g/*mL* , D_{Gold} = 19.3 g/*mL* ,

(A) Aluminum (B) Zinc (C) Copper (D) Silver (E) Gold

23. What is the accepted SI (Metric) unit for *specific gravity*?
(A) g/cm^2 (B) g/mL (C) kg/m^2 (D) kg/m^3 (E) specific gravity has no unit

24. A large glass container holds 2-kg of pure liquid water. 1-kg of water ice is added to the water. This mixture is then allowed to sit for a long time at room temperature. After all the ice has melted, the mass of the contents of the glass container is approximately
[Density of water = 1000 kg/m^3 and density of ice = 900 kg/m^3]
(A)1-kg (B) 2-kg (C) 2.9-kg (D) 3-kg (E) 3.1-kg

25. During a typical high school Physics Lab to calculate a person's "horsepower", students run as fast as possible up a flight of stairs, thus increasing their own gravitational potential energy. Given that Sally's mass is 50-kg, the stairs have a vertical rise of 5-m, the steps are on a 30^o incline, and Sally can run up the flight of steps in 5 seconds, what is Sally's calculated power in Watts?
(A) 50-W (B) 100-W (C) 200-W (D) 500-W (E) 2500-W

FIRST YEAR PHYSICS

JANUARY, 2013
SOLUTIONS

1. D	14. C
2. B	15. C
3. B	16. B
4. A	17. B
5. E	18. B
6. B	19. C
7. D	20. C
8. B	21. B
9. D	22. A
10. C	23. E
11. B	24. D
12. A	25. D
13. A	

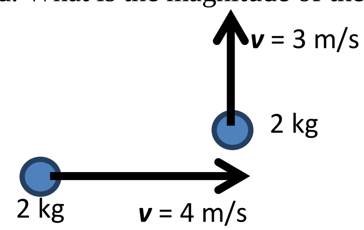
FIRST YEAR PHYSICS

FEBRUARY, 2013

Directions: For each question or statement fill in the appropriate space on the answer sheet. Use the letter preceding the word, phrase, or quantity which best completes or answers the question. Each of the 25 questions is worth 4 points. **Use: g =10 m/s^2**

1. Based on the information provided in the following situation, a 2-kg ball was initially moving at 4 m/s to the right. After contact with an unknown object, it then moved due North with a different speed. What is the magnitude of the change in momentum of the ball?

(A) 1 kg m/s (B) 5 kg m/s (C) 7 kg m/s (D) 10 kg m/s (E) 14 kg m/s



2. During the Australian Open Tennis Championships last month, Novak Djokovic won for an unprecedented 3rd consecutive time. During the game, a tennis ball of mass ***M*** was traveling horizontally at speed ***v*** when it was struck by Djokovic's racket. The ball completely reverses its direction 180^o and left the racquet at speed ***v***. What was the magnitude of the momentum change of the tennis ball?

(A) Zero (B) $\frac{Mv}{2}$ (C) Mv (D) $2Mv$ (E) $4Mv$

3. A baseball is thrown from the outfield to the catcher. While the ball is in the air, its momentum is

(A) conserved just after it leaves your hand.
(B) conserved when it is at the maximum height.
(C) conserved just before the catcher catches it.
(D) conserved everywhere in the trajectory.
(E) conserved nowhere in the trajectory.

4. During a Super Bowl commercial, a 500-kg ice-skating Coca-Cola™ polar bear traveling linearly at 10 m/s grabs onto an identical stationary ice-skating polar bear on the frictionless ice and hangs on. What is the resulting velocity of the pair of bears?

(A) 0 (B) 1 m/s (C) 2.5 m/s (D) 5 m/s (E) 10 m/s

5. A Hula Hoop™ of radius 0.5 m is being used by a small child. The child spins the Hula Hoop™ with a force of 50 N tangentially. What is the magnitude of the torque the child produces on the Hula Hoop™? [NOTE: Hula Hoop™ is a simple plastic ring used as a toy wrapped around one's waste. Used extensively in the 60's and early 70's.]

(A) 25 Nm (B) 50 Nm (C) $25\sqrt{3}$ Nm (D) $50\sqrt{3}$ Nm (E) 250 Nm

6. During a Fizzix Field Trip, a 50.0-kg Fizzix student sits on the end of a 4.0-m see saw which has the fulcrum in the middle. How far from the fulcrum should a 70-kg Fizzix student sit to balance the see-saw?

(A) 1/7 m (B) 1/2 m (C) 1 m (D) 10/7 m (E) 20/7 m

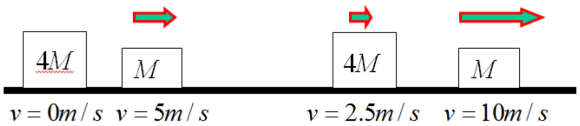
7. The following quantities are conserved in an inelastic collision:

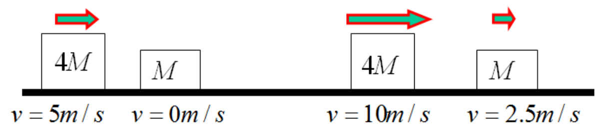
(A) Momentum and Potential Energy
(B) Kinetic and Potential Energy
(C) Momentum and Kinetic Energy
(D) Momentum, Potential and Kinetic Energy
(E) Momentum

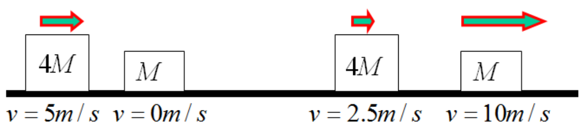
8. A collision between two objects is described mathematically below.

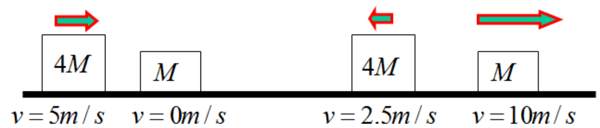
$$\left[M(0\frac{\text{m}}{\text{s}})+4M(5\frac{\text{m}}{\text{s}})\right]_{initial}=\left[M(10\frac{\text{m}}{\text{s}})+4M(2.5\frac{\text{m}}{\text{s}})\right]_{final}$$

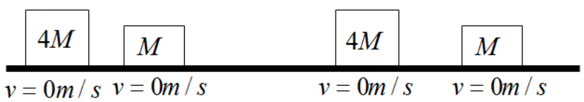
Which of the following images matches the above mathematical description?

(A) 

(B) 

(C) 

(D) 

(E) 

9. A collision is described mathematically below.

$$m_1(0\frac{m}{s})+m_2(0\frac{m}{s})=m_1(5\frac{m}{s})+m_2(-10\frac{m}{s})$$

Based on the mathematical description above, what can be correctly concluded about the masses, $\boldsymbol{m_1}$ and $\boldsymbol{m_2}$?

(A) $m_1 = m_2$ (B) $m_1 = 5m_2$ (C) $5m_1 = m_2$ (D) $m_1 = 2m_2$ (E) $2m_1 = m_2$

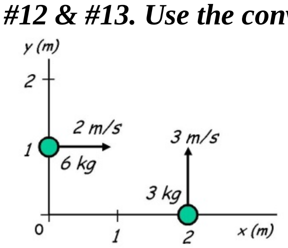
10. A flywheel goes from rest to 600 rpm in 20 seconds. What is its angular acceleration?

(A) $\frac{1}{4}\,{}^{rad}/_{s^2}$ (B) $\frac{1}{2}\,{}^{rad}/_{s^2}$ (C) $\pi\,{}^{rad}/_{s^2}$ (D) $2\pi\,{}^{rad}/_{s^2}$ (E) $3\pi\,{}^{rad}/_{s^2}$

11. Pick the equation which is a rotational analog of Newton's second law

(A) $F\tau = \Delta P$ (B) $F = \tau\alpha$ (C) $\tau = m\alpha$ (D) $\tau = ma$ (E) $\tau = I\alpha$

Use the following diagram to answer Questions #12 & #13. Use the convention of positive=clockwise rotation.



12. What is the angular momentum of the 6 kg ball about the point (0,1)?

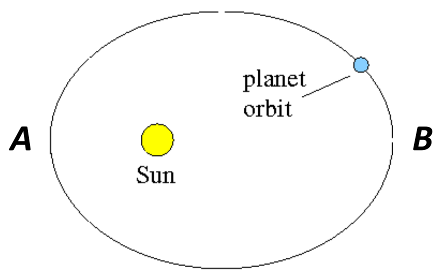
(A) Zero (B) $6\,{}^{kg\cdot m^2}/_{s}$ (C) $12\,{}^{kg\cdot m^2}/_{s}$ (D) $-6\,{}^{kg\cdot m^2}/_{s}$ (E) $-12\,{}^{kg\cdot m^2}/_{s}$

13. What is the angular momentum of the two-body system about the origin (0,0)?

(A) Zero (B) $6\,{}^{kg\cdot m^2}/_{s}$ (C) $12\,{}^{kg\cdot m^2}/_{s}$ (D) $-6\,{}^{kg\cdot m^2}/_{s}$ (E) $-12\,{}^{kg\cdot m^2}/_{s}$

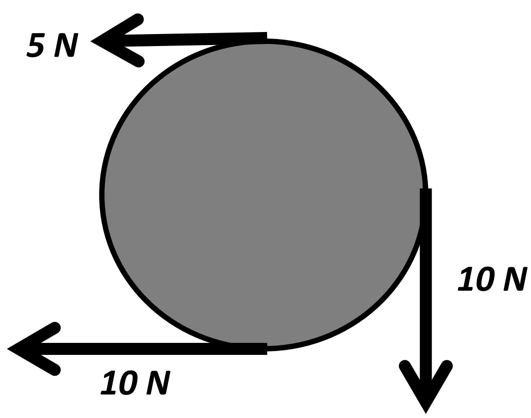
14. If a body is spinning about a principal axis, which two vectors are necessarily in exactly the same direction?
(A) torque and angular momentum (B) force and angular momentum
(C) angular velocity and torque (D) angular velocity and angular momentum (E) torque and force

15. The earth travels about the sun in a slightly elliptical path as depicted in an exaggerated view below. As the earth moves from point ***B*** to point ***A***, which of the following quantities must be conserved?



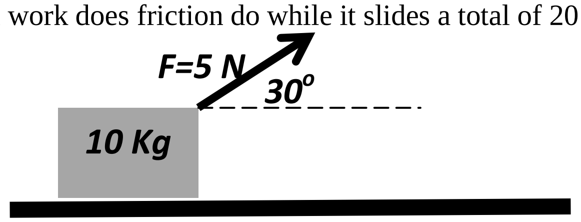
(A) Kinetic energy (B) Potential energy (C) Linear momentum (D) Angular velocity (E) Angular momentum

16. The solid disc below is allowed to rotate about a perpendicular axis through its geometric center. The radius of the disc is 0.5m. There are several forces acting on the outside rim of the disc, as labeled. What is the magnitude of the net torque acting on the disc?



(A) Zero (B) 7.5 Nm (C) 12.5 Nm (D) 15 Nm (E) 25 Nm

17. The block shown moves at constant velocity. How much work does friction do while it slides a total of 20 m?



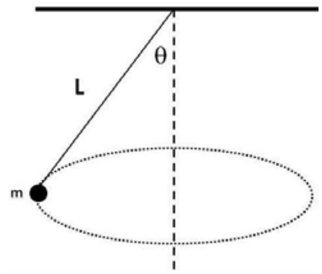
(A) Zero (B) 50 J (C) 87 J (D) 100 J (E) Not enough info to tell.

18. You are provided with two very long identical springs, each with a force constant of 100 N/m. You want to make a spring that stretches 1 meter when a 20 kg mass is hung from it. How do you do this?
(A) Hang the mass from one spring. (B) Cut a spring in half and hang the mass.
(C) Put two springs together in series and hang the mass.
(D) Put two springs together in parallel and hang the mass. (E) This cannot be done given the materials provided

19. A 1000 kg elevator is moving upward at a constant speed of 10 m/s. It then slows to a complete stop in 5 seconds. What is the tension in the elevator cable while it was slowing down?

(A) 8000 N up (B) 8000 N down (C) 10,000 N up (D) 10,000 N down (E) 12,000 N up

20. For a conical pendulum produced by a string of length L and a mass M, what is the vertical component of the tension in the string?

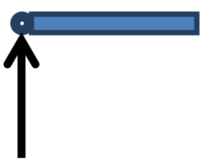
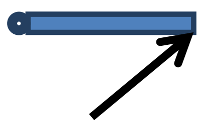
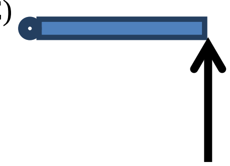
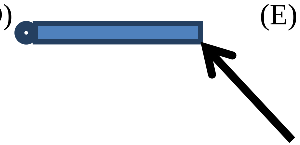


(A) Mg (B) $Mg\cos\theta$ (C) $Mg\sin\theta$ (D) $\frac{Mg}{\cos\theta}$ (E) $\frac{Mg}{\sin\theta}$

21. A meter stick is supported at each side by a spring scale. A heavy mass is then hung on the meter stick so that the spring scale on the left hand side reads four times the value of the spring scale on the right hand side. If the mass of the meter stick is negligible compared to the hanging mass, how far from the right hand side is the large mass hanging.

(A) 25 cm (B) 50 cm (C) 67 cm (D) 75 cm (E) 80 cm

22. A door (seen from above in the figures below) has hinges on the left hand side. Which force, depicted by the black arrows and all the same magnitude, F, produces the largest torque?

(A)  (B)  (C)  (D)  (E) 

23. Assume that the Earth attracted John Glenn with a gravitational force ***F*** at the surface of the Earth. Glenn was the 1st American to orbit the Earth; aboard Friendship 7 on February 20, 1962, on the Mercury-Atlas 6 mission, circling the globe three times during a flight lasting 4 hours, 55 minutes, and 23 seconds. When he made this famous flight in orbit, the gravitational force on John Glenn while he was in orbit at an average altitude of 200 km was closest to which of the following?

(A) 0.95***F*** (B) 0.50***F*** (C) 0.25***F*** (D) 0.10***F*** (E) Zero

24. In Newton's famous 3rd Law, the "reaction" force *does not* cancel the "action" force because:

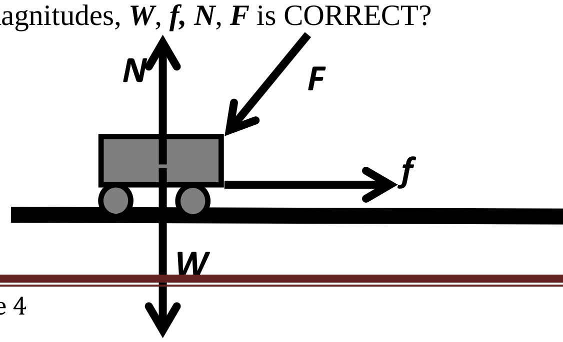
(A) The action force is greater than the reaction force. (B) The action force is less than the reaction force.

(C) They act on different bodies. (D) They are in the same direction.

(E) The reaction exists only after the action force is removed.

25. A landscaper pushes a lawn mower across a horizontal section of grass with a constant speed by applying a force ***F*** along the handles of the mower. The arrows in the diagram correctly indicate the directions, but not necessarily the magnitudes of the various forces on the lawn mower. ***W*** is the weight, ***N*** is the Normal force, and ***f*** is friction. Which of the following relations among the various force magnitudes, ***W***, ***f***, ***N***, ***F*** is CORRECT?

(A) ***F*** > ***f*** and ***N*** > ***W***
(B) ***F*** < ***f*** and ***N*** = ***W***
(C) ***F*** > ***f*** and ***N*** < ***W***
(D) ***F*** = ***f*** and ***N*** > ***W***
(E) none of the above



FIRST YEAR PHYSICS: **Salmon test**

FEBRUARY, 2013

SOLUTIONS

1. D	14. D
2. D	15. E
3. E	16. B
4. D	17. C
5. A	18. D
6. D	19. A
7. E	20. A
8. C	21. E
9. D	22. C
10. C	23. A
11. E	24. C
12. A	25. A
13. D	

FIRST YEAR PHYSICS

MARCH, 2013

***Directions*: For each question or statement fill in the appropriate space on the answer sheet. Use the letter preceding the word, phrase, or quantity which best completes or answers the question. Each of the 25 questions is worth 4 points.**

Use: g = 10 m/s^2

Work done *on a system* is expressed as *W*.

Latent Heat of Fusion of water, $L_F = 80\,{cal}/{g} = 335\,{J}/{g}$

Latent Heat of Vaporization of water, $L_v = 540\,{cal}/{g} = 2260\,{J}/{g}$

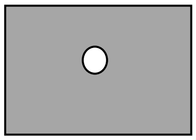
Specific Heat Capacity of water, $c = 1\,{cal}/{g \cdot C^o} = 4.186\,{J}/{g \cdot C^o}$

$PV = nRT = NkT$ **, where Universal Gas Constant,** $R = 8.31\,{J}/{mol°K}$ **, Boltzmann's Constant,** $k = 1.38x10^{-23}\,{J}/{K}$ **, *n* is number of moles, and *N* is number of molecules.**

1. Which of the following relationships between $\boldsymbol{k}$ and $\boldsymbol{R}$ in two different depictions of the *Ideal Gas Law* is correct? Avogadro's Number is $\boldsymbol{N_A}$.

A. $\boldsymbol{k = RN_A}$ B. $\boldsymbol{R = kN_A}$ C. $\boldsymbol{kR = N_A}$ D. $1/\boldsymbol{k} = \boldsymbol{RN_A}$ E. none of these

2. A solid steel rectangular plate has a hole drilled in it as shown. When the plate is uniformly heated, the hole



A. gets bigger. B. gets smaller. C. stays the same size.
D. changes its shape. E. cannot be predicted without more information.

3. Which of the following is ***NOT*** part of the kinetic theory? Gas molecules...
A. exert attractive forces on each other. B. are very far apart except when colliding. C. have no preferred direction of motion.
D. undergo mostly elastic collisions with each other.
E. absolute temperature of an object is proportional to the average kinetic energy of the molecules of that object.

4. The pressure on 3 liters of a gas is tripled as its temperature remains constant. The new volume is

A. 1/3 liter B. 1 liters C. 3 liters D. 9 liters E. must know T and P to answer.

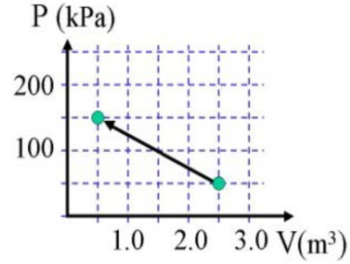
5. An equation representing the 1st Law of Thermodynamics using current accepted positive/negative protocol is

A. W = PΔV B. W = -PΔV C. ΔU = Q - W D. ΔU = Q + W E. ΔS = Q/T

6. If the average kinetic energy of the molecules in an ideal gas at an absolute temperature *T* is *E*, the average kinetic energy at temperature 2*T* is

A. $\dfrac{E}{\sqrt{2}}$ B. E C. $\sqrt{2}E$ D. $2E$

7. Shown below is a single process PV-diagram of an ideal gas. How much work is done on the gas? (Pa is N/m^2)



A. 100 kJ B. -100 kJ C. 200 kJ D. -200 kJ E. none of these

8. A 240 MW(output) electric generating plant is found to operate at 80 % efficiency. How much energy is "lost" in one day?

A. 2.6×10^{6} J B. 6.4×10^{6} J C. 3.0×10^{9} J D. 5.2×10^{12} J E. 3.0×10^{15} J

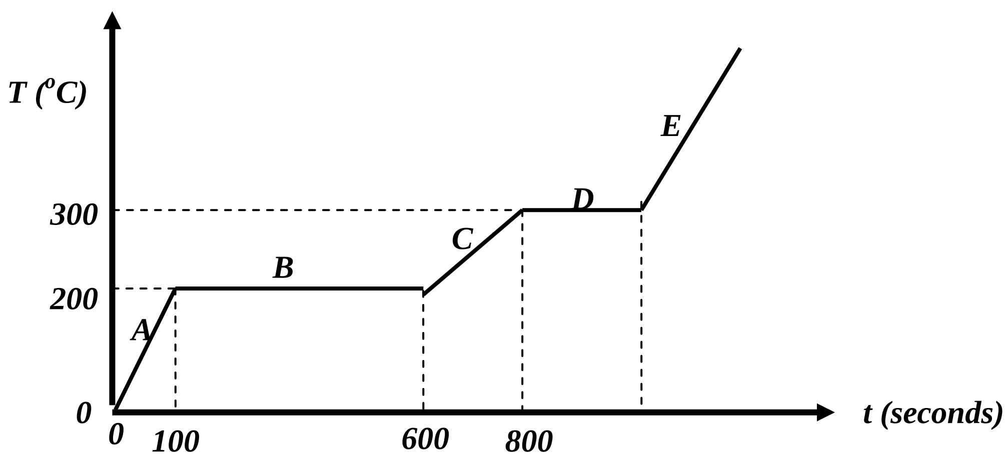
9. Which of the following is always characteristic of an adiabatic process?

A. The temperature remains constant, $\Delta T = 0$
B. The pressure remains constant, $\Delta P = 0$
C. The internal energy remains constant, $\Delta U = 0$
D. No heat flows into or out of the system, $Q = 0$

10. A 2.00-kg metal object requires 5.02×10^{3} J of heat to raise its temperature from 20.0 °C to 40.0 °C. What is the specific heat capacity of the metal?

A. 63.0 J/(kg · C°) B. 126 J/(kg · C°) C. 251 J/(kg · C°) D. 502 J/(kg · C°)

Use the following information to answer questions #11 & 12. The diagram below depicts a temperature vs. time relationship of 50 g of an unknown solid substance initially at 0^{o}C at ***t***=0. Heat energy is being added to the substance at a constant rate of 100 J/s.



11. Which section represents the entire substance in gaseous phase?

A. ***A*** B. ***B*** C. ***C*** D. ***D*** E. ***E***

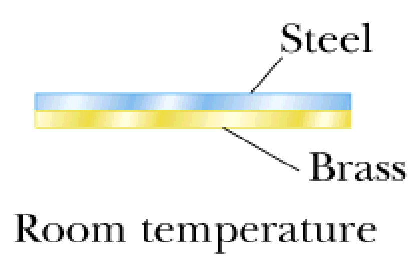
12. Based on the graph, what is the latent heat of fusion of this unknown substance?

A. 2,000 J/kg B. 2,500 J/kg C. 10,000 J/kg D. 25,000 J/kg E. 1×10^{6} J/kg

13. As shown below, courtesy Serway's popular high school physics textbook, two metals bars are welded together length-wise. The coefficients of linear expansion for steel and brass are provided below. What will happen when the temperature rises? The bar...

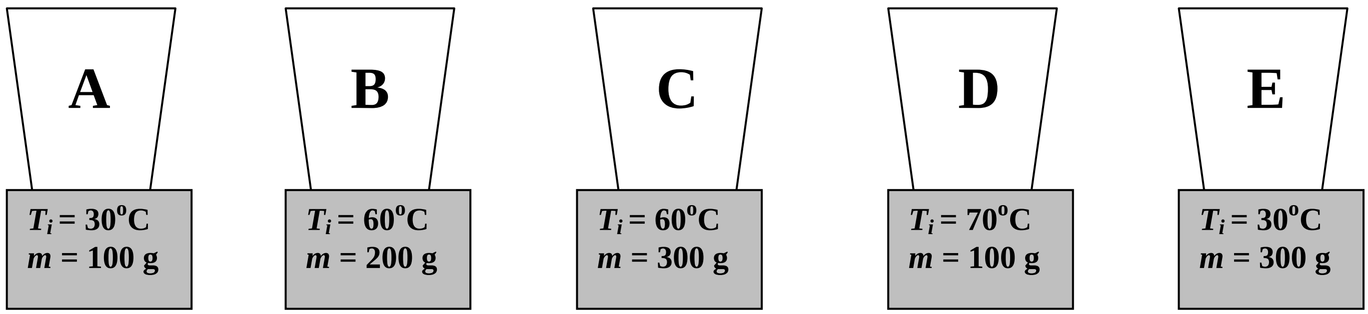
$\alpha_{Steel} = 12x10^{-6}\, /^{o}\, C$ and $\alpha_{Brass} = 19x10^{-6}\, /^{o}\, C$

Serway, Physics for Scientists and Engineers, 5/e
Figure 19.9ab

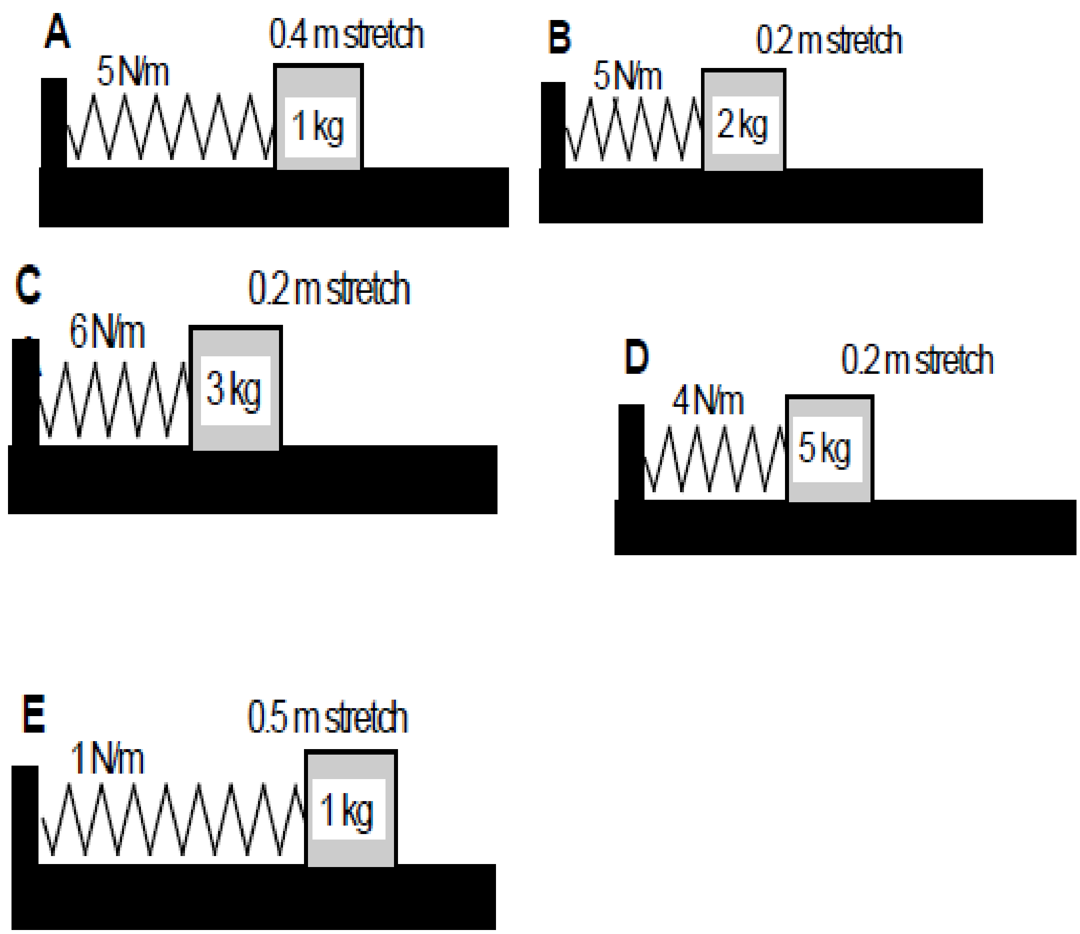


A. curves upward B. curves downward C. shortens
D. remains straight
E. cannot determine without knowing the original length of metal bar.

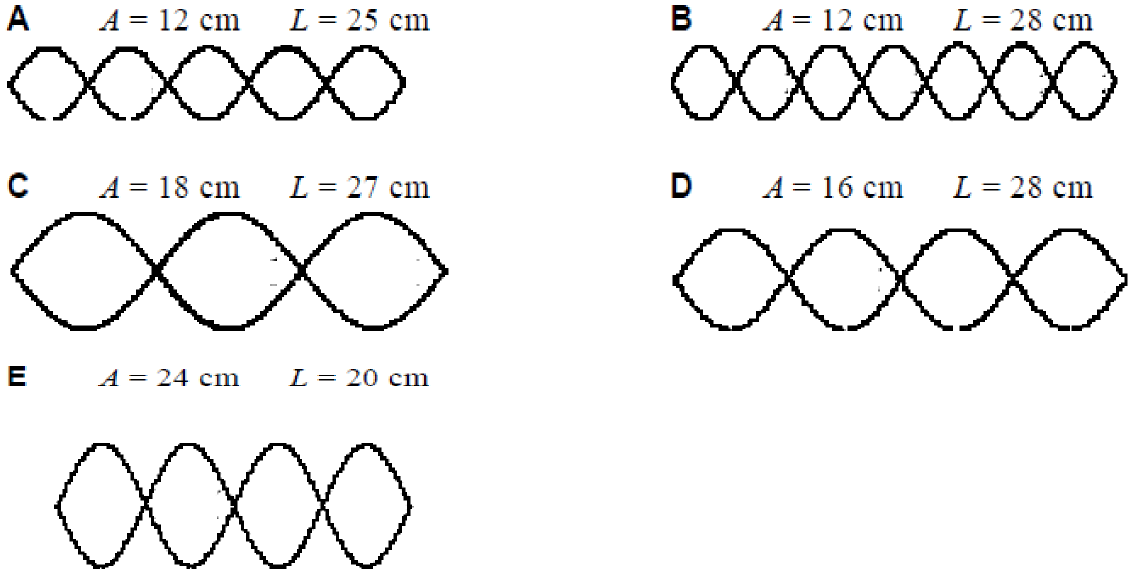
14. During a physics class lab activity, you are given the following five situations to investigate. You have five perfectly insulated Styrofoam™ cups containing exactly 1 liter of water at 20° C. You are then given five metal blocks of the masses and initial temperatures provided; each is composed of the same metal. One block goes into each cup and the temperature is carefully measured at regular intervals for a long time. Which of these cups will end up with the highest temperature of the water after the system reaches thermal equilibrium. NOTE: Cups and blocks are NOT drawn to scale.



15. Which of the following demonstration set-ups will yield the shortest period of oscillation when released? The surfaces are frictionless and each distance stretched is to the right from equilibrium point,



16. The figures below show five standing waves set up in strings, fixed at both ends. All of the strings are identical except for their lengths and are under the same tension. Which one of the standing waves has the highest frequency?



A. ***A*** B. ***B*** C. ***C*** D. ***D*** E. ***E***

17. A block attached to the lower end of a vertical spring anchored at the top oscillates up and down. If the spring obeys Hooke's law, the period of oscillation depends on which of the following?

I. Mass of the block
II. Amplitude of the oscillation
III. Force constant of the spring

A. I only B. II only C. III only D. I and II E. I and III

Use the following information to answers question #18 & 19. If you have been following the news lately, there is an eccentric multi-millionaire, Dennis Tito, who is funding a human tourist round-trip tour to Mars. Yes, Mars. Let's say he succeeds and gets a few other eccentric rich folks to spend not only a Bajillion dollars, but more than a year together in a cramped space craft. Mars has a mass of about 1/9 and a radius of about ½ of earth.

18. A landing party sets up a simple demonstration on the surface of Mars. A mass ***M*** is suspended vertically by a spring with force constant ***k***. This same set-up has a period ***T*** when set into oscillation on Earth. Its period on Mars is most nearly

A. ***T***/3 B. 2***T***/3 C. ***T*** D. 3***T***/2 E. 3***T***

19. For another demonstration, Mr. Tito sets up a mass ***M*** suspended on a string of length ***L***. This same set-up has a period ***T*** when set into oscillation on Earth. Its period on Mars is most nearly

A. ***T***/3 B. 2***T***/3 C. ***T*** D. 3***T***/2 E. 3***T***

20. A middle C has a frequency of 256 Hz. If the speed of sound in air is 342 m/s, what is its period?

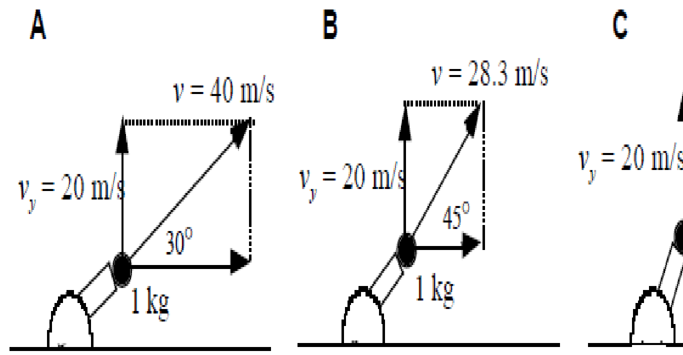
A. 0.0029 s B. 0.0039 s C. 0.74 s D. 1.34 s E. 87,600 s

21. Which of the following describes the fundamental frequency of a standing wave in an organ pipe open at both ends?

A. Node at each end, antinode in the middle.
B. Antinode at each end, node in the middle.
C. Antinode at one, node at the other.
D. Antinode at both ends, no nodes.
E. Nodes at both ends, no antinodes.

22. What physics term describes the changing amplitude pattern shown to the ri

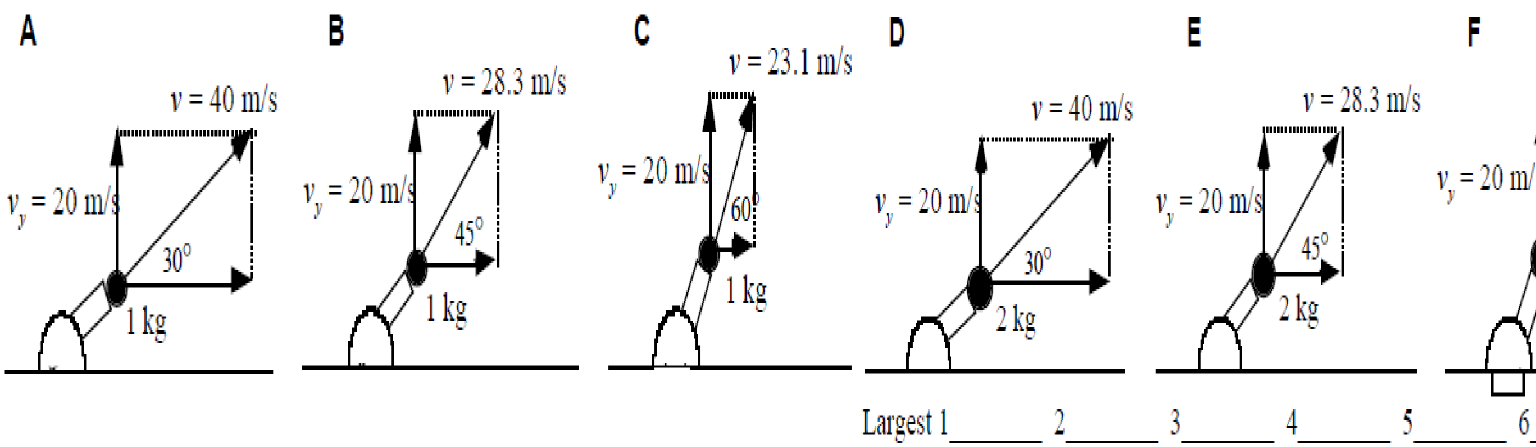
A. Resonance B. Beats C. Doppler effect D. Waves



23. If the pattern shown to the right represents a sound wave, what does the liste
Regularly changing...

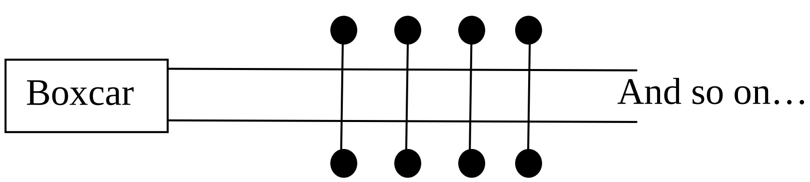
A. pitch B. frequency C. loudness D. A or

24. The drawings below depict cannonballs of two different masses projected at
Which of the five cannon situations shown will result in the largest time of fligh



A. ***A*** B. ***B*** C. ***C*** D. ***E*** E. ***They are all the same air time***

25. Near the beginning of the classic 1970 John Wayne movie, *Rio Lobo*, Confederate soldiers steal a Union payroll train through a series of semi-clever and semi-possible actions. After the theft, in order to stop the runaway payroll boxcar full of gold bars, they tied a series of strong ropes across the tracks, each end tied to a tree. This is similar to Spiderman's maneuver in stopping a runaway subway train in *Spiderman 2*. Shown below, below the diagram, is a list of the masses and speeds of five boxcars set up to demonstrate this movie science marvel. Each boxcar is moving along a horizontal straight track. Each boxcar will stop within the *same distance* by plowing through a ***large number*** of these ropes; only four ropes are shown for brevity. Which of the five situations shown will require each individual rope to provide the largest consistent force?



	Speed (m/s)	***Mass (Mg)***
A.	4	10
B.	5	12
C.	6	12
D.	5	16
E.	7	9

FIRST YEAR PHYSICS **Salmon test**

MARCH, 2013

SOLUTIONS

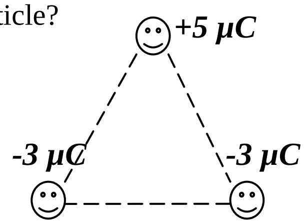
1. B	14. C
2. A	15. A
3. A	16. B
4. B	17. E
5. D	18. C
6. D	19. D
7. C	20. B
8. D	21. B
9. D	22. B
10. B	23. C
11. E	24. E
12. E	25. E
13. A	

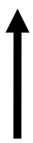
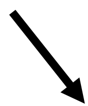
FIRST YEAR PHYSICS
APRIL, 2013

***Directions*: For each question or statement fill in the appropriate space on the answer sheet. Use the letter preceding the word, phrase, or quantity which best completes or answers the question. Each of the 25 questions is worth 4 points. <u>Use: g = 10 m/s^2.</u> Unless specifically stated, use <u>conventional current direction</u>.**

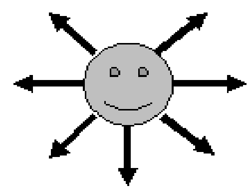
1. Generally speaking, a positively charged conductor
(A) has an excess of electrons . (B) has a deficiency of electrons. (C) repels a negatively charged object.
(D) has the same number of protons as electrons. (E) has no electrons.

2. Assuming the three electrical charges at the vertices of an equilateral triangle are isolated from any other influence, in what direction is the net force on the 5 μC particle?

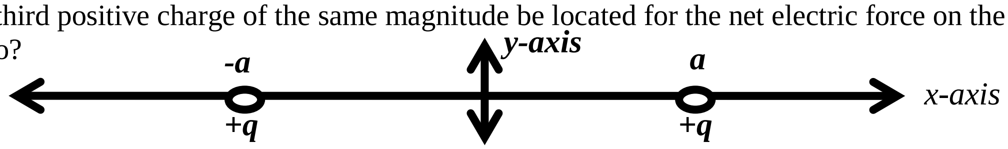


(A)  (B)  (C)  (D)  (E) 

3. The arrows represent electric field lines. What is the sign of the charge on the object?
(A) Positive (B) Negative (C) Neutral (D) Pisces
(E) Not enough information to tell.



4. As shown below, two positive charges, each of magnitude $\boldsymbol{q}$, are on the x-axis at points $\boldsymbol{x = +a}$ and $\boldsymbol{x = -a}$. Where would a third positive charge of the same magnitude be located for the net electric force on the third charge to be zero?

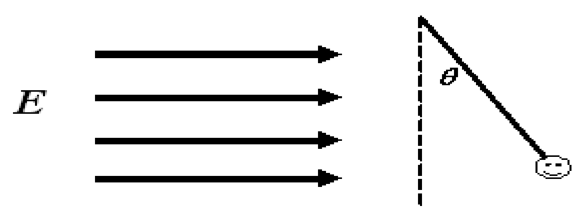


(A) at $\boldsymbol{x} = 2\boldsymbol{a}$ (B) at $\boldsymbol{x = -a}$ (C) at $\boldsymbol{x} = -2\boldsymbol{a}$ (D) at the origin (E) Anywhere on the y-axis

5. A typical CG (Cloud-to-Ground) lightning strike delivers 30 *KA* (kiloAmps) in 1.0 *ms*. What is the charge displaced in the strike?

(A) 3 C (B) 30 C (C) 300 C (D) 3,000 C (E) 30,000 C

6. A small object with charge $\boldsymbol{q}$ and mass $\boldsymbol{m}$ is attached to one end of a string of length $\boldsymbol{L}$ as shown. The other end is attached to a stationary support. The system is placed in a uniform horizontal electric field $\boldsymbol{E}$ directed to the right (the electric field extends all the way across the paper). In the presence of the field, the string makes a constant angle $\boldsymbol{\theta}$ with the vertical. What is the sign and magnitude of $\boldsymbol{q}$?



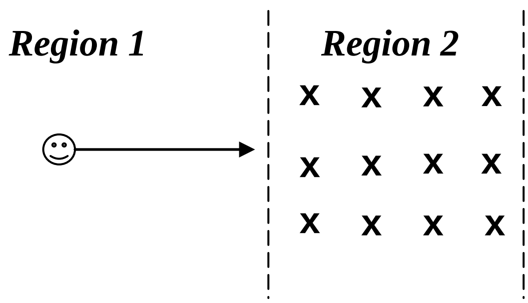
(A) positive with magnitude $\dfrac{mg}{E}$ (B) positive with magnitude $\dfrac{mg}{E}\tan\theta$ (C) negative with magnitude $\dfrac{mg}{E}$

(D) negative with magnitude $\dfrac{mg}{E}\tan\theta$ (E) positive with magnitude $\dfrac{E}{mg}\tan\theta$

7. Consider three identical metal spheres; **A**, **B**, and **C**. Sphere **A** carries a charge of -2.0 μC; sphere **B** carries a charge of -6.0 μC; and sphere **C** carries a charge of +6.0 μC. Spheres **A** and **B** are touched together and then separated. Spheres **B** and **C** are then touched and separated. Does sphere **C** end up with an excess or a deficiency of electrons and how many electrons is it?

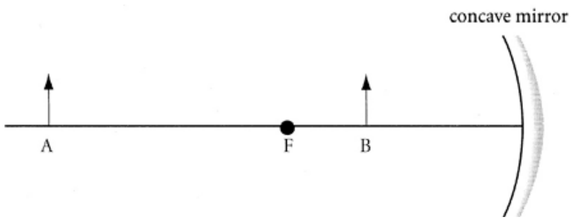
(A) deficiency, 3.12×10^{12} (B) excess, 3.12×10^{12} (C) excess, 1.87×10^{13}
(D) deficiency, 6.24×10^{12} (E) excess, 6.24×10^{12}

8. As shown below, an electron is moving with speed v in a straight line through Region 1. It then enters Region 2 where there is a uniform magnetic field of strength B oriented into the page. What happens to the motion of the electron?



(A) Nothing. It continues in a straight line.
(B) It will slow down due to a retarding force to the left.
(C) It will accelerate in a straight line due to a force to the right.
(D) It will experience an upward (toward top of page) force and follow a circular path upward.
(E) It will experience a downward (toward bottom of page) force and follow a circular path downward.

Use the following information to answer questions #9 & 10: The diagram below represents a spherical concave mirror with focal point at ***F*** and two objects located at points ***A*** and ***B***.



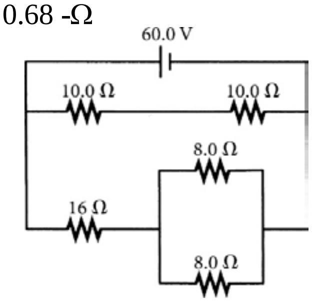
9. The mirror will form an image of object ***A*** that is
(A) virtual, enlarged, and inverted. (B) real, enlarged, and upright. (C) virtual, reduced, and upright.
(D) virtual, enlarged, and upright. (E) real, reduced, and inverted

10. The mirror will form an image of object ***B*** that is
(A) virtual, enlarged, and inverted. (B) real, enlarged, and upright. (C) virtual, reduced, and upright.
(D) virtual, enlarged, and upright. (E) real, reduced, and inverted

11. During a Physics lab, you are provided two resistors, R_1 and R_2. You connect the resistors in parallel then measure the equivalent resistance of the combination to be 5 Ω. Which of the following statements about the resistances is correct?
(A). Both R_1 and R_2 are greater than 5 Ω. (B). Both R_1 and R_2 are equal to 5 Ω.
(C). Both R_1 and R_2 are less than 5 Ω. (D). The sum of R_1 and R_2 is 5 Ω.
(E). One of the resistances is greater than 5 Ω, one of the resistances is less than 5 Ω.

12. A battery is manufactured to have an *emf* of 24.0 V, but the terminal voltage is only 22.0 V when the battery is connected across a 7.5-Ω resistor. What is the internal resistance of the battery?
(A) 3.2 -Ω (B) 0.27 -Ω (C) 1.2 -Ω (D) 0.75 -Ω (E) 0.68 -Ω

13. What is the equivalent resistance of the resistors in the figure shown on the right?
(A) 7.5 -Ω (B) 10 -Ω (C) 16 -Ω (D) 18 -Ω (E) 52 -Ω



14. A positively charged conductor attracts a second object. Which of the following statements *could* be true?

I. The second object is a conductor with negative net charge.
II. The second object is a conductor with zero net charge.
III. The second object is an insulator with zero net charge.

(A) I only (B) II only (C) III only (D) I & II only (E) I, II & III

15. When red light is compared with violet light,
(A) both have the same frequency. (B) both have the same wavelength.
(C) both travel at the same speed in a vacuum. (D) red light travels faster in glass.
(E) blue light bends less when entering a medium of higher optical density.

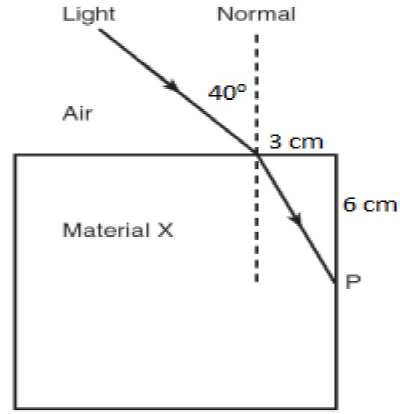
16. A photon of gamma radiation has a frequency of 5×10^{22} Hz. The wavelength of this photon in a vacuum is most nearly
(A) 1.5×10^{-15} m (B) 3×10^{-15} m (C) 4.5×10^{-15} m (D) 6×10^{-15} m (E) 7.5×10^{-15} m

17. Which of the following choices cannot be accomplished by a single converging lens surrounded by air?
(A) Converting a spherical wave front into a planar wave front.
(B) Converting a planar wave front into a spherical wave front.
(C) Forming a virtual image of a real object.
(D) Forming a real upright image of a real upright object.
(E) Forming a real inverted image of a real upright object.

18. A concave mirror focuses parallel rays at a distance of 9 cm from the mirror. An object placed 6 cm in front of the mirror will correspond to an image where?
(A) 18 cm in front of the mirror (B) 18 cm behind the mirror (C) 3.6 cm in front of the mirror
(D) 5.6 cm behind the mirror (E) 9.2 cm in front of the mirror

19. Light that has wavelength of 500 nm in air has wavelength 400 nm in an unknown transparent material. What is the index of refraction of this unknown material?
(A) 1.00 (B) 1.125 (C) 1.25 (D) 1.38 (E) 1.50

Use the following information for #20 & 21: A ray of light passes from air into a block of transparent material as shown.



20. What is the index of refraction of material "***X***".

(A) 1.22 (B) 1.33
(C) 1.44 (D) 1.55 (E) 1.66

21. What happens to the beam of light at the material-air surface inside the material at Point ***P***.

(A) It bends away from the normal upon entering air. (B) It bends toward the normal upon entering air.
(C) It continues in a straight line path upon entering air. (D) It bends onto the normal upon entering air.
(E) It reflects totally inside Material X.

22. In another Physics lab, you perform an experiment similar to *Young's Double Slit Experiment*. A monochromatic light passes through two narrow slits and produces a pattern of alternating bright and dark lines on a distant screen. Which of the following would cause the bright lines on the screen to be further apart?

I. Increasing the distance between the slits while keeping everything else constant.
II. Decreasing the distance between the slits while keeping everything else constant.
III. Decreasing the wavelength of the light while keeping everything else constant.

(A) ***I*** only (B) ***II*** only (C) ***III*** only (D) ***I*** & ***III*** only (E) ***II*** & ***III*** only

23. Monochromatic light falls on a single slit 0.01 cm wide and develops a first-order minimum (dark band) 0.59 cm from the center of the central bright band on a screen that is one meter away. Determine the wavelength of the light.

(A) 5.90×10^{-7}m (B) 5.90×10^{-5}m (C) 1.18×10^{-7}m (D) 1.18×10^{-5}m (E) 1.18×10^{-9}m

Use the following information to answer questions #24 & 25: During the recent winter storm, bales of hay had to be dropped from a NJ National Guard airplane to a herd of cattle stranded below. Assume the airplane flew horizontally at an altitude of 180 m with a constant velocity of 50 m/s and dropped one bale of hay every two seconds. Of course, air resistance is negligible for all free-fall situations in NJ.

24. As the bales are falling through the air, what happens to distance of separation between them?

(A) The distance of separation will increase.
(B) The distance of separation will decrease.
(C) The distance of separation will remain constant.
(D) The distance of separation will depend on the mass of the bales.
(E) None of the above are always true.

25. About how far apart from each other will the bales land on the ground?

(A) 50 m (B) 100 m (C) 180 m (D) 300 m (E) 600 m

FIRST YEAR PHYSICS

APRIL, 2013 **<u>Salmon test</u>**

SOLUTIONS

1. B	14. E
2. B	15. C
3. A	16. D
4. D	17. D
5. B	18. B
6. B	19. C
7. D	20. C
8. E	21. E
9. E	22. B
10. D	23. A
11. A	24. A
12. E	25. B
13. B	