SECOND YEAR PHYSICS TEST - JANUARY 2014

DIRECTIONS: Please PRINT your name, school, area, and which test you are taking on the scantron answer sheet/card. For each statement or question, completely fill in the appropriate space on the answer sheet. Use the letter preceding the word or phrase or sketch which best completes the statement or answers the question. Each question is worth 4 points. Use 9.8 m/s^2 as the value of the acceleration due to gravity. Unless otherwise stated, assume ideal conditions including no friction with the air. Figures are not to scale.

1. Given a 0.200 kg point mass that is released vertically upward. It reaches a maximum height of 10.0 m above the ground. Just before the mass reaches the ground, the speed of the mass is ___ times its speed when it had fallen half-way back to the ground.

A) 2.0 B) 1.4 C) 1.2 D) 0.7 E) 0.5

2. Two horizontal forces are applied to a 4.0 kg object. The object is initially at rest on a horizontal frictionless surface. The forces are each 30.0 N. They are parallel to the surface and make an angle of 60.0 degrees to each other. The magnitude of the resulting acceleration of the object is ___ m/s^2 .

A) 10.0 B) 13.0 C) 22.2 D) 26.0 E) 30.0

The following description is to be used for questions 3 through 4.

3-4. Given two “small masses”, one of 1.5 kg and a second of 3.0 kg. They are moving on a horizontal frictionless surface toward each other. The kinetic energy of the two vehicles is the same. The 1.5 kg mass is traveling at 2.0 m/s. The two masses have a head-on collision and stick together.

3. Prior to the collision the magnitude of the speed of the 3.0 kg mass was ___ m/s.

A) 0.7 B) 1.4 C) 2.9 D) 4.5 E) 9.0

4. The magnitude of their speed after the collision would have been __ m/s.

A) 0.28 B) 0.71 C) 1.4 D) 1.6 E) 1.7

5. A 1000.0 kg automobile accelerates at a constant rate from 0. m/s to 10.0 m/s in 8.0 s. A 50.0 kg passenger is sitting in the automobile. The linear impulse the passenger receives is ___ N-s.

A) 6.7 B) 13.4 C) 123 D) 500 E) 4000

The following description is to be used for questions 6 and 7.

6-7. Given three small masses projected from the same point a height h above the ground , all with the same speed, v and the same mass. MI, point mass I, is projected vertically upward; MII, point mass II, is projected horizontally; MIII, point mass III, is projected vertically downward. The ground is 5.0 m below the launch point.

6. The rank order of the three masses on the basis of the order in which each strikes the ground, putting the first to strike the ground as first, second as second, and third as the last to strike the ground, is ___ .

A) I=II=III B) II, III, I C) III, II, I D) III, I, II E) I, III, II

7. The rank order of the three masses on the basis of the order of the magnitude of their speed when each strikes the ground, putting the largest speed first, second as second, and slowest speed as third, is ___ .

A) I=II=III B) II, III, I C) III, II, I D) III, I, II E) I, III, II

8. A person wants to cross a stream of water. He is using a boat which has a maximum speed of 10.0 m/s in still water. The person wants to reach the shore 8.0 m further upstream from where the boat is launched. The downstream speed of the water is 4.0 m/s. The stream is 100.0 m wide. To achieve this, with the boat at maximum speed the person heads the boat ___.

A) straight toward the other side of the stream B) 30 degrees downstream
C) 45 degrees downstream D) 45 degrees upstream E) none of the other choices

9. If I hold a 4.0 Newton apple at rest about 3.0 m above the floor, the net force on the apple is __ N .

A) 39.2 B) 4 C) 4/9.8 D) 0.4 E) zero

10. If I release the 4.0 Newton apple from rest, upon release the net force on the apple is __ N .

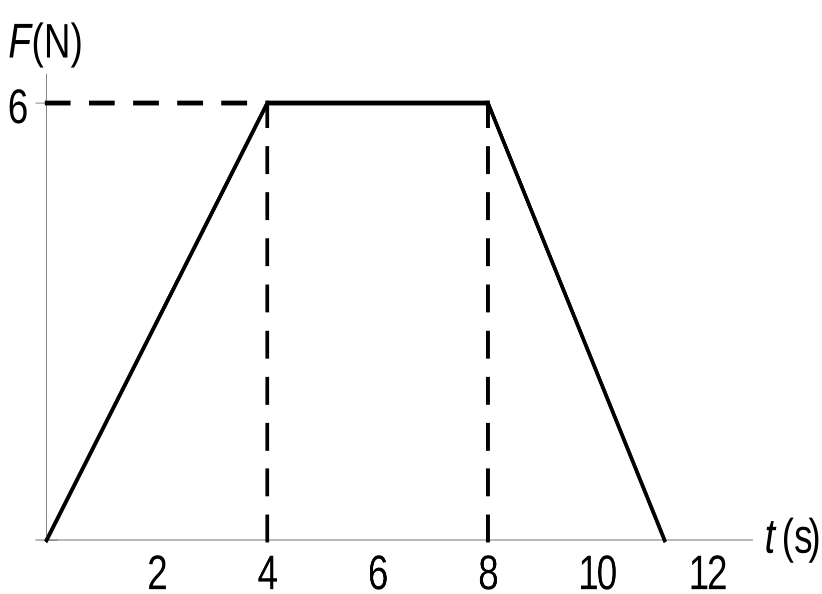
A) 39.2 B) 4 C) 4/9.8 D) 0.4 E) zero

11. Given two masses in rectilinear motion on a horizontal, frictionless surface, traveling toward each other. Object I has a mass of 4.0 kg and a speed to the right of 4.0 m/s. The second object, object II has a mass of 2.0 kg and is moving to the right also but at 2.0 m/s . The objects have a perfectly elastic collision. As a result of the collision, object I is traveling at __ m/s.

A) -1.3 B) 0.4 **C)** 2.7 D) 4.7 E) 5.3

12. Given a graph(below) of Force in Newtons vs Time in seconds of a horizontal force on a 4.0 kg mass in linear motion on a horizontal frictionless surface. When time was zero, the mass was in motion at 10.0 m/s in the same direction as the direction of the force. When time is 8.0 s the force decreases from 6.0 N to zero N when time is 11.0 s. The speed of the mass when the time was 10.0 s was ___ m/s

A) 21.0 B) 11.0 C) 7.3 D) 6.0 E) 5.2



13. An object is tossed vertically up in the air. If there were friction from the air, the object would ____ .

A) take longer to fall back than to rise to the top, and arrive back traveling slower than when it started upward.

B) take longer to fall back than to rise to the top, and arrive back traveling as fast as it started upward.

C) take as long to rise as to fall back, and arrive back traveling slower than when it started upward.

D) take more time to rise to the top than to fall back, and arrive back traveling slower than when it started upward.

E) take more time to rise to the top than to fall back, and arrive back traveling faster than when it started upward.

14. A car traveling at 100 km/hour strikes an unfortunate bug and splatters it. The force of impact is ___

A) greater on the bug B) the same in size on both C) greater on the car

The following description is to be used for questions 15, 16 and 17.

15 - 17. Given a 100.0 N block. It is at the upper end of a plane. The plane is inclined at 30.0 degrees with the horizontal. The block starts from the upper end at a speed of 10.0 m/s and continues down the plane 9.0 m along the plane until it comes to a stop.

15. The coefficient of kinetic friction is ___ .

A) 0.22 B) 0.40 C) 0.99 D) 1.10 E) 1.23

16. If the angle of elevation for the inclined plane were 60.0 degrees instead of 30.0 degrees, the work done against friction while moving down the plane would _____ .

A) decrease B) remain the same C) increase

17. Assume the plane is inclined at 30 degrees, is frictionless and that the block slides to the bottom of the plane. The speed of the block when it reaches the bottom would be approximately___ m/s

A) 8 B) 10 C) 12 D) 14 E) 16

The following description is to be used for questions 18, 19 and 20.

18. 19, 20 A 5.0 kg object slides from rest on a horizontal surface. The force due to kinetic friction is 10 N. When time is zero, the object is at the origin. Starting at time is zero, a horizontal force acts on the object. The result is that the object accelerates along the surface with an acceleration proportional to time t . The equation representing the acceleration is:

acceleration equals (5 m/s^3) times time. **$a = (5\ m/s^3)\ t$**

18. When time was 5.0 seconds, the net force on the 5.0 kg object was _____ N

A) 250 B) 175 C) 150 D) 125 E) 100

19. When time was 5 seconds, the net force was ____.

A) positive and constant B) positive and increasing C) positive and decreasing

D) negative but increasing E) negative but decreasing

20. The kinetic energy of the 5.0 kg object at the end of 5 seconds was approximately __ J

A) 19,800 B) 9770 C) 1220 D) 360 E) 225

The following table and description are used for ques. 21 -25 .

21-25 . Given a table of the velocity (in m/s) vs. time (in seconds) for the rectilinear motion of a 2.0 kg mass over a 10.0 s time interval. The mass was at the zero mark moving at 1.0 m/s when the time was zero.

Time (s)	Velocity (m/s)
0.0	1.
1.0	2.
2.0	16.
3.0	54.
4.0	128.
5.0	250.
6.0	432.
7.0	686.
8.0	1024.
9.0	1458.
10.0	2000.

21. The average acceleration of the 4.0 kg mass for the 10.0 s interval was ___ m/s^2 .

A) 282.8 B) 199.9 C) 141.0 D) 121.0 E) 100.0

22. When the time was 3.8 seconds, the velocity of the mass was __ m/s .

A) 110 B) 100 C) 70 D) 67 E) 58

23. When the time was 2.0 seconds, the kinetic energy of the mass was ___ J .

A) 14,000 B) 1400 C) 256 D) 222 E) 141

24. Of the five time intervals indicated, the maximum force on the mass occurred when the time interval was ___ seconds.

A) 0-1 B) 3-4 C) 5-6 D) 8-9 E) 9-10

25. If you were to use a power series in "t" to describe the velocity of the mass as a function of time for this motion, the highest power of time required to describe the velocity would be the ____ .

(illustration $X = Xo + C1 * t + C2 * t^2 + C3 * t^3 + C4 * t^4 + \dots$)

A) zeroth B) first C) second D) third E) fourth

SECOND YEAR PHYSICS TEST – January 2014

Answer Key: Golden Rod Test

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

PHYSICS 11 ***Second year, but not Physics C (Calculus)*** ***25 multiple choice questions per exam.***

JANUARY: Vectors, kinematics, Newton's laws of motion, work, energy, power, systems of particles, linear momentum, conservation of linear momentum, collisions

FEBRUARY: (approx. 50% of the test) Uniform circular motion, torque and rotational statics, angular momentum, conservation of angular momentum, simple harmonic motion, mass on a spring, pendulum, Newton's law of gravity, circular orbits of planets and satellites, (approx. 50% of the test) Fluid mechanics including pressure, buoyancy, fluid flow continuity, and Bernoulli's equation, Temperature, heat, Ideal gases, 1st and 2nd laws of thermodynamics.

MARCH: Electricity and Magnetism: electrostatics, Coulomb's Law, electric field, electric potential, conductors, capacitors (no dielectrics), current, power, resistance, DC circuits (not Kirchhoff's Laws, not RC circuits), batteries, capacitors in steady state circuits, parallel plate capacitors, forces on moving charges, forces on current-carrying wires in magnetic fields, magnetic fields, induction, Faraday's law, and Lenz's law.

APRIL: Wave motion, sound, standing waves, superposition, geometric optics including reflection, refraction, mirrors and lenses. Physical optics including interference, diffraction, dispersion and spectrum

Dates for 2014 Season

Thursday January 9, 2014   Thursday February 13, 2014

Thursday March 13, 2014   Thursday April 10, 2014

New Jersey Science League

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What is to be mailed back to our office?

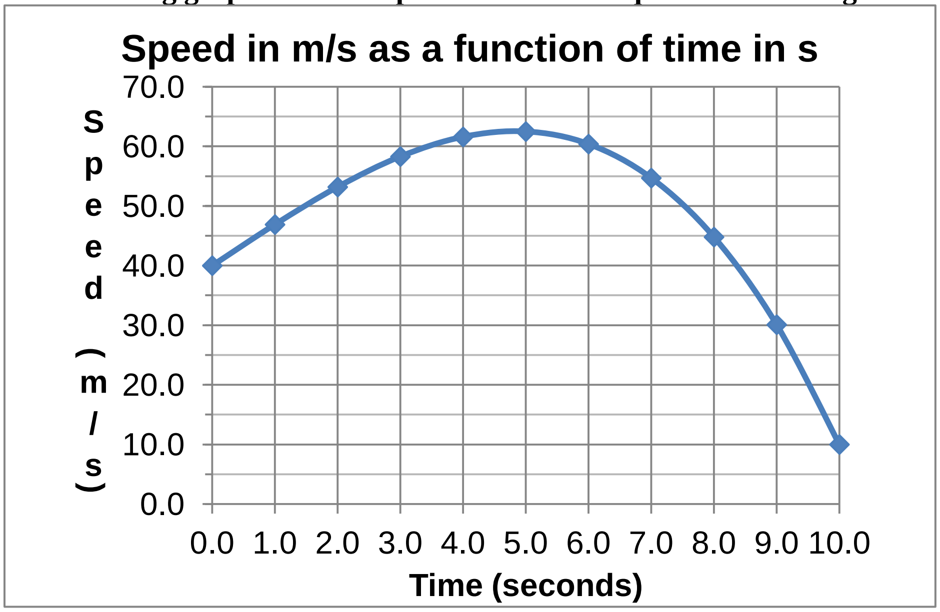
PLEASE RETURN THE AREA RECORD AND ALL TEAM MEMBER SCANTRONS(ALL STUDENTS PLACING 1ST, 2ND, 3RD, AND 4TH).

If you return scantrons of alternates, then label them as ALTERNATES.

SECOND YEAR PHYSICS TEST - FEBRUARY 2014

DIRECTIONS: For each statement or question, completely fill in the appropriate space on the answer sheet. Use the letter preceding the word or phrase or sketch which best completes the statement or answers the question. Each question is worth 4 points. Use 9.8 m/s^2 as the acceleration due to gravity and 15 psi as 1 Atm. Unless otherwise stated assume ideal conditions including no friction with the air.

The following graph and description are used for questions 1 through 4.



1-4. Given a record of a 4.0 kg "point mass" traveling in a circle with a radius of 2.5 meters.

1. When time was 3.0 s, the speed was 58.3 m/s. The angular speed was approx. _ rad/s.
A) 29 B) 23
C) 20 D) 14
E) 0.04

2. During the first four seconds the mass traveled through an angle of approximately ___ radians.
A) 162 B) 149 C) 140 D) 81 E) 0.01

3. At the end of the time interval 0 to 10 seconds, the rotational kinetic energy of the 8.0 kg mass was approximately ___ J .
A) 100 B) 200 C) 300 D) 400 E) 560

4. When the object's speed was 30.0 m/s, its angular momentum was approximately ___ kg-m^2/s.
A) 360 B) 300 C) 120 D) 80 E) 60

The following description is used for questions 5, 6, and 7.

5-7. Given a horizontal "massless spring" resting on a frictionless horizontal plane surface. There is a small 0.4 kg mass attached to the right hand end of the spring. The left end of the spring is attached to a rigid vertical support. The force constant, k , of the spring is 64.0 N/m The mass and spring are initially in equilibrium and at rest. Then, the mass is displaced from rest 0.4 m to the right of its equilibrium point and released with an initial speed of 4.0 m/s toward the right, away from the rigid support. The mass oscillates in simple harmonic motion about its equilibrium point.

5. When the acceleration of the mass is 18.2 m/s^2 , the mass is ___ m from its equilibrium point.
A) 0.05 B) 0.11 C) 0.18 D) 1.41 E) 12

6. The amplitude for the simple harmonic motion is approximately ___ m .
A) 0.1 B) 0.2 C) 0.3 D) 0.4 E) 0.5

7. If the spring constant had been 49.0 N/m , instead of 64.0 N/m , the frequency of the simple harmonic motion would have been ___ times its value when the spring constant was 64.0 N/m.
A) 1.14 B) 1.07 C) 0.94 D) 0.88 E) 0.77

8. A small object is in distant space. It is being accelerated by a 5 N force acting to the right. Then, the small object encounters a second force of 5 N acting to the left. Now, it has two forces acting on it. The small object__

A) slows slowly to rest
B) is brought abruptly to rest
C) continues with the speed it had when the second force was applied
D) continues to accelerate at a constant rate to the right
E) continues to accelerate at a constant rate but to the left

9. According to the ideal gas law, a given mass of a gas which occupies a volume of 2.0 liters at 127 degrees Celsius and an absolute pressure of 100,000 Pa will occupy a volume of approximately ___ liter(s) at 327 degrees Celsius and an absolute pressure of 200,000 Pa.

A) 1.0   B) 1.2   C) 1.5   D) 1.6   E) 2.6

10. Given a uniform ladder 10.0 m long with a weight of 200.0 N . The ladder is leaning against a “smooth wall” with the top of the ladder 8.0 m above the floor. The bottom of the ladder is 6.0 m from the wall. (The ladder makes an angle with the horizontal floor of 53 degrees). The coefficient of static friction between the bottom of the ladder and the floor is 0.50 . The force of friction is approximately ___ N .

A) 1.5   B) 75   C) 200   D) 533   E) 1500

The following description is to be used for questions 11 and 12.

11-12. Given a horizontal uniform rigid rod 2.0 m long. It is supported by a vertical force at the 1.0 m mark, its midpoint and is initially in equilibrium. In addition to the weight and the support force, three forces are applied to the rod. The first applied force is a 100.0 N force applied at the 1.5 m mark (0.5 m from the right end), making an angle of 45 degrees with the rod (upward and to the right, equiv. to 70.7 N upward and 70.7 N to the right). A second applied force of 200.0 N is applied vertically downward at the right end of the rod, call it the 2.0 m mark. A third force is applied and puts the rod in total equilibrium again.

11. The magnitude of the third applied force is ___ N .

A) 71   B) 98   C) 129   D) 147   E) 162

12. All three of the applied forces and the original support force are removed from the rod. The balance point is shifted from the midpoint to the right end, the 2.0 m mark. An upward force of 200.0 N is applied 0.5 m from the left end. The rod is in equilibrium. The weight of the rod is ___ N .

A) 300   B) 250   C) 200   D) 133   E) 90

13. Given a spherical planet with constant density. Its mass is 4.0×10^{20} kg and radius is 4.0×10^{6} m . A small object weighs 300.0 N when it is at rest on the surface of the planet. The object is placed in a space craft which is in a circular orbit about the planet. The radius of the object’s orbit is 100,000 m above the surface of the planet. The gravitational force on the object in orbit is approximately ___ times the 300.0 N gravitational force on the object when it was on the planet’s surface.

A) zero (it is weightless)   B) 0.3   C) 0.5   D) 0.7   E) almost one

14. Given a 400.0 kg mass setting on a horizontal surface which is rotating at constant speed. The result is that the mass is moving in a circle of 2.0 m radius at a constant speed of 3.0 m/s . The minimum coefficient of friction required so that the mass maintains the circular path, and doesn’t slide outward is ___ .

A) 0.25   B) 0.38   C) 0.46   D) 0.52   E) 0.88

15. Given a gasoline engine which operates at 33.0 % efficiency. The engine operates through a range of temperature between a low temperature of 300.0 K and a high temperature of approximately ___ K .

A) 600 B) 505 C) 450 D) 400 E) 333

16. An ideal liquid is flowing through a hose with a cross-sectional area of A. A clamp is placed over the end of the hose reducing the exit area to one-fourth the area of the hose. The ratio of the speed of the water through the clamped area to the speed of the water when it moves in the hose is___ .

A) 8 B) 4 C) 2 D) 1.41 E) 0.71

17. Given a 0.20 kg mass of a solid metal. The metal is heated and placed in water. that is in a container. The specific heat of the metal is 400 J/kg-Celsius degree. The container is equivalent to 0.06 kg of water. It contains 0.200 kg of water. Assume that no heat is lost to nor gained from the surroundings. The original temperature of the water and container was 18.0 degrees Celsius. The final temperature of the water, container, and metal was 35 degrees Celsius . The specific heat of water is 4,186 J/kg-Celsius degree. The original temperature of the metal was ___ degrees Celsius.

A) 299 B) 270 C) 235 D) 196 E) 175

The following description is used for questions 18, 19, 20.

18-20. Given a flat square bottomed tank, like a box. It is constructed of sheets of metal. The metal sheets are 0.01 m thick. The tank is 0.50 m wide and 0.50 m long. It is 0.50 m tall. A similar but smaller box is floating in the center of the tank. The box is empty. The dimensions of the box are half those of the tank, 0.25 m wide by 0.25 m long by 0.25 m tall. The smaller box is floating in fresh water in the tank with 0.20 m under the water and 0.05 m above the water level. With the smaller box floating in the larger tank, the water level in the larger is at the very top. The box and tank are open at the top. The density of water is 1,000 kg/m^3 . The box and tank are made from the same metal.

18. The density of the metal is approximately __ kg/m^3

A) 800 B) 1000 C) 1250 D) 2500 E) 4000

19. If the smaller box is removed from the larger tank, the water level in the tank would ___ .

A) rise (water would overflow) B) drop 0.05 m C) drop $12 X 10^{-2}$ m
D) drop $32 X 10^{-3}$ m E) not change

20. If the smaller box is returned, and the original conditions restored, except that the smaller box is filled with ice so that the smaller box has enough ice in it to float with the top at the water level (flush with the water level; zero meter out of the water). Over time the ice melts. The smaller box __ .

A) floats with 0.025 m out of the water
B) floats with 0.050 m out of the water
C) floats with the top at the water level (zero out of the water**)**
D) sinks half way to the bottom and stops
E) sinks to the bottom

21. Given four containers standing vertically upright on a horizontal plane. Water is placed in all of them to the same height. All four are open to the atmosphere at their upper ends. I and II are right circular cylinders. The diameter of I is 0.20 m. The diameter of II is 0.10 m. III is shaped like the lower portion of a flask. Its diameter at its bottom is 0.20 m and tapers from 0.20 m at the bottom to a diameter of 0.10 m at the upper end. IV has a square cross-section 0.20 m on a side. The weight on the bottom of ___ due to the water is (are) the largest.

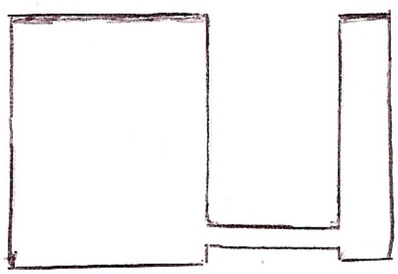
A) only IV B) only I and III C) only III and IV D) only I, II, and III
E) -all have the same weight

22. Given an open circular vertical tank 15.0 m tall and 10.0 m in diameter. The tank is filled to a depth of 14.0 m. One meter off the bottom of the tank there is a hole with a radius of 0.04 m from which water escapes. The exit velocity of the water is ___ m/s .

A) 16.6 B) 16.0 C) 14.1 D) 11.3 E) 9.9

The following figure and description are used for questions 23, 24, and 25.

23, 24, and 25 Given a Pascal's Principle device, a hydraulic lift. The two cylinders which are joined by a small tube to form the device have square cross-sections. The two square cylinders are of equal height, stand next to each other, and are joined by a tube 0.05 m long and 0.01 m in diameter located 0.04 m off the bottom of the square cylinders near their bottoms. The square cylinders are 0.40 m tall. They are filled with an ideal liquid. They each have essentially friction free "massless" square pistons at their tops. The cylinder on the left has a side of 0.20 m , and has a weight of 60.0 N placed on the piston. The square cylinder on the right has a side of 0.10 m , and has a weight on it left to set the system in equilibrium.



23. The weight placed on the square piston of the smaller cylinder is approximately ___ N .

A) 15 B) 120 C) 180 D) 240 E) 480.

24. The pressure on the bottom of the larger cylinder is ___ times the pressure on the bottom of the smaller cylinder.

A) 9 B) 3 C) 1 D) 0.33 E) 0.11

25. If the original ideal liquid were replaced by a second ideal liquid with half the density of the original liquid, the weight on the smaller square piston required to balance the 60.0 N on the larger piston, would have been ___ times the original weight.

A) 9 B) 3 C) 1 D) 0.33 E) 0.11

SECOND YEAR PHYSICS TEST –FEBRUARY, 2014

Answer Key (Corrections)

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

PHYSICS 11 **Second year, but not Physics C (Calculus)** **25 multiple choice questions per exam.**

JANUARY: Vectors, kinematics, Newton's laws of motion, work, energy, power, systems of particles, linear momentum, conservation of linear momentum, collisions

FEBRUARY: (approx. 50% of the test) Uniform circular motion, torque and rotational statics, angular momentum, conservation of angular momentum, simple harmonic motion, mass on a spring, pendulum, Newton's law of gravity, circular orbits of planets and satellites, (approx. 50% of the test) Fluid mechanics including pressure, buoyancy, fluid flow continuity, and Bernoulli's equation, Temperature, heat, Ideal gases, 1st and 2nd laws of thermodynamics.

MARCH: Electricity and Magnetism: electrostatics, Coulomb’s Law, electric field, electric potential, conductors, capacitors (no dielectrics), current, power, resistance, DC circuits (not Kirchhoff’s Laws, not RC circuits), batteries, capacitors in steady state circuits, parallel plate capacitors, forces on moving charges, forces on current-carrying wires in magnetic fields, magnetic fields, induction, Faraday's law, and Lenz's law.

APRIL: Wave motion, sound, standing waves, superposition, geometric optics including reflection, refraction, mirrors and lenses. Physical optics including interference, diffraction, dispersion and spectrum

Dates for 2014 Season

Thursday January 9, 2014 Thursday February 13, 2014

Thursday March 13, 2014 Thursday April 10, 2014

All areas and schools must complete the last exam and mail in the results by April 25th, 2014

New Jersey Science League

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Dates for 2015 Season

Thursday January 8, 2015 Thursday February 12, 2015

Thursday March 12, 2015 Thursday April 9, 2015

SECOND YEAR PHYSICS TEST - MARCH, 2014

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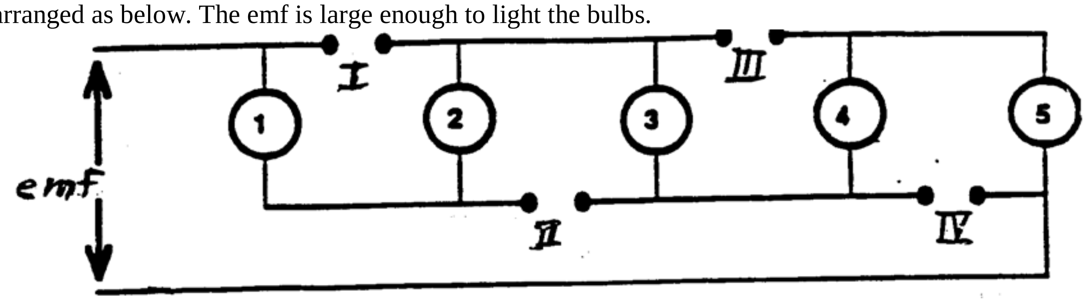
Wires and switches have no resistance.

The figure and description below are for questions 1 and 2.

1, 2. Given five identical bulbs (1, 2, 3, 4, 5), four switches (I, II, III, IV, all originally open), and an emf, arranged as below. The emf is large enough to light the bulbs.



1. If only switch III were closed, which bulbs will light?
A) only 1, 4, and 5 B) only 1, 3, and 4, C) only 1, 2, and 5
D) only1, 3, and 5 E) all five light

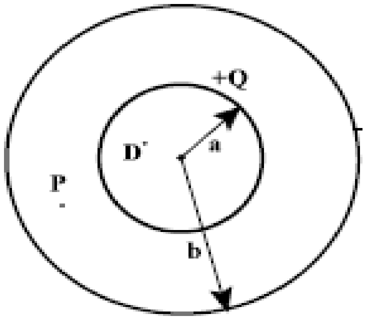
2. If only switches I and IV are closed, which bulb(s) would glow the brightest?
A) 1,2,3,4 B) 3 C) 3,4,5 D) 1,3,5 E) all will glow the same

3. Two small masses are held at rest close to each other, but not touching. Then they are released and are no longer constrained to be at rest. They move . The electric force on each mass decreases . Therefore, ___
A) the two masses must have the same type of charge, either both positive or both negative
B) the two masses must have opposite signs
C) only one mass is charged
D) neither mass has a charge on it

4. Electric field lines ____ .
A) cannot cross magnetic field lines
B) indicate the direction of electric force on a positive charge
C) cannot be used to show relative electric field strength
D) form closed loops
E) are always drawn in red

The following description and figure are to be used for question #s 5 and 6.

5, 6 Given a hollow metal sphere of radius **a** concentric with another hollow metal sphere of radius **b**, where radius **b** is larger than radius **a** . The inner sphere has a charge +Q



5. The magnitude of the electric field E, at a point D inside the inner sphere at a distance equal to 0.5a from the center is ___ .
A) $kQ/4a^2$ B) kQ/a C) $4(kQ/a^2)$
D) $kQ/b^2 + 4(kQ/a^2)$ E) zero

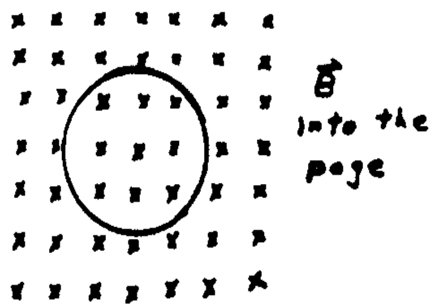
6. The electric potential at the center of the spheres is ___
A) $kQ/4a^2$ B) kQ/a C) $4(kQ/a^2)$
D) kQ/b + kQ/a E) zero

7. Given a battery connected to a resistor forming a closed circuit. The battery has an internal resistance of 10.0 ohms. With the battery connected to the resistor, the potential difference across the resistance is 9.25 volts. The resistor is disconnected. The potential difference across the battery is now approximately 12.0 volts. The value of the resistor is approximately __ohms.
A) 1.2 B) 9.7 C) 15.5 D) 23.0 E) 33.5

8. Given two light bulbs connected in series to an ideal emf. One bulb is a 100 Watt bulb and the other is a 200 Watt bulb. The current is ___
A) greater in the 200 W bulb B) the same in both bulbs C) greater in the 100 W bulb

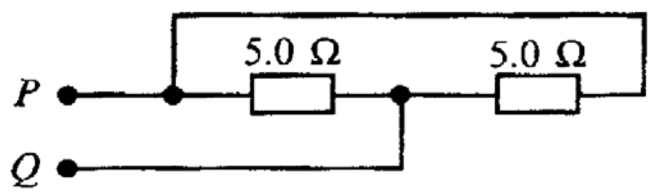
9. 2,000 N/Coul expressed in Volts per meter would be ___ V/m .
A) 20 B) 200 C) 2,000 D) 20,000 E) none of these (V/m cannot be used)

The following description and figure are to be used for question # 10.
10. Given a uniform field directed into this page. A loop of wire is in the magnetic field in a plane perpendicular to the field. The magnetic field is increasing. There is a current induced in the wire loop. The induced current is ___



A) None induced – zero
B) directed upward out of the paper
C) directed downward into the paper
D) clockwise around the loop
E) counterclockwise around the loop

The following description and figure to the right is to be used for question # 11.
11. Two 5.0 ohm resistors are connected as shown. The equivalent resistance across P and Q is ___ ohms.



A) 1.1 B) 2.5 C) 5 D) 7.5 E) 10

12. Given three charged particles (I an alpha particle, II a proton, and III an electron). The alpha particle has two positive charges and a mass about 4 times that of the proton. All three are projected at the same velocity into a uniform magnetic field. They move perpendicular to the magnetic field. All three move in circular paths. Rank order the particles in descending order on the basis of the magnitude of the radius of the circle they travel. List first the largest radius. If a tie, use an equals sign.

A) I, II, III B) III, II, I C) I = II, III D) III, II = I E) I, III, II

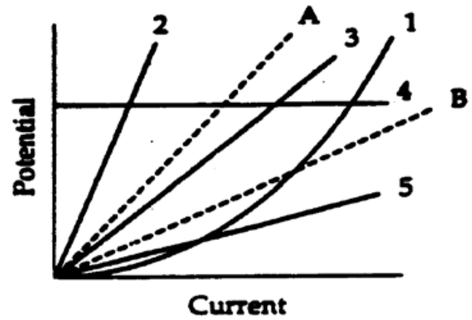
The description below is to be used for questions 13 and 14
13, 14 . Given four point charges , each located at a corner of a square. The order of the charges around the square is +q, -q, -2q, and +2q. That places +q and -2q at the ends of one diagonal, and –q and +2q at the ends of the other diagonal. The length of a side is L. The length of a diagonal is 1.41 L
13.The magnitude of the electric field, E, at the center of the square is ___ kq/L^2
A) 8.5 B) 6.7 C) 5.0 D) 3.3 E) 0.33

14. The electric potential is zero at the midpoint of the side connecting charges ___
A) none of the sides B) +q to –q, and +2q to -2q, C) +q to +2q D) -q to -2q

The following description and figure are to be used for question 15 below.

15 Given graphs below of "Potential Difference as a function of current" for two resistors, resistors A and B. The dashed lines represent data for resistors A and B. If resistors A and B are placed in series, which of the five solid lines would represent the data for the series combination? ___

A) 5 B) 4 C) 3 D) 2 E) 1



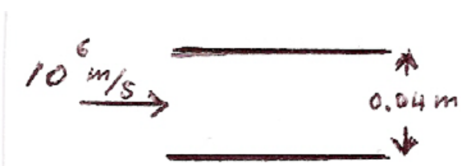
16. A proton and an electron are accelerated from rest and each reaches a velocity of 1,000,000 m/s.
A) The proton gains more energy than the electron and in less time
B) The electron gains more energy than the proton and in less time
C) The proton and the electron gain the same amount of energy and have the same speed.
D) The proton and the electron gain the same speed but the electron requires less time.
E) The proton and the electron gain the same speed and in the same time.

The following description is to be used for question 17.

17. Given three thin walled hollow metal spheres. Sphere one, S1, has a radius of 0.12 m. Sphere two, S2, has a radius of 0.08 m . Sphere three, S3, has a radius of 0.04 m . The spheres are not touching each other and are uncharged. A charge Q is placed on sphere one (S1) giving it a potential difference V. Sphere one touches sphere two. They are separated and sphere two touches sphere three. The spheres are separated. At a point 0.02 m from the center of sphere three, the electric potential difference is ___ .

A) zero B) 2V/5 C) V/2 D) V E) 2V

The following description and figure are used for questions 18, 19, 20,



18, 19, 20 Given a parallel plate capacitor with air or a vacuum between the plates. The plates of the capacitor are horizontal. They are squares, 0.10 m on a side , and are thin. An emf is attached to the capacitor fully charging the capacitor. The emf is removed once the plates are fully charged. Assume the resulting electric field in the space between the plates is uniform. The plus terminal of the emf is attached to the lower plate of the capacitor, and the negative terminal is connected to the upper plate. The plates are 4.0 cm (0.040 m) apart. The magnitude of the uniform electric field between the plates is two thousand Newtons per Coulomb (2 000 N/C). An alpha particle is moving horizontally toward the middle of the gap between the plates as shown. When the alpha particle enters the uniform field, the alpha particle has a velocity of 1,000,000 m/s (10^6 m/s). Consider the charge on the alpha particle to be 3.2 x 10^{-19} Coulomb and 6.8 x 10^{-27} kg as its mass.

18. The particle is deflected upward as it moves in the electric field. The vertical component of its velocity when it impacts the upper plate is approx. ___ m/s

A) 723,000 B) 63,000 C) 4,200 D) 2,999 E) never hits

19. The particle had been accelerated from rest to the 10^{+6} m/s velocity . The potential difference that produced this velocity was approximately ___ volts.

A) 10^{+3} B) 10^{+4} C) 10^{+5} D) 10^{+7} E) 10^{+9}

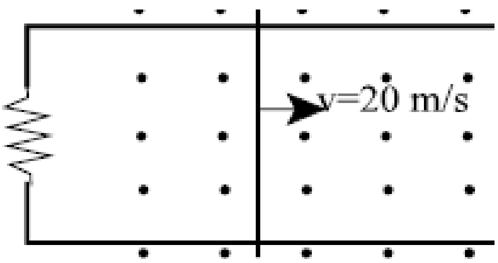
20. A uniform magnetic field is applied in the region of the electric field to offset the deflection by the electric field and allow the particle to move horizontally undeflected through the fields. The magnetic field would be approximately __ T .

A) 0.002 B) 0.2 C) 2.0 D) 2,000 E) 20,000

21. Given a 0.002 Farad(F) parallel plate capacitor with a vacuum or air gap between the plates. The capacitor is charged to 100 V. The plates are square and separated by a gap of 0.00001 m. The charge on the positive plate is ____ Coulomb. A) 0.2 B) 100 C) 5,000 D) 100,000 E) 10^{+16}

The following description and figure are used for questions 22, and 23

22, 23 Given a 0.02 kg wire rod moving to the right at a speed of 20.0 m/s on a pair of horizontal parallel frictionless metal rails. The rails are 2.0 m apart . There is a magnetic field in the region pointing vertically upward, and perpendicular to the velocity of the rod (upward and out of the page). The magnitude of the magnetic field is 5.0 Tesla. A resistance of 800.0 ohms joins the two rails.

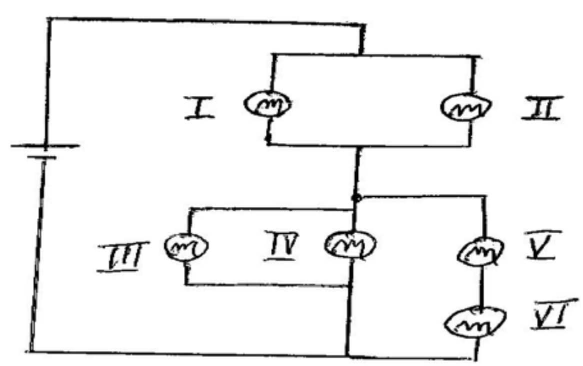


22. While the rod is moving , the current in the 800.0 ohm resistor is approximately ___ A .
A) 0.05 B) 0.10 C) 0.25 D) 0.50 E) 20.0

23. Given the same apparatus except the rod is at rest on the rails. The resistor, rails, and rod form a loop. The area of the loop is 80.0 m^2 . The loop is entirely in the magnetic field. At time equals zero the magnitude of themagnetic field is 5.0 T . The magnetic field decreases at a rate of 0.5 T/s .
While the magnetic field is decreasing, the current in the resistor is ___ A .
A) zero B) 0.002 C) 0.05 D) 1.00 E) 40.0

The following figure and description are used for ques. 24, and 25.

24, 25 Given six identical light bulbs wired as shown. Consider the resistance of each bulb to be R. They are connected to an ideal emf. Charge is flowing in the circuit, lighting the bulbs



24. The equivalent resistance for the 6 bulbs is ___ R.
A) 5/6 B) 9/10 C) 3 D) 4 E) 6

25. If bulb V burns out, the current through bulb II will ___ .
A) cease B) decrease C) remain the same D) increase, but not double E) double

SECOND YEAR PHYSICS TEST – MARCH 2014

Answer Key: <u>Golden Rod test</u>

Corrections (   )

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

PHYSICS 11 Second year, but not Physics C (Calculus) 25 multiple choice questions per exam.

JANUARY*: Vectors, kinematics, Newton's laws of motion, work, energy, power, systems of particles, linear momentum, conservation of linear momentum, collisions*

FEBRUARY: (approx. 50% of the test) Uniform circular motion, torque and rotational statics, angular momentum, conservation of angular momentum, simple harmonic motion, mass on a spring, pendulum, Newton's law of gravity, circular orbits of planets and satellites, (approx. 50% of the test) Fluid mechanics including pressure, buoyancy, fluid flow continuity, and Bernoulli's equation, Temperature, heat, Ideal gases, 1st and 2nd laws of thermodynamics.

MARCH: Electricity and Magnetism: electrostatics, Coulomb's Law, electric field, electric potential, conductors, capacitors (no dielectrics), current, power, resistance, DC circuits (not Kirchhoff's Laws, not RC circuits), batteries, capacitors in steady state circuits, parallel plate capacitors, forces on moving charges, forces on current-carrying wires in magnetic fields, magnetic fields, induction, Faraday's law, and Lenz's law.

APRIL: Wave motion, sound, standing waves, superposition, geometric optics including reflection, refraction, mirrors and lenses. Physical optics including interference, diffraction, dispersion and spectrum

Dates for 2014 Season

Thursday March 13, 2014   Thursday April 10, 2014

All areas and schools must complete the last exam and mail in the results by April 25th, 2014

New Jersey Science League

PO Box 65 Stewartsville, NJ 08886-0065

phone # 908-213-8923 fax # 908-213-9391 email newjsl@ptd.net **Web address: www://entnet.com/~personal/njscil/html**

PLEASE RETURN THE AREA RECORD AND ALL TEAM MEMBER SCANTRONS(ALL STUDENTS PLACING 1ST, 2ND, 3RD, AND 4TH).

If you return scantrons of alternates, then label them as <u>ALTERNATES</u>.

Dates for 2015 Season

Thursday January 8, 2015   Thursday February 12, 2015

Thursday March 12, 2015   Thursday April 9, 2015

SECOND - YEAR PHYSICS EXAM APRIL 2014

DIRECTIONS: Please check to see that your copy of this exam has 25 questions. For each statement or question, completely fill in the appropriate space on the answer card. Use the letter preceding the word, phrase, or figure which best completes the statement or answers the question. Each question is worth 4 points. Use 3.00 X 10^8 m/s as the speed of light in a vacuum, 9.8 m/s^2 as the acceleration due to gravity, and 3.1416 for PI or π

1. The image formed by a single convex mirror of a real object can be ___.
A) real and reduced B) real and enlarged C) real and same size as object
D) virtual and reduced E) virtual and enlarged

2. A positive lens in air is made from a glass with an index of refraction of 2.0 . If the index had been 1.5, the focal length would have been ___ .
A) the same B) less, but not half C) halved
D) doubled E) increased but not double

3. The addition of waves is called _____ .
A) Refraction B) Reflection C) Aberration D) Superposition E) Umbra

4. When sound goes from a medium in which its speed is v into a medium in which its speed is v/2, its frequency _____.
A) doubles
B) is the square root of 2 times its original value
C) equals its original frequency divided by the square root of 2
D) is halved
E) remains the same

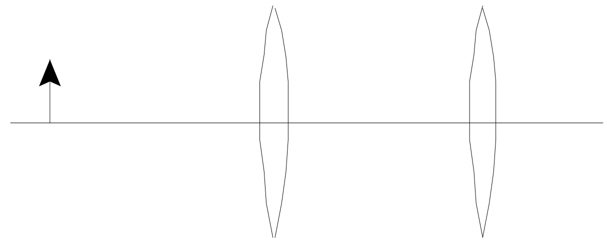
5. Given a superposition of two sinusoidal waves seen below. The superposition represent

A) a standing wave B) beats C) resonance
D) impedance E) light of different frequency

6. The image formed on the retina of the eye is always ___
A) 0.001 the size of the object
B) farther from the eye's lens than the object
C) erect
D) real
E) larger than the object

The following description and figure are used for questions 7, 8, and 9

7-9 Given a small arrow object 0.04 m tall. It is placed 0.075 m to the left of a thin positive lens of focal length 0.15 m. A second thin positive lens with a focal length of 0.20 m, is placed 0.45 m to the right of the first lens. The lenses and the object are in air. The principal axes of the lenses coincide. The small object is also on that principal axis .



7. The final image formed by this combination of lenses compared with the original small object is ____.
A) real and inverted B) real and erect
C) virtual and inverted D) virtual and erect E) no image is formed

8. The magnitude of the distance of the final image from the right hand lens is___ m .
A) 0.14 B) 0.30 C) 0.55 D) 0.60 E) no image

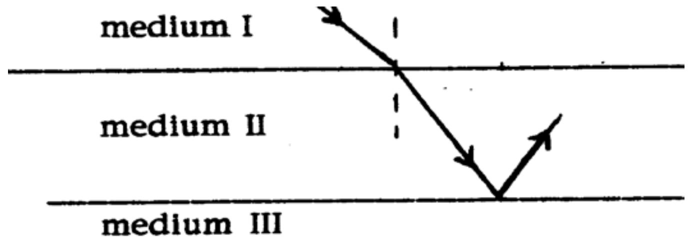
9. If the two lenses are placed touching each other to form a rudimentary compound lens, the approximate focal length for this compound lens would be approximately.___ m .
A) 0.300 B) 0.141 C) 0.086 D) 0.052 E) 0.042

10. An unpolarized beam of light from a common incandescent lamp strikes a perfect polaroid polarizer. The preferred plane for this filter is vertical. The intensity of the beam striking filter one is I_0. It is I_1 after leaving the filter. The light from filter one strikes filter two which has a preferred plane orientation 30.0 degrees to that of filter one. The intensity of the beam leaving filter two is ____ percent of that of the original beam intensity, I_0 .
A) 267 B) 87 C) 71 D) 50 E) 38

11. Given two tuning forks which when sounded individually produced about the same volume. The frequencies of the forks are 240 Hz and 250 Hz. When sounded together they produce a note of 245 Hz which has ______ beats.
A) 1 B) 5 C) 10 D) 15 E) 20

The following description and figure are used for question 12

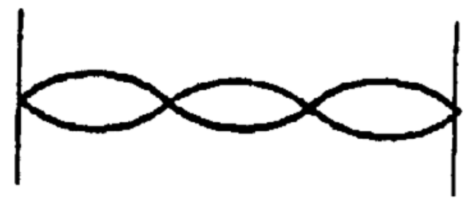
12. Given a beam of light in medium I. The beam passes into a second medium, II, and has a total internal reflection when it tries to pass from medium II into a third medium, III. The speed of light in each medium is vI, vII, and vIII respectfully. The faces of the media where they meet are flat. The figure below represents the path of the beam. The speed of the light in the first medium, medium I is ___ the speed in medium III.



A) greater than B) equal to C) less than
D) not enough data to tell

The following description and figure are used for questions # 13, 14, and 15.

13, 14, 15 Given a light string in tension vibrating in a transverse standing wave. The standing wave formed by the string has three loops, as shown below. Three meters of string are in vibration. The vibration rate is 160.0 Hz. The amplitude for the motion is 3.0 cm (0.03m). The string's linear density is 1.40×10^{-4} kg/m. The speed of sound in the room is 340 m/s . Consider the string's ends as nodes.



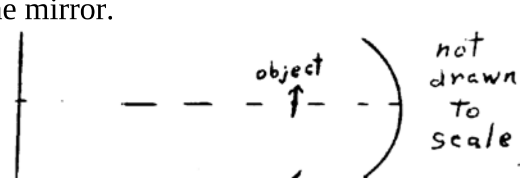
13. The frequency of the note in the air produced by the vibrating string is ___ Hz .
A) 53.0 B) 70.7 C) 106 D) 160 E) 225

14. The speed of the wave on the string is ____ m/s .
A) 600 B) 320 C) 280 D) 240 E) 200

15. The frequency required to produce a standing wave of two loops is ___ Hz .
A) 71 B) 107 C) 141 D) 160 E) 320

The following description and figure are used for questions 16, 17, 18, 19, and 20.

16-20 Given a concave spherical mirror with a 0.04 m tall object that is 0.6 m from the mirror. An image is formed on a screen 3.0 m from the mirror.



16. The magnitude of the radius of curvature of the mirror is approximately ___ m .
A) 0.33 B) 0.60 C) 0.67 D) 1.00 E) 1.50

17. The image on the screen is __
A) real and inverted B) real and erect C) virtual and erect
D) virtual and larger E) virtual and reduced

18. If the screen were removed, the image formed by the mirror ___ .
A) would be moved closer to the mirror B) would be moved further away from the mirror
C) would be in its original position D) would be virtual and larger
E) no sharp image can be formed

19. If the screen were returned to its original location, but the top half of the mirror were removed, in order to obtain a sharp image of the object on the screen, the screen __.
A) would be moved closer to the mirror
B) would be left in its position
C) would be moved further away
D) no sharp image can be formed of the entire object, only half.
E) no sharp image can be formed of the entire object, only one-quarter.

20. If the object, screen, and mirror were placed in water with the object remaining 0.60 m from the mirror, the location of the image would be ___ .
A) 2.00 m from the mirror B) closer to the mirror , but not 2.00 m
C) 3.67 m from the mirror D) further from the mirror, not 3.67 m
E) the same, 3.00 m from the mirror.

The following description is used for questions 21, and 22.
21-22. Given a "point" sound source radiating a single frequency equally in all directions. At 2.0 m from the source, the intensity of the source is 0.040 W/m^{+2}.
21. The intensity of the source at 6.0 m from the source is ___ W/m^{+2}
A) 0.0015 B) 0.0044 C) 0.025 D) 0.040 E) 0.16

22. The source's power is approximately __ W .
A) 16 B) 8 C) 5.6 D) 4 E) 2

The following description is used for questions 23 and 24.
23 -24 Given a monochromatic coherent light beam which passes through a double slit. The double slit forms an interference pattern on a screen. The pattern has maximums 0.03 m apart.

23. If light with twice the frequency had been used, the maximums would have been ___ m apart.
A) 0.15 B) 0.09 C) 0.06 D) 0.03 E) 0.015

24. If the original light were used but the screen was half as far away, the separation between interference maximums would ____.
A) double B) increase but less than double C) be the same
D) be halved E) decrease

25. A monochromatic beam of light is incident upon a transmission diffraction grating producing Fraunhofer diffraction. The wavelength in a vacuum of the beam is 6.0×10^{-7} m. The second order diffraction maximum of the 6.0×10^{-7} m light is formed at an angle of 45 degrees. The first order maximum for the 6.0×10^{-7} m light will be at an angle of _____ degrees.
A) 14.1 B) 20.7 C) 22.5 D) 33.3 E) 45.0

SECOND YEAR PHYSICS TEST –APRIL 2014

Answer Key : Golden Rod Test

Record onto the area record the % correct

Correct ans ( )

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

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Thursday April 10, 2014

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