FIRST YEAR PHYSICS
JANUARY, 2012

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. Which of the following statements is ***true***?
(A) *Displacement* is a scalar and *distance* is a vector.
(B) *Displacement* is a vector and *distance* is a scalar.
(C) Both *displacement* and *distance* are vectors.
(D) Neither *displacement* nor *distance* are vectors.
(E) *Displacement* and *distance* are always equal.

2. Which of the following is a proper notation for a *velocity*?
(A) 60 MPH (B) 30 m/s (C) 30 km at 45° Northeast (D) 40 km/hr (E) 50 km/hr South

3. A jogger runs 4 km in 0.4 hr and then another 8 km in 0.8 hr. What is the average speed of the jogger?
(A) 10 km/hr (B) 3 km/hr (C) 1 km/hr (D) 0.1 km/hr (E) 100 km/hr

4. Which of the following is NOT true of a projectile launched from the ground at an angle if you ignore air resistance?
(A) The horizontal velocity is constant
(B) The horizontal acceleration is zero.
(C) The vertical acceleration is upward during the first half of the flight, downward during the second half of the flight.
(D) The vertical acceleration has a constant magnitude of 10 m/s^2.
(E) The time of flight can be found by horizontal distance divided by horizontal velocity.

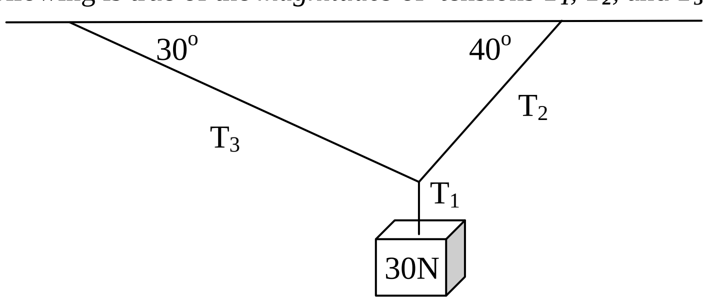
5. A projectile is launched horizontally from the edge of a cliff 20 m high with an initial speed of 10 m/s. What is the horizontal distance the projectile travels just before striking the horizontal ground below the cliff?
(A) 5 m (B) 10 m (C) 20 m (D) 40 m (E) 60 m

6. A projectile is launched from level ground with a velocity of 40 m/s at an angle of 30° from the horizontal. What is the magnitude of the vertical component of the projectile's velocity just before it strikes the ground?
(*sin* 30°=0.5, *cos*30=0.87)
(A) 10 m/s (B) 20 m/s (C) 30 m/s (D) 35 m/s (E) 40 m/s

7. The amount of force needed to keep a 0.2 kg hockey puck moving at a constant speed of 7 m/s on frictionless ice is
(A) Zero (B) 0.2 N (C) 0.7 N (D) 7 N (E) 70 N

8. Two blocks of mass ***m*** and 5***m*** are connected by a light string which passes over a pulley of negligible mass and friction. What is the acceleration of the masses when released in terms of the acceleration due to gravity, ***g***?
(A) 4***g*** (B) 5***g*** (C) 6***g*** (D) (4***g***)/5 (E) (2***g***)/3

9. Which of the following is true of the *magnitudes* of tensions T_1, T_2, and T_3 in the strings in the diagram shown below?



(A) T_1 must be greater than 30 N.
(B) The tension T_2 is greater than T_1.
(C) The sum of the *y*-components of T_2 and T_3 is equal to 30 N.
(D) The sum of the magnitudes of T_2 and T_3 equals T_1.
(E) The sum of the magnitudes of T_1 and T_2 equals T_3.

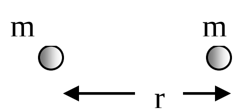
10. Friction
(A) can only occur between two surfaces which are moving relative to one another.
(B) is equal to the normal force divided by the coefficient of friction.
(C) opposes the relative motion between the two surfaces in contact.
(D) only depends on one of the surfaces in contact.
(E) is always equal to the applied force.

11. A 2 ***kg*** wooden block rests on ramp inclined at 30^{o} above the horizontal. The frictional force between the block and the plane is most nearly (*sin* 30 = 0.5, *cos* 30 = 0.87, *tan* 30 = 0.58)

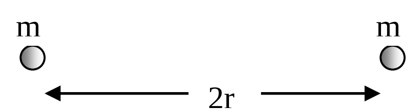
(A) 2 N (B)10 N (C) 12 N (D) 17 N (E) 20 N

12. Which of the following diagrams of two planets would represent the largest gravitational force between the masses?

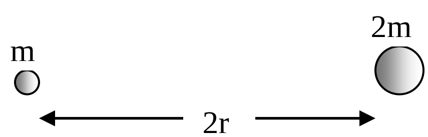
(A)



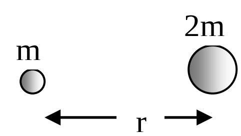
(B)



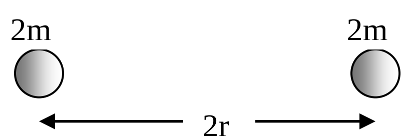
(C)



(D)



(E)



13. A satellite is in orbit around the earth. Consider the following quantities:

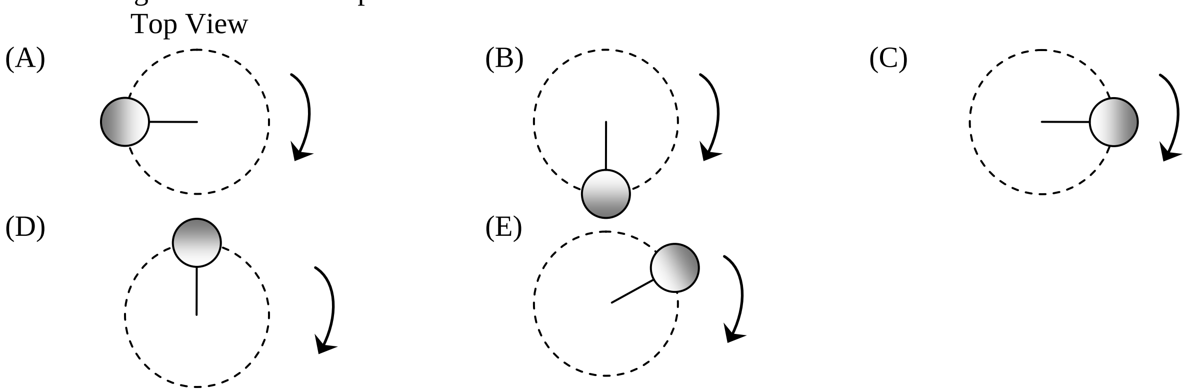
I. *distance from the center of the earth*
II. *mass of the earth*
III. *mass of the satellite*

The gravitational acceleration felt by the satellite, ***g***, depends on which of the above?

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

14. A ball on the end of a string is swung in a horizontal circle, rotating clockwise as shown below. When the ball is at one of the choices, the direction of the velocity (***v***), centripetal force (***F***), and centripetal acceleration (***a***) vectors respectively are shown below:

Which diagram below best represents the vector arrows above as the ball rotates clockwise?



15. If the string above were suddenly cut when the ball is at the position shown in choice (E) in the previous question, the subsequent motion of the ball would be
(A) to move to the right. (B) to move to the left. (C) to move to the top of the page.
(D) to move down and to the right (E) to move up and to the left.

Use the following information for Questions 16-18. A 40 kg child sits on the edge of a carnival ride at a radius of 4 m. The ride makes 3 complete revolutions in 6 s.

16. The period of revolution for this ride is
(A) ½ rev/s (B) ½ s (C) 2 rev/s (D) 2 s (E) 4 s

17. The speed of the child is most nearly
(A) 4 m/s (B) 12 m/s (C) 24 m/s (D) 120 m/s (E) 360 m/s

18. The force which is holding the child on the ride is most nearly
(A) 30 N (B) 160 N (C) 320 N (D) 1440 N (E) 2880 N

19. A car has a mass ***m*** and a speed ***v*** as it moves around the track of radius ***R***. Which of the following expressions can be used to find the value of the coefficient of friction between the tires and the road?

(A) $\mu = \frac{gR}{v}$ (B) $\mu = \frac{gv}{R}$ (C) $\mu = vgR$ (D) $\mu = \frac{v^2}{gR}$ (E) $\mu = \frac{mv^2}{R}$

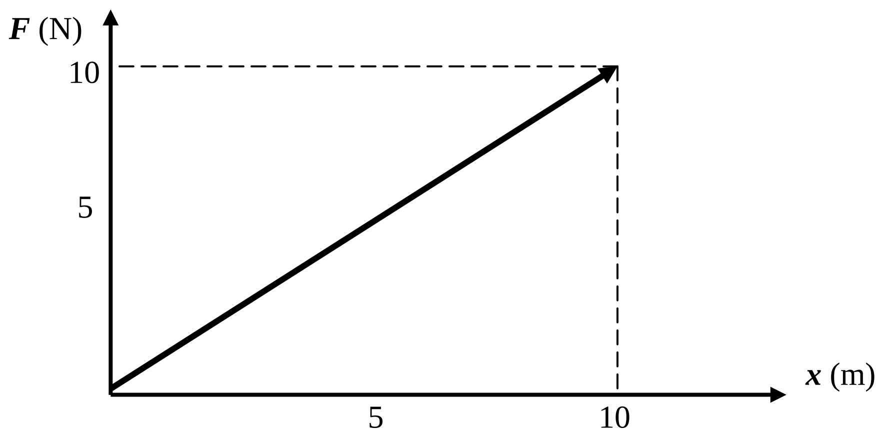
20. In general,
(A) the smaller the orbital radius of a satellite, the longer its orbital period.
(B) the larger the orbital radius of a satellite, the shorter its orbital period.
(C) the larger the orbital radius of a satellite, the longer its orbital period.
(D) the smaller the orbital radius of a satellite, the smaller its acceleration.
(E) the larger the orbital radius of a satellite, the greater the gravitational force acting on it.

21. A 20 ***kg*** cart initially at rest is pushed up the inclined plane below by a force ***F*** to a height of 3 ***m***. ***F*** is directed parallel to the plane. What is the gravitational potential energy of the cart when it reaches the top of the inclined plane?
(A) 1500 J (B) 630 J (C) 600 J (D) 300 J (E) 150 J

22. David lifts a 60 ***kg*** crate onto a truck bed 1 ***meter*** high in 3 ***seconds***. Cindy lifts sixty 1-***kg*** boxes onto the same truck in a time of 2 ***minutes***. Which of the following statements is true?
(A) David does more work than Cindy does.
(B) Cindy does more work than David does.
(C) They do the same amount of work, but David operates at a higher power level.
(D) They do the same amount of work, but Cindy operates at a higher power level.
(E) David and Cindy do the same amount of work and operate at the same power level.

23. An average adult human being will float in water of density 1000 kg/m^3 with 10% of his/her body above water level. This indicates the density of this average human being is
(A) 10 kg/m^3 (B) 90 kg/m^3 (C) 100 kg/m^3 (D) 900 kg/m^3 (E) 1000 kg/m^3

Use the following information for Questions #24 & 25. The following is a force ***F*** vs. displacement ***x*** graph produced by a lab group during a physics lab activity. It represents an applied variable force to a 3 ***kg*** air cart (no friction) starting at rest.



24. How much work is done by this force in the first 10 ***m***?
A) 5 J B) 10 J C) 20 J D) 50 J E) 100 J

25. What constant force would achieve the same work as this variable force over the 10 ***m*** distance graphed?
A) 5 N B) 10 N C) 15 N D) 20 N E) 100 N

FIRST YEAR PHYSICS

JANUARY, 2012
SOLUTIONS

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

JANUARY: scalars, vectors, kinematics, projectiles, mass, density, Newton's laws, forces (mechanical, gravitational, frictional, centripetal), work, energy (potential, kinetic), and its conservation, power.
FEBRUARY: impulse, linear momentum and its conservation, elastic and inelastic collisions, angular measure and motion, the concept of angular momentum and its conservation, equilibrium of forces and torques, simple machines, plus Jan topics
MARCH: temperature, thermal equilibrium, linear expansion and contraction, specific heat, calorimetry, modes of energy transfer, thermodynamic laws, simple harmonic motion, wave propagation, standing waves, sound, plus Feb and March topics.
APRIL: electrical charges and force, coulombs law, voltage sources and resistances, series/parallel networks, electricity and magnetism, light, index of refraction, color, optics, lenses, mirrors, interference phenomena, plus Feb, Mar, and April topics.

Testing Dates for 2012
Thursday January 12, 2012, Thursday Feb 9, 2012;
Thursday March 8, 2012; *Thursday April 12, 2012

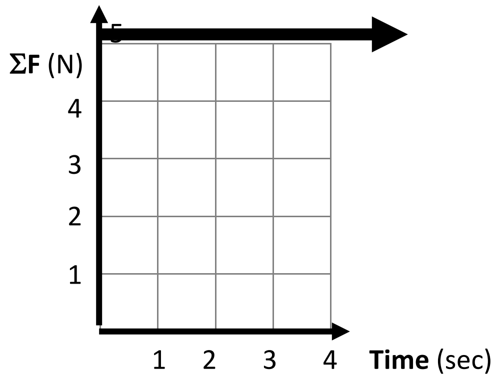
* The testing date for the April will be decided by each local area during the January exam. The date of the April exam should be a date that all schools in the area can attend. The April exam must be completed by April 30th. No area may take the April exam during the first week of April.

New Jersey Science League www.enter.net/~njscil
PO Box 65
Stewartsville, NJ 08886-0065
Phone # (908) 213-8924
Ema il newjsl@ptd.net or njscil@enter.net

FIRST YEAR PHYSICS
FEBRUARY, 2012

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. If you change your answer be sure to completely erase your first choice. **Please PRINT your name, school, area, and which test you are taking onto the scan-tron**. **Use: g =10 m/s²**

Use the following information for Questions #1 & 2. The net force, ***ΣF***, acting on a 5-kg box of NJ Science League Physics-I exams is represented in the following ***ΣF*** (N) versus ***time*** (sec) graph.



1. What is the impulse given to the box for the first three seconds shown?

(A) 5 *N•s* (B) 10 *N•s* (C) 15 *N•s* (D) 20 *N•s* (E) 25 *N•s*

2. Assuming the box started at rest at ***t***=0 and ***ΣF*** remains constant, with what speed is it moving at ***t***=5 sec?

(A) 5 $\frac{m}{s}$ (B) 10 $\frac{m}{s}$ (C) 15 $\frac{m}{s}$ (D) 20 $\frac{m}{s}$ (E) 25 $\frac{m}{s}$

3. In a typical ballistics pendulum set-up, a high-speed bullet with speed $\boldsymbol{v_i}$ hits and embeds into a large block of wood suspended by strings. The block of wood with bullet embedded then swings upward as a pendulum to a vertical height of ***h*** above the original position of the block. Which statement below is a **correct assessment** of this situation?

(A) The initial kinetic energy of the bullet before the collision is equal to the kinetic energy of the bullet and block immediately after the collision.

(B) The initial kinetic energy of the bullet before the collision is equal to the potential energy of the bullet and block when they reach the maximum height ***h***.

(C) The initial momentum of the bullet before the collision is equal to the momentum of the bullet and block at the instant they reach the maximum height ***h***.

(D) The initial momentum of the bullet before the collision is equal to the momentum of the bullet immediately after the collision.

(E) The kinetic energy of the bullet and block immediately after the collision is equal to the potential energy of the bullet and block at the instant they reach the maximum height ***h***.

4. Which statement below **is correct** when comparing the momentum of two objects with non-zero velocities?

(A) The object with the higher velocity will have less momentum is the masses are equal.
(B) The more massive object will have less momentum if its velocity is greater.
(C) The more massive object will have more momentum no matter what the velocities are.
(D) The less massive object will have less momentum if the velocities are the same.
(E) The more massive object will have less momentum if the velocities are the same.

5. A 100-kg cannon at rest contains a 10-kg cannon ball. When fired, the cannon ball leaves the cannon with a speed of 90 m/s. What is the recoil speed of the cannon?

A) 4.5 m/s B) 9 m/s C) 45 m/s D) 90 m/s E) zero

Use the following to answer Questions #6-8. An asteroid of mass ***m*** has a speed ***v*** is moving through deep space. For some unknown reason, it suddenly splits into two equal mass pieces. One piece is at rest just after the separation.

6. Which one of the following statements concerning this situation is true?

A) The moving piece has speed 2***v***.
B) This process conserves kinetic energy.
C) The piece at rest possesses kinetic energy.
D) The process does not conserve total energy.
E) This process does not conserve momentum.

7. What is the kinetic energy of the moving piece just after the separation?

A) zero B) (1/4)mv^2 C) (1/2)mv^2 D) mv^2 E) $2mv^2$

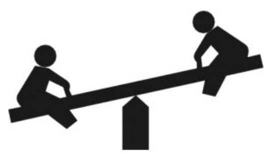
8. What is the work done by the internal forces that caused this separation?

A) zero B) (1/4)mv^2 C) (1/2)mv^2 D) mv^2 E) $2mv^2$

9. Torque

(A) is always greatest for short lever arms.
(B) is always equal to force.
(C) is a scalar.
(D) is the vector product of a displacement and a force acting perpendicularly to each other.
(E) is always greatest for long lever arms.

10. Two children, one small of mass 30-kg on the right and one large of mass 90-kg on the left, are trying to play see-saw (teeter-totter) on a playground. If they want to balance this seesaw, of total length ***L***, so both can remain suspended above the ground simultaneously, then where should the fulcrum be placed?



(A) In the middle (B) ¼ L from the small child (C) $^1/_3$ L from the small child
(D) ¼ L from the large child (E) $^1/_6$ L from the small child

11. When a figure skater starts a slow spin with her arms outstretched, she can dramatically increase her rotational speed by bringing her arms into her side. This effectively reduces her radius. Why does her rotational speed increase?

(A) Conservation of energy
(B) Conservation of mass
(C) Law of Universal Gravitation
(D) Conservation of linear momentum
(E) Conservation of angular momentum

12. The world's largest Ferris wheel is the Singapore Flyer at 165 m (541 ft) tall, has a wheel measuring 150m diameter, and has a seating capacity of 784 people! The Singapore Flyer completes one revolution in 30 minutes. What is the angular velocity of a passenger while the wheel is rotating?

(A) $\frac{2\pi}{30} rad/_{sec}$ (B) $\frac{\pi}{90} rad/_{sec}$ (C) $\frac{\pi}{150} rad/_{sec}$

(D) $\frac{\pi}{165} rad/_{sec}$ (E) $\frac{\pi}{900} rad/_{sec}$

13. What is the speed of a satellite in circular orbit of radius ***R*** around a planet of mass ***M***, if the acceleration due to gravity from the planet at this satellite's distance is 9.0 m/s^2?

(A) $v = 3\sqrt{r}$ (B) $v = 3r$ (C) $v = 9\sqrt{r}$ (D) $v = 9r$ (E) $v = 3\sqrt[3]{r}$

14. In general,

(A) the larger the orbital radius of a satellite, the greater the gravitational force acting on it.
(B) the smaller the orbital radius of a satellite, the smaller its acceleration.
(C) the larger the orbital radius of a satellite, the longer its orbital period.
(D) the larger the orbital radius of a satellite, the shorter its orbital period.
(E) the smaller the orbital radius of a satellite, the longer its orbital period.

15. A uniform density one-meter long aluminum rod of mass 200-g is placed on a fulcrum at a position 40 cm from the left end. Where should a mass of 500-g be hung to balance the rod?

(A) 16 cm to left of fulcrum (B) 16 cm to right of fulcrum (C) 4 cm to left of fulcrum
(D) 4 cm to right of fulcrum (E) At the center of the bar.

16. A 60-kg X-Games athlete runs at 7 m/s and jumps onto a stationary 10-kg skateboard. The speed of the athlete-skateboard system is approximately:

(A) 1 m/s (B) 3 m/s (C) 6 m/s (D) 7 m/s (E) 14 m/s

17. Two GPS satellites, ***GPS-A*** and ***GPS-B***, are put into circular orbit at the same altitude above Earth's surface. The mass of ***GPS-A*** is ***M*** and that of ***GPS-B*** is 3***M***. If the period of ***GPS-A*** is ***T***, what is the period of satellite ***GPS-B***?

(A) T/9 (B) T/3 (C) T (D) 3T (E) 9T

18. A 0.2-kg ball is dropped straight down onto a hard horizontal floor and bounces vertically back up. The speed of the ball immediately before and immediately after impact with the floor is 5 m/s. What is the magnitude of the impulse delivered to the floor by the ball?

(A) Zero (B) 1 N•s (C) 2 N•s (D) 10 N•s (E) 100 N•s

19. An object of mass 3***m***, initially at rest, explodes breaking into two fragments of mass ***m*** and ***2m*** respectively. Which one of the following statements concerning the fragments after the explosion is true?

(A) They will fly off at right angles.
(B) They will fly off in the same direction.
(C) The smaller fragment will have twice the speed of the larger fragment.
(D) The larger fragment will have twice the speed of the smaller fragment.
(E) The smaller fragment will have four times the speed of the larger fragment.

20. The amount of force needed to keep a 0.2 kg hockey puck moving at a constant speed of 7 m/s on frictionless ice is

(A) Zero (B) 0.2 N (C) 0.7 N (D) 7 N (E) 70 N

21. Friction

(A) can only occur between two surfaces which are moving relative to one another.
(B) is equal to the normal force divided by the coefficient of friction.
(C) opposes the relative motion between the two surfaces in contact.
(D) only depends on one of the surfaces in contact.
(E) is always equal to the applied force.

22. A 1000-kg car traveling east at 20 m/s collides with a 1500-kg car traveling west at 10 m/s. The cars stick together after the collision. What is their common velocity after the collision?

(A) 6 m/s, east (B) 6 m/s, west (C) 2 m/s, west (D) 2 m/s, east (E) 1 m/s, east

23. A cannonball is aimed 30.0° above the horizontal and is fired with an initial speed of 125 m/s at ground level. How far away from the cannon will the cannonball hit the ground?

(A) 125 m (B) 130 m (C) 680 m (D) 1020 m (E) 1350 m

24. Two point masses ***m*** and ***M*** are separated by a distance ***d***. If the separation ***d*** is tripled and ***m*** is increased to 3***m*** while ***M*** remains unchanged, how does the gravitational force between them change?

(A) The force will be one-third as great.
(B) The force will be one-ninth as great.
(C) The force will be three times as great.
(D) The force will be nine times as great.
(E) It is impossible to determine without knowing the numerical values of m, M, and d.

25. In a tug-of-war, 5 men on each team pull with an average force of 500 N ***each***. What is the tension in the center of the rope?

(A) Zero (B) 100 N (C) 500 N (D) 2500 N (E) 5000 N

FIRST YEAR PHYSICS

FEBRUARY, 2012
SOLUTIONS

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

PHYSICS 1 for All First year Students in physics. If you are taking physics for the first time, then sign up for physics I.
25 multiple choice questions per exam.

JANUARY: scalars, vectors, kinematics, projectiles, mass, density, Newton's laws, forces (mechanical, gravitational, frictional, centripetal), work, energy (potential, kinetic), and its conservation, power.
FEBRUARY: impulse, linear momentum and its conservation, elastic and inelastic collisions, angular measure and motion, the concept of angular momentum and its conservation, equilibrium of forces and torques, simple machines, plus Jan topics
MARCH: temperature, thermal equilibrium, linear expansion and contraction, specific heat, calorimetry, modes of energy transfer, thermodynamic laws, simple harmonic motion, wave propagation, standing waves, sound, plus Feb and March topics.
APRIL: electrical charges and force, coulombs law, voltage sources and resistances, series/parallel networks, electricity and magnetism, light, index of refraction, color, optics, lenses, mirrors, interference phenomena, plus Feb, Mar, and April topics.

TESTING DATES FOR THE NEW JERSEY SCIENCE LEAGUE

Thursday January 12, 2012, Thursday Feb 9, 2012; Thursday March 8, 2012; *Thursday April 12, 2012

The April exam must be completed by April 30th. No area may take the April exam during the first week of April or during the first week of May.

New Jersey Science League
PO Box 65 Stewartsville, NJ 08886-0065
phone # 908-213-8923 fax # 908-213-8924 email newjsl@ptd.net **Web address**
www.enter.net/~njscil

FIRST YEAR PHYSICS
MARCH 8, 2012

***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>

Work done *on an ideal gas system* is expressed as a negative quantity.

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,** $R = 8.31\, {}^{J}\!/_{mol^\circ K}$ **, Boltzmann's Constant,** $k = 1.38x10^{-23}\, {}^{J}\!/_{K}$ **, *n* is number of moles, and *N* is number of molecules.**

1. An ideal gas is made up of N diatomic molecules, each of mass ***M***. All of the following statements about this gas are true **<u>EXCEPT</u>**:
   A. All of the molecules have the same speed.
   B. The temperature of the gas is proportional to the average translational kinetic energy of the molecules.
   C. The molecules make elastic collisions with the walls of the container.
   D. The molecules make elastic collisions with each other.
   E. The average number of collisions per unit time that the molecules make with the walls of the container depends on the temperature of the gas.

2. What is the net work done by an ideal gas during an isobaric process of pressure ***P*** that expands to three times the original volume, ***V***?
   A. $\frac{3P}{V}$ B. $2PV$ C. $\frac{P}{3V}$ D. $\frac{PV}{3}$ E. $3PV$

3. In a specific ideal gas system, 500 J of heat are added while 125 J of work are done on the system. What is the change in internal energy of the system?
   A. – 625 J B. – 375 J C. Zero D. + 375 J E. + 625 J

4. The *latent heat of fusion* is defined as the energy required per unit mass at constant temperature to change
   A. a solid to a liquid B. a liquid to a gas C. a gas to a liquid D. a gas to a plasma
   E. the density of a mass

5. For an ideal gas in a constant volume container at constant temperature, which of the following is true?
   I. Pressure results from molecular collisions with the container walls.
   II. The molecules all have the same speed.
   III. The average kinetic energy is directly proportional to the temperature.
   A. I, II, & III B. I & II only C. II & III only D. II only E. I & III only

6. A periodic wave is produced on a stretched string. Which one of the following properties is not related to the speed of the wave? Note march 2002
   A. frequency B. amplitude C. period D. wavelength E. tension in the string

7. What are the SI units of the product of pressure and volume, PV?

A. newton B. joule C. kg · m/s D. m^2 E. newton · second

8. There are two equal masses of silver insulated from each other. ***Sample A*** is maintained at 20°C. ***Sample B*** has twice as much thermal energy as ***Sample A***. Silver has a specific heat of $233 \ J/Kg^oC$. What is the temperature of ***Sample B***?

A. 0°C B. 20°C C. 40°C D. 273°C E. 313°C

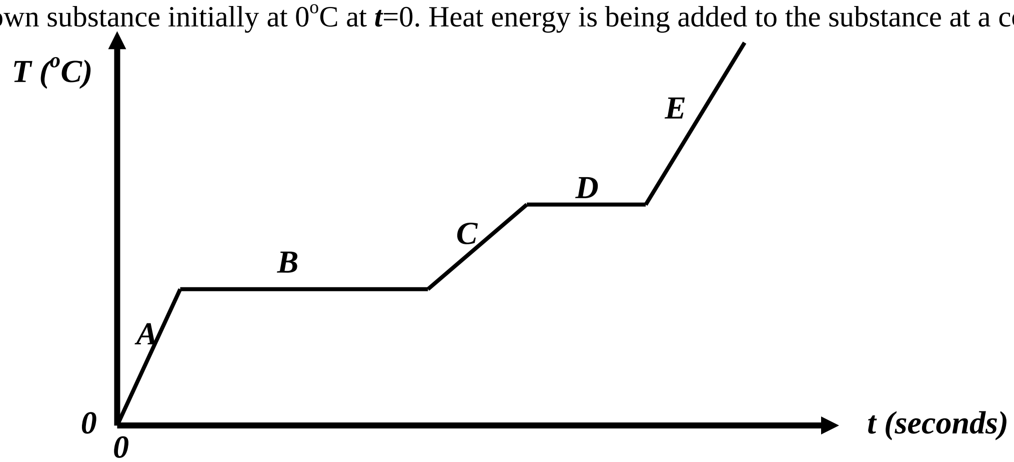
9. An aluminum strip is 51.250 m long when in a room at temperature of 20°C. With a coefficient of linear expansion of $25x10^{-6}$ /C°, what would the length be if placed in a freezer and allowed to cool to 0°C?

A. 51.100 m B. 51.181 m C. 51.224 m D. 51.250 m E. 51.276 m

10. How much energy, in Joules, is necessary to convert 3 Kg of water at 20°C entirely into steam? Assume 100% efficiency.

A. 1.1×10^4 J B. 5.5×10^5 J C. 1.0×10^6 J D. 6.8×10^6 J E. 7.8×10^6 J

Use the following information to answer questions #11 & 12. The diagram below depicts a temperature vs. time relationship of an unknown substance initially at 0°C at ***t***=0. Heat energy is being added to the substance at a constant rate.



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

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

12. Which one of the following statements is true based on the graph?

A. Latent heat of fusion is higher than the latent heat of vaporization.
B. Heat is escaping to the surrounding environment.
C. This substance never turns to a gas.
D. This substance is in thermal equilibrium with another substance.
E. This substance does not obey the First Law of Thermodynamics.

13. During a physics lab activity, you determine that a pendulum of length 0.25 m has a period of one second. Based on this data, to what length should this pendulum be changed to yield a period of two seconds?

A. 0.5 m B. 0.75 m C. 1 m D. 1.5 m E. 2 m

14. A massless spring is suspended vertically. It is found to stretch a distance of 0.15 m when a 3.25 Kg mass is attached to the bottom. Now, the spring is placed on a horizontal surface. What is the maximum energy "stored" in the spring if it is oscillating at a maximum amplitude of 0.25 m?

A. 0.65 J B. 1 J C. 3.3 J D. 6.7 J E. 9.8 J

15. A hollow tube open at both ends has a length of 3m. Which of the following sound wavelengths will not produce a standing wave in the tube?

A. 1 m B. 2 m C. 3 m D. 4 m E. 6 m

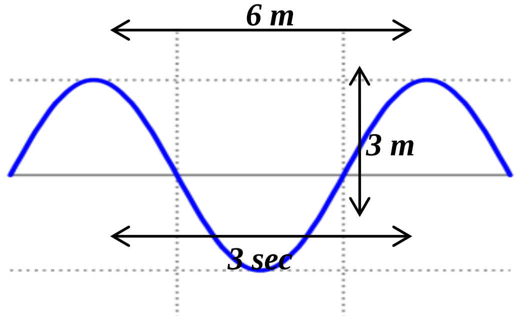
16. Once upon a time, Eric Clapton was visiting your physics teacher for a birthday celebration. After Eric, your teacher and he are on a first name basis, sang the *Happy Birthday* song to your teacher, he put his guitar down and joined the festivities. The guitar he used that night was named "Blackie", a 12-string (each string is 0.9 m long) Stratocaster™ Hybrid currently listed as the 4th most expensive guitar in history at just over $\$1 \times 10^6$. Later, your teacher noticed something odd. One of the strings was vibrating all by itself with one antinode present. The only sound source close by was a 250*Hz* sound produced by a humming air-conditioner. What was the wave speed on the string?

A. 110 m/s B. 225 m/s C. 340 m/s D. 450 m/s E. 675 m/s

17. A physics teacher is given a tuning fork of unknown frequency. She strikes both the unknown fork and one of frequency 496 Hz simultaneously and hears a beat of frequency 3 Hz. When sounded simultaneously with a 484 Hz tuning fork, she hears a beat frequency of 9 Hz. What is the frequency of the unknown tuning fork?

A. 475 Hz B. 487 Hz C. 490 Hz D. 493 Hz E. 499 Hz

Use the following information to answers question #18 & 19. The following diagram represents a standing wave "snapshot" at some given instant.



18. The wavelength is

A. 6 m B. 4 m C. 3 m D. 2 m E. 1 m

19. The speed of this wave is

A. 6 m/s B. 4 m/s C. 3 m/s D. 2 m/s E. 1 m/s

20. As sound travels from air into water, both its speed and its:

A. wavelength increase B. wavelength decrease C. frequency increase
D. frequency decrease E. frequency remain unchanged

21. Which of the following factors affect the frequency an observer hears from an emitting source?

I. The speed of the source
II. The speed of the observer
III. The loudness of the sound

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

22. There are two masses separated by a distance ***R*** exerting a gravitational force ***F*** on each other. Which of the following situations would effectively triple the force to 3***F***?

A. Triple each mass
B. Triple the distance to $3R$
C. Decrease the distance to $R/3$
D. Triple one mass and decrease the other mass to 1/3 its original value.
E. Decrease the distance to $R/\sqrt{3}$

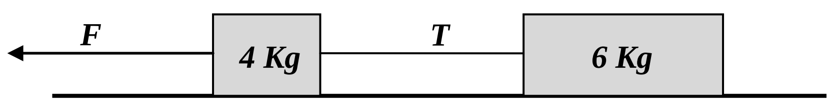
23. A newly discovered exoplanet (as of Feb 02 2012) is orbiting a star cleverly named *GJ 667C* only 22 light years from earth; basically in our stellar "backyard". The planet is considered quite earth-like with a "similar" mass ***M***, orbital radius ***R***, and orbital period ***T***. If this planet were actually twice as massive, 2***M***, what would the orbital period be?

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

24. During a physics lab demonstration, two unequal masses, ***M*** and ***m***, are placed on a frictionless air track with a spring compressed between them. The spring is not physically attached to either mass. When released from rest, the two masses move apart. Mass ***M*** moves at velocity ***V***. What is the velocity of mass ***m***?

A. $\frac{M}{m}V$ B. $-\frac{M}{m}V$ C. $\frac{m}{M}V$ D. $-\frac{m}{M}V$ E. $\frac{m}{m+M}V$

25. The following diagram represents a force ***F*** pulling two blocks that are connected by a thin cord. The cord has a tension ***T***. The value of ***F*** in terms of ***T*** is



A. $\frac{3T}{2}$ B. $\frac{3T}{5}$ C. T D. $\frac{5T}{3}$ E. $\frac{5T}{2}$

FIRST YEAR PHYSICS
MARCH, 2012
SOLUTIONS

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

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25 multiple choice questions per exam.

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Testing Dates for 2012
Thursday March 8, 2012; *Thursday April 12, 2012
***The April 2012 exam can be changed based upon the School's spring break.**
New Jersey Science League
PO Box 65 Stewartsville, NJ 08886-0065
phone # 908-213-8923 fax # 908-213-8924 email newjsl@ptd.net **Web address** www.enter.net/~njscil
Testing Dates 2013
Thursday January 10, 2013, Thursday Feb 14, 2013;
Thursday March 14, 2013; *Thursday April 11, 2013
***The April 2013 exam can be changed based upon the School's spring break.**

FIRST YEAR PHYSICS
APRIL, 2012

***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: $g = 10\ m/s^2$*. Unless specifically stated, use *conventional current direction*.**

1. When electric charge is transferred from one object to another, which of the following is actually transferred?
(A) electrons (B) protons (C) neutrons (D) quarks (E) photons

2. Two conducting hollow spheres of equal size and identical material have charges of – 3 C and +1 C, respectively. A conducting wire is connected from the first sphere to the second. What is the new charge on each sphere?
(A) – 4 C (B) + 4 C (C) – 1 C (D) + 1 C (E) zero

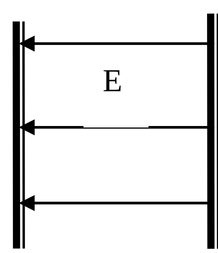
3. According to Coulomb's Law, if the force between two charges is positive, which of the following must be true?
(A) One charge is positive and the other charge is negative.
(B) The force between the charges is repulsive.
(C) The force between the charges is attractive
(D) The two charges must be equal in magnitude.
(E) The force must be directed toward the larger charge.

4. Two charges q_1 and q_2 are separated by a distance r and apply a force F to each other. If both charges are doubled and the distance between them is halved, the new force between them is
(A) ¼ F (B) ½ F (C) 4F (D) 8F (E) 16F

5. A force of 40 N acts on an electric charge of 0.25 C in a region of space. The electric field at the point of the charge is
(A) 10 N/C (B) 100 N/C (C) 160 N/C (D) 40 N/C (E) 0.00625 N/C

Use the following information for #6 & 7. Two charged vertical parallel plates are shown below with the direction of the electric field between the plates. Each of the following particles can be placed between the plates, one at a time:

I. electron
II. proton
III. neutron



6. Which of the particles would move to the right between the plates?
(A) I and II only (B) I and III only (C) II and III only (D) II only (E) I only

7. Which of the particles would not experience a force while between the plates?
(A) I and II only (B) II and III only (C) I only (D) III only (E) I, II, & III

8. Electric potential
(A) is a vector quantity.
(B) is proportional to the work done on a charge in an electric field.
(C) is always equal to the electric field.
(D) is zero when a charge is in an electric field.
(E) is measured in N/C.

9. A hollow metal sphere has a radius ***R*** and a charge ***Q*** placed on it. The electric field inside the sphere is

(A) zero (B) $\frac{KQ}{r}$ (C) $\frac{KQ}{r^2}$ (D) $\frac{KQ}{R^2}$ (E) $\frac{KQ}{R}$

Use the following information for #10-12. Two resistors of 2 Ω and 4 Ω are placed in series with a 12-V battery.

10. Which of the following statements is true?

(A) The 2Ω will get more current than the 4 Ω resistor since it has less resistance.
(B) The 4 Ω will get more current than the 2 Ω resistor since it has more resistance.
(C) The 2 Ω and 4 Ω resistors will use the same voltage.
(D) The 2Ω resistor will use more voltage than the 4Ω resistor.
(E) The 4Ω resistor will use more voltage than the 2Ω resistor.

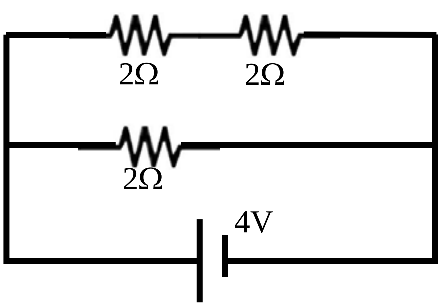
11. The current in the 2 Ω resistor is

(A) 6A (B) 4A (C) 3A (D) 2A (E) 1A

12. The voltage across the 4 Ω resistor is

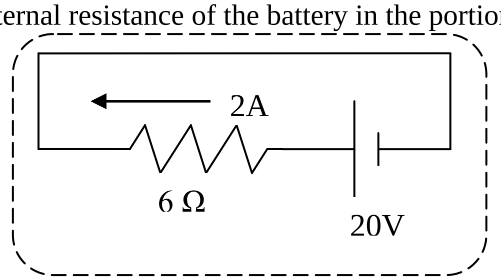
(A) 2V (B) 4V (C) 6V (D) 8V (E) 12V

13. What is the total current in the circuit shown below?



(A) 4 A (B) 3 A (C) 2 A (D) 4/3 A (E)2/3 A

14. The internal resistance of the battery in the portion of the circuit below is



(A) 12 Ω (B) 10 Ω (C) 8 Ω (D) 7 Ω (E) 4 Ω

15. Which of the following lists a few electromagnetic waves from shortest wavelength to longest wavelength?
(A) x-ray, ultraviolet, visible light
(B) visible light, ultraviolet, x-ray
(C) ultraviolet, x-ray, visible light
(D) ultraviolet, visible light, x-ray
(E) x-ray, visible light, ultraviolet

16. A photon of light has a frequency of 7.5 x 10^{14} Hz. The wavelength of this violet light is most nearly
(A) 2.25 x 10^{23} m (B) 2.5 x 10^{6} m (C) 4 x 10^{-7} m (D) 7.5 x 10^{-7} m (E) 2.25 x 10^{7} m

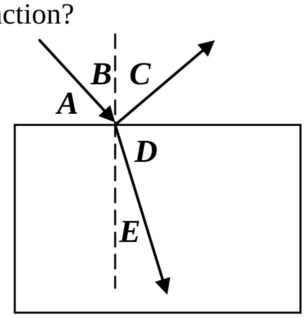
17. The frequency of light emitted by the Red Giant star Betelgeuse, is known to be 7 x 10^{14} Hz. A team of astronomers measures the frequency of the light from Betelgeuse to be 6 x 10^{14} Hz. The star must be
(A) moving toward the astronomer
(B) moving away from the astronomer
(C) stationary
(D) expanding
(E) orbiting Earth

18. Find the height and orientation of an object placed 8 cm in front of a concave spherical mirror that produces an

18 cm high inverted image located 24 cm in front of the mirror?

(A) 6 cm upright (B) 6 cm inverted (C) 52 cm inverted (D) 52 cm upright (E) 18 cm inverted

19. A beam of light passes from the air through a thick piece of glass as shown below. Which of the labeled angles is the angle of refraction?

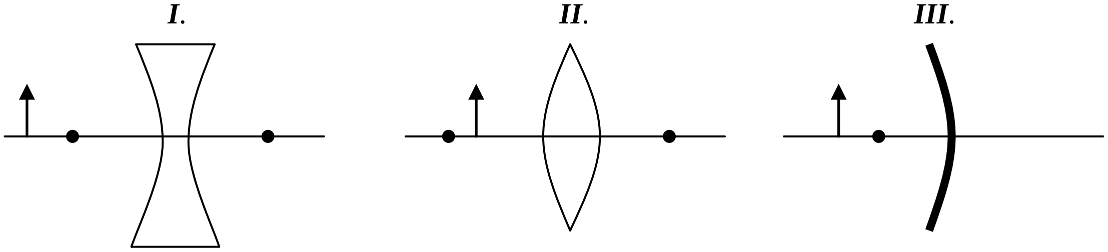


(A) A (B) B (C) C (D) D (E) E

20. A beam of monochromatic laser light passes from air into glass. Which of the following statements is true?
(A) The angle of incidence is greater than the angle of refraction in the glass.
(B) The angle of incidence is less than the angle of refraction in the glass.
(C) The angle of incidence is equal to the angle of refraction in the glass.
(D) The frequency of the light decreases.
(E) The frequency of the light increases.

21. Total internal reflection occurs when
(A) light passes from air into water.
(B) light refracts as it exits glass into air.
(C) light reflects off a mirror.
(D) the angle of incidence is more than the critical angle.
(E) the angle of incidence is less than the critical angle.

22. An object, designated as the arrow below, is placed on the principal axis in front of three different optical devices. ***I*** and ***II*** are glass lenses while ***III*** is a concave spherical mirror. Each has a focal point located at the large dot. Which of these will produce a real image?



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

23. The primary colors of light are
(A) red, blue, and yellow.
(B) red, green, and yellow.
(C) red, green, and blue
(D) red, orange, yellow, green, blue, indigo, violet (ROY G BIV)
(E) green, blue, and yellow

24. Light passing through a double-slit produces bright and dark bands on a distant screen. The dark bands are caused by waves from each slit
(A) interfering constructively.
(B) meeting exactly one wavelength out of phase.
(C) meeting exactly one-half wavelength out of phase.
(D) meeting exactly one-fourth wavelength out of phase.
(E) missing the screen altogether

25. What is the ratio of the momentum and kinetic energy for an object of mass ***M*** moving in a straight line at a constant speed ***v***?

(A) v^2 (B) $\frac{M}{v}$ (C) $\frac{v^2}{M}$ (D) $\frac{2}{v}$ (E) $\frac{4v}{M}$

FIRST YEAR PHYSICS

APRIL, 2012

SOLUTIONS

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

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Please review the topics above. Considering that the last test is in April which topics would you leave out?

Please send your comments to newjsl@ptd.net