SECOND YEAR PHYSICS TEST - JANUARY 2012

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. Sketches are not to scale.

1. Given a 0.200 kg point mass that is projected straight upward in the air with an initial speed of 10.0 m/s. The magnitude of the momentum of the mass when it is at half its maximum height is ___ kg m/s.

A) 0.14 B) 0.20 C) 1.00 D) 1.41 E) 2.28

2. Two small masses of mass 0.500 kg each are moving on a frictionless flat surface at 2.0 m/s. Midway between them is a “massless” spring with a force constant of 100N/m. The masses strike the spring at the same time and compress the spring, finally coming to rest before they rebound. The spring’s compression when the masses come to rest is ___ m .

A) 0.14 B) 0.20 C) 0.28 D) 1.41 E) 2.28

3. Given a simple pendulum consisting of a small mass, point mass, of 0.60 kg attached at one end to a very light cord. The cord is 0.50 m long. The opposite end of the cord is attached to a rigid point so that the pendulum can swing. The cord is pulled taught and the mass is raised so that the cord is horizontal. The mass is released from rest. At the low point of the swing of the mass with the cord vertical, the mass has a head-on collision with a 0.90 kg mass that is at rest on a horizontal frictionless surface. As a result of their collision, the speed of the 0.90 kg mass is 2.0 m/s and the speed of the 0.60 kg mass is ___ m/s .

A) 0.13 B) 0.20 C) 0.28 D) 1.31 E) 2.8

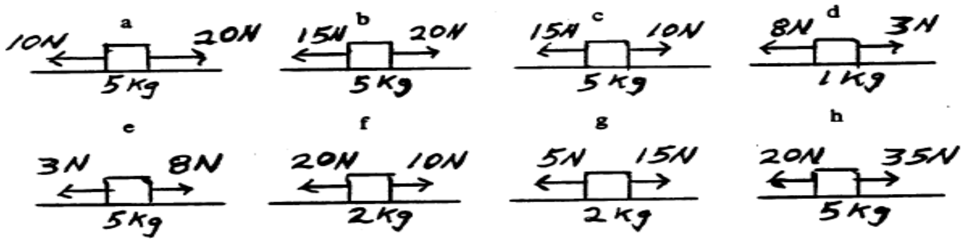
4. Given a 1000 kg object with a speed of 4.0 m/s moving to the right. It makes a right-angle turn resulting in it moving 2.0 m/s at the end of the turn. The 90 degree turn requires 3.0 seconds. The magnitude of the average force required for the turn was approximately ___ N.

A) 2500 B) 2000 C) 1500 D) 1000 E) 500

5. For a frame of reference to be an “inertial frame of reference” it must have ___ with respect to another frame of reference.

A) increasing acceleration B) increasing velocity C) constant acceleration
D) constant velocity E) decreasing acceleration

6. The eight figures below represent eight blocks moving to the right at 10.0 m/s on a horizontal frictionless surface when time is zero. Five have masses of 5.0 kg; two have masses of 2.0 kg; one has a mass of 1.0 kg. Neglect friction with the air. A pair of forces as indicated in the figures is applied to each block at time zero. Rank order the blocks on the basis of the magnitude of the velocity of each block when time is 2.0 seconds. Rank order in descending order with the largest first. Use the equals sign, = , to indicate a tie in the ranking.



A) g, h, a, d=f, b=e, c   B) d=f, g, h, b=e, a, c
C) g, h, a, b=e, c, d=f   D) d, g=f, h=e=c=b=a
E) none of the choices are correct

7. Given a 1.0 kg block. It is projected up an inclined plane and slides 4.0 m up the plane. It comes to rest and slides back down to its starting point. The coefficient of friction between the block and the plane is 0.25 . The time for the block to slide back down the plane ___ the time to slide up the plane.
A) is more than B) equals C) is less than
D) Cannot be determined without knowing the starting speed of the block
E) Cannot be determined without knowing the ending speed of the block

8. Given two blocks of equal mass of 2.0 kg . One is placed upon the other. They are moving on a horizontal plane at 1.15 m/s . The coefficient of static friction between the blocks is 0.25 and of kinetic friction between a block and the plane is 0.20 . The magnitude of the maximum deceleration that the lower block can have in slowing to rest without the upper block sliding off is ___ m/s^2 .
A) 0.49 B) 1.41 C) 1.96 D) 2.45 E) 3.05

9. A 2.2 m long light cord is attached at its ends to two fixed points. A 40.0 kg mass is suspended from the cord's midpoint. The maximum tension possible in the cord is 900 N . The minimum angle with the horizontal possible with this cord is ___ degrees . A) 2 B) 6 C) 13 D) 20 E) 24

The following table and description are used for questions 10 through 12.
10 - 12 Given the table below which is a record of velocity in meters per second as a function of time in seconds for the rectilinear motion of a 2.0 kg mass at point zero at time equals zero.

Time (s)	0.00	1.00	2.00	3.00	4.00	5.00	6.00
Velocity (m/s)	2.0	6.0	14.0	26.0	42.0	62.0	86.0

10. In the 6.0 seconds the mass moved approximately ___ m .
A) 265 B) 260 C) 190 D) 160 E) 140
11. The average net force on the 2.0 kg mass for the 6.0 second time interval was ___ N .
A) 28.0 B) 31.0 C) 44.0 D) 50.5 E) 84.0
12. If the mass had been doubled (4.0 kg instead of 2.0 kg) and the same force were applied for the 6.0 s, the final kinetic energy of the mass would be approximately ____ its value when the mass had been 2.0 kg.
A) double B) the same as C) three-fourths D) one-half E) one -quarter

13. Given three blocks placed in a line on a horizontal surface. They are in contact with each other. The left one has a mass of 2.0 kg. The middle one has a mass of 4.0 kg and the right one a mass of 6.0 kg. The coefficient of friction between the blocks and the surface is 0.20 . A horizontal force of 60.0 N is applied to the left block moving all three blocks to the right. The force from the 2.0 kg block on the 4.0 kg block is ___ N .

A) 50.0 B) 45.0 C) 40.0 D) 38.0 E) 32.0

14. An object travels 10.0 m at 36.8 degrees, then 20.0 m at 270.0 degrees, and then 30.0 m at 135.0 degrees. The time for the total trip was 15.0 seconds. The average speed for the trip was approximately ___ m/s .

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

15. A person is sliding down a long cord. (neglect the weight of the cord) The person clasps the cord softly and accelerates downward. The person grasps the cord harder and harder, until the tension in the cord equals the person's weight. When the tension equals the person's weight, the person ___

A) accelerates at the acceleration of gravity.
B) accelerates at half the acceleration of gravity.
C) stops
D) slows
E) descends at constant velocity

16. A small mass, m, is projected horizontally. It hits a vertical surface of mass M. It rebounds and falls to the ground. The magnitude of the force of the vertical surface on the small mass ___ the magnitude of the force of the small mass on the vertical surface.

A) is greater than B) is equal to C) is less than D) is m/M E) is M/m

17. At time equals zero, an outside construction elevator is 10.0 m above the ground. It is rising with an upward speed of 2.0 m/s and an upward acceleration of 3.0 m/s^2 . A person on the elevator projects a ball upward at a speed of 4.0 m/s relative to the elevator. When time is 2.0 seconds, the ball is ___ m above the ground.

A) zero (it hits the ground) B) 2.4 C) 12 D) 21.6 E) 31.6

18. A person wants to cross a stream of water in the shortest time possible. The downstream speed of the water is 5.0 m/s . The stream is 40.0 m wide. The maximum speed of the boat relative to the water is 10.0 m/s . To cross in the minimum time the person heads the boat ___ .

A) 30 degrees upstream B) 60 degrees upstream C) 30 degrees downstream
D) 60 degrees downstream E) straight toward the other side of the stream

19. A person at rest on a train flips a coin up in the air. It rises 1.0 m and returns. He catches it upon its return down. The train is moving at 5.0 m/s eastward. A second person, who is on the train platform and therefore off the train, is 10.0 m from him when the coin is flipped and walking at 2.0 m/s westward. The two persons are ___ m apart when the coin is caught.

A) zero B) 2.1 C) 3.7 D) 5.4 E) 6.3

20. Given a 2.0 kg block resting on a horizontal surface. The coefficient of static friction between the block and the surface is 0.30 and the coefficient of kinetic friction is 0.20. A 0.005 kg bullet is fired horizontally and enters the block travelling at 70.0 m/s, embedding itself in the block.
The kinetic energy of the block with the bullet inside is initially ___ J .

A) 12.2 B) 6.1 C) 0.35 D) 0.18 E) 0.03

The following description is to be used for ques. 21 through 25.
21-25 A 2.0 kg block is held at rest at the top of an inclined plane 10.0 meters long, the upper end being 6.0 meters above the lower end (i.e. inclined at an angle of approximately 37 degrees with the horizontal). A force, F, **down the plane** along the plane is applied to the block as it is released. After the block travels from rest down the plane for 5.0 meters, the force stops and the block continues down the plane. When at the 5.0 meter mark, the block was moving at 8.16 m/s downward along the plane. At the 7.5 meter mark the block is moving at 9.35 m/s along the plane. There is constant friction over the plane's length.

21. The coefficient of sliding friction between the block and the plane is approximately ___ .

A) 0.10 B) 0.14 C) 0.18 D) 0.22 E) 0.27

22. The force, F, which was applied between the zero and the 5.0 meter mark was approximately ___ N.

A) 25 B) 20 C) 15 D) 10 E) 5

23. At the 10.0 meter mark the block would be moving at approximately ___ m/s .

A) 10.4 B) 11.0 C) 11.3 D) 11.9 E) 12.3

24. It required __ seconds to travel from the 0.0 m mark (the top of the plane) to the midpoint of the plane, (the 5.0 m mark).

A) 0.6 B) 1.0 C) 1.2 D) 1.4 E) 1.6

25. If the applied force down the plane were zero (that is, not applied), the time for the 2.0 kg block to travel from the 0.0 m mark to the 10.0 m mark would require ___ the original value when the force was applied.

A) one-quarter the time B) less time than C) the same time as
D) more time than (but not double) E) more than double the time

SECOND YEAR PHYSICS TEST - JANUARY, 2012

Answer Key

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

***PHYSICS II 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

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.

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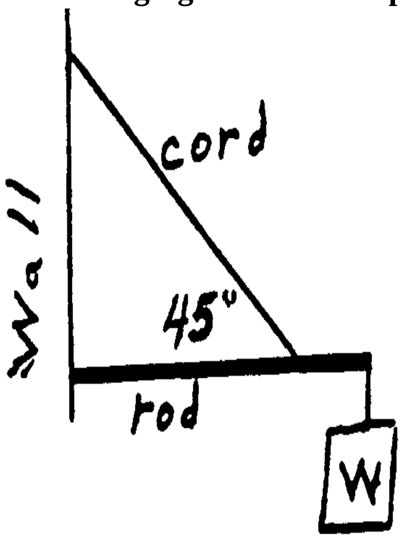
SECOND YEAR PHYSICS TEST - FEBRUARY 2012

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 value of the acceleration due to gravity. Unless otherwise stated assume ideal conditions including no friction with the air. **Please PRINT your name, school, area, and which test you are taking onto the scan-tron.**

The following figure and description are used for items 1, 2, & 3.

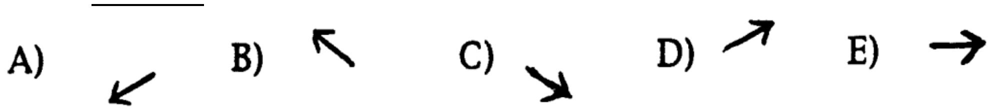


1-3 Given a horizontal 4.0 m rod with a weight of 300.0 N. The left end of the rod is attached at a wall. The center of gravity of the rod is 1.5 m from the left end. A cord is attached to the rod 1.0 m from its right end. The other end of the cord is attached to a vertical wall, and makes an angle of 45.0 degrees with the rod. A weight of 600.0 N is attached at the right end of the rod.

1.The magnitude of the tension in the cable is ___ N.

A) 600 B) 673 C) 919
D) 1100 E) 1344

2. The direction of the force from the wall on the rod at the left end of the rod is best represented by figure _______



3. If the cord were attached at the right end of the rod, but still at an angle of 45 degrees with the rod, the force exerted by the wall would be ___.

A) double B) larger, but not double C) the same
D) less, but not half E) half

The following description is used for questions 4 and 5 .

4-5 Given a 70.0 kg object whirling around in a vertical circle as a mass at the end of a light wire. When it is at the midpoint in its path between highest and lowest, its angular velocity is 0.314 rad/s . The radius of the vertical circle is 15.0 m .

4. When the object is at the midpoint in its path between highest and lowest, the magnitude of the net force on the object is ___ N.

A) 814 B) 694 C) 686 D) 678 E) 558

5. When the object is at the midpoint, its translational speed is ___ m/s .

A) 300 B) 141 C) 5.2 D) 4.7 E) 2.0

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

6-7. Given a 1.5 kg object rotating on a flat, frictionless, surface in a horizontal circle. The radius of the circle is 1.5 m. When t is zero, the object is rotating in a circle, but is slowing down at a constant rate of 0.1 radian per second per second. Between t = 0 seconds and t = 4.0 seconds, the deceleration results in the object rotating through an angle of 31.2 radians. The motion, including the slowing, continues until the object comes to rest.

6. When t was 0.0 s (zero), the angular velocity of the object was ___ rad/s .

A) 0.12 B) 8 C) 15 D) 19 E) 22

7. When t was 0.0 s, the kinetic energy of the object was approximately ___ J.

A) less than 1 B) 5 C) 108 D) 200 E) 20,000

8. Given a 30.0 N uniform horizontal rod that is 5.0 m long. The left end of the rod is point 0.0 m and the right end is point 5.0 m. Three **upward forces** are placed on the rod. 5.0 N is at the 1.0 m point; 4.0 N at the 3.0 m point; 2.0 N is at the 4.0 m point. An additional force is applied and sets the rod in both translational and rotational equilibrium. The magnitude of that additional force is approximately ___ N.

A) 19 B) 16 C) 13 D) 10 E) 7

The following description is used for questions 9, 10, and 11.

9-11. Given a small 2.0 kg mass attached to the right hand end of a "massless spring" on a frictionless horizontal surface. The left end of the spring is attached to a rigid support. The force constant, k , of the spring is 100.0 N/m (A force of 100 N is required to stretch the spring horizontally a distance of 1.0 m). The mass is initially in equilibrium and at rest. Then, it is displaced from rest a distance of 0.2 m to the right and released with an initial speed of 2.0 m/s back toward the left, toward the rigid support. The mass oscillates in simple harmonic motion.

9. At the 0.1 m mark, the acceleration of the mass is ___ m/s^2 .

A) 32 B) 22 C) 19 D) 10 E) 5

10. The amplitude for the simple harmonic motion is ___ m .

A) less than 0.3 B) 0.2 C) 0.35 D) 0.51 E) 11

11. When the object is 0.1 m from equilibrium, its speed was ___ m/s .

A) 1.4 B) 1.7 C) 2.0 D) 2.3 E) 2.8

12. Given an ideal gas under an absolute pressure of 30.0 Pascals at a temperature of 400 Kelvin. If the absolute pressure on the gas were changed to 20.0 Pascals and its temperature were reduced to 300.0 Kelvin, its volume, which originally was 1.0 liter , would be changed to ___ L

A) 1.12 B) 0.98 C) 0.89 D) 0.67 E) 0.23

The following description is used for questions 13, 14 and 15

13-15 Given a spherical planet with uniform density and a mass of 6.0 X 10^{24} kg . Its radius is 6 x 10^{6} m . A small mass of 20.0 kg is in circular orbit about the planet. The radius of the orbit is 10^{7} m about the center of the planet. The speed of the mass is 0.00063 rad/s in its orbit about the planet.

13. The kinetic energy of the mass in orbit is approximately ___ J

A) 10^{6} B) 10^{8} C) 10^{10} D) 10^{12} E) 10^{14}

14. When in orbit the centripetal force on the 20 kg mass is approximately ___ N .

A) 5000 B) 400 C) 120 D) 80 E) 46

15. If the mass of the planet had been 6.0 x 10^{24} kg, but the planet's radius were halved or 3 x 10^{6} m , the centripetal force on the mass in a 10^{7} m orbit would be ___ times its original value.

A) 0.25 B) 0.50 C) 1.0 D) 2.0 E) 4.0

The following description is used for questions 16, 17, and 18

16-18 Given a 10.0 m tall cylindrical water tank supported by legs so that the bottom of the tank is 6.0 m above the ground. The tank is filled with water to a height of 8.0 m above the bottom of the tank. The upper end of the tank is open to the atmosphere. The tank is 8.0 m in radius. There is a round hole 0.02 m in diameter in the side of the tank 2.0 m above the bottom of the tank.

16. The force on the bottom of the tank created by the water in the tank is __ N .

A) 6.2x 10^{4} B) 7.8 x 10^{5} C) 2.0x 10^{6} D) 1.6x 10^{7} E) 2.0x 10^{8}

17. The speed of the water as it exits the hole is ___ m/s .

A) 17.1 B) 13.4 C) 12.1 D) 10.8 E) 7.0

18. The water strikes the ground ___ m to the right of the hole in the tank.

A) 8.0 B) 13.8 C) 15.1 D) 16.8 E) 17.3

19. Given a 0.10 kg mass of a solid metal which is heated and placed in water. The mass is heated to a temperature of 300 degrees Celsius and placed in 0.15 kg of water that is in a container. The container is equivalent to 0.03 kg of water. Assume that no heat is lost to the surroundings nor gained from the surroundings. The original temperature of the water and container was 20.0 degrees Celsius. The final temperature of the water, container, and metal was __ degrees Celsius . The specific heat of water is 4,186 J/kg-Celsius degree. The specific heat of the metal is 390 J/kg-Celsius degree.

A) 14 B) 24 C) 29 D) 34 E) 39

Use the following information for questions 20 and 21.

20 -21 Given a flat square bottomed boat. It is constructed of thin sheets of metal. The boat is 4.0 m by 4.0 m by 2.0 m tall. It is floating in fresh water with 0.8 m under the water and 1.2 m above the water level. A load of ice is placed on the boat It now floats with 1.8 m below the water level and 0.2 m above the water level. The density of water is 1,000 kg/m^3 .

20. The mass of the boat is ___ kg .

A) 1300 B) 12500 C) 12800 D) 14100 E) 19200

21. The boat is in a very large tank. The ice is removed from the boat and slowly placed in the water in the tank. With the ice floating, the water level in the tank ___ the level in the tank when the ice was in the boat.

A) is higher than B) is 1.0 m higher than C) is the same as
D) is lower than E) is 1.0 m lower than

22. Given an ideal liquid flowing through a horizontal pipe. The pipe remains horizontal but increases in radius from 0.20 m to a larger value of 0.30 m. The volume flow rate in the smaller radius section of the pipe is 0.20 liter/second. The volume flow rate in the larger section is __ liter/s

A) 0.13 B) 0.20 C) 0.30 D) 0.45 E) 0.6

23. Given a P-V diagram. The area of the diagram represents __ .

A) temperature B) change in temperature C) force
D) momentum E) energy

24. Given a gasoline engine which absorbs heat and performs mechanical work. During each cycle of its operation the engine performs 800 J of mechanical work after it absorbs 2000 J of heat. The efficiency of the engine is ___ % .

A) 25 B) 40 C) 50 D) 60 E) You need the input temperature

25. Given a quantity of an ideal gas. If the volume of the gas increases while its pressure remains constant, the average speed of the molecules of the gas ___ .

A) decreases B) does not change C) increases

SECOND YEAR PHYSICS TEST – 9 FEBRUARY, 2012

Answer Key

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

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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

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.

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SECOND YEAR PHYSICS TEST - MARCH, 2012

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/s²** as the value of the acceleration due to gravity. Unless otherwise stated assume ideal conditions including no friction with the air. Sketches are not to scale. All motion is to be treated as non-relativistic. All current, unless otherwise described, is traditional current in the direction of the flow of positive charge.

Charge on the electron = 1.6×10^{-19} Coul. Proton mass = 1.67×10^{-27} kg Electron mass = 9.1×10^{-31} kg $k = 9 \times 10^{+9}$ Newton-meter^{+2}/ Coul^{+2} Wires and switches have no resistance.

1. Given a charged particle moving in a circular path in a plain perpendicular to a uniform magnetic field. Of the following four quantities, which remain constant as the particle goes around in circular motion.

I. radius of its circle II. momentum III. energy IV. time for a revolution

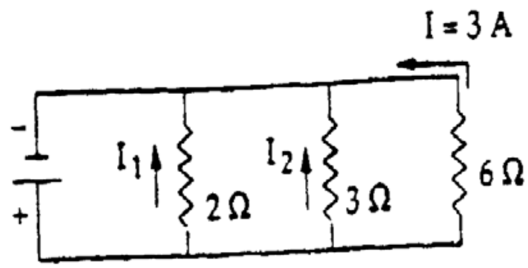
A) All four B) I, II, and III C) I, II, and IV D) I, III, and IV E) I only

2. The unit Farad could be expressed ___

A) Coulomb/Volt B) Volt Coulomb C) Ampere Volt

D) Ampere second E) Volt/Coulomb

The following description and figure are to be used for question #3 below.



3. Given three resistors, (2 ohms, 3 ohms, and 6 ohms , arranged in parallel with an ideal emf. The directions of the currents in the resistors are shown. The current is 3 amperes in the 6 ohm resistor.

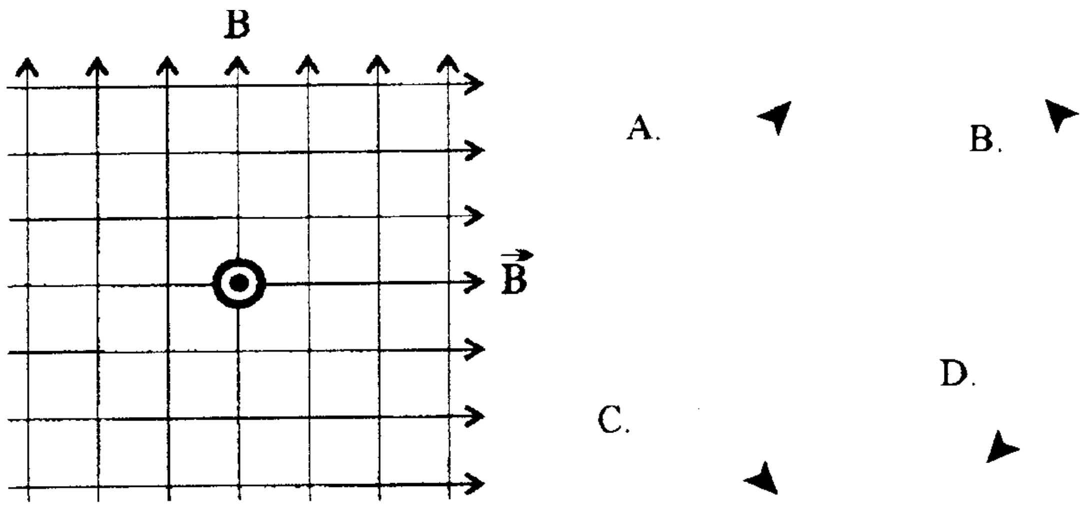
The equivalent resistance of the three resistors is ___ ohm(s) .

A) 18 B) 11 C) 9 D) 61 E) 1

4. Electric field lines ____ .

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

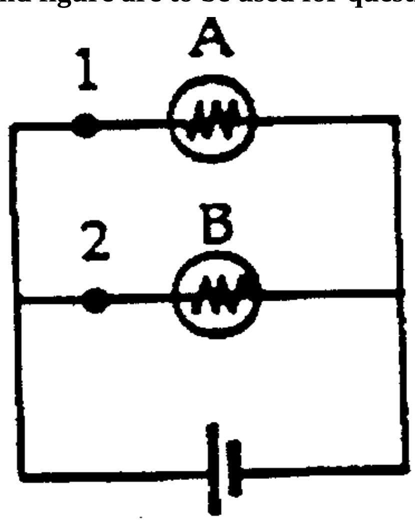
The following description and figures are to be used for question #5 below.



5. Given a vertical straight wire placed in a horizontal magnetic field. The wire has a constant current pointing upward perpendicular to the page. The magnetic field is formed by two horizontal uniform magnetic fields. One magnetic field points south to north while the other points west to east (they are perpendicular to each other). As a result, there is a force on the vertical wire. The force is in the direction indicated by arrow ___ .

A) A B) B C) C D) D E) no force

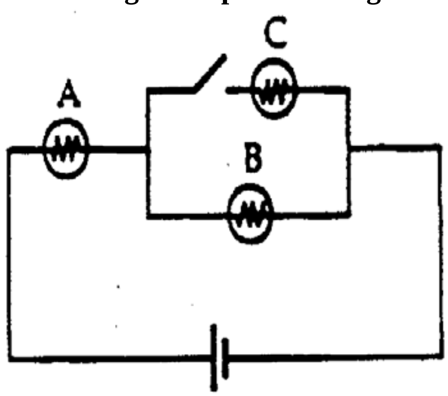
The following description and figure are to be used for question #6 below.



6. The figure above represents two identical light bulbs, A and B, that are connected to an ideal emf. Then, a very low resistance wire is attached joining points 1 and 2. As a result, ____.

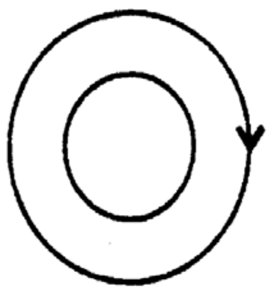
A) the brightness of the bulbs is unchanged
B) neither bulb lights
C) the brightness of A and B increases
D) the brightness of A and B decreases
E) the brightness of A increases and of B decrease

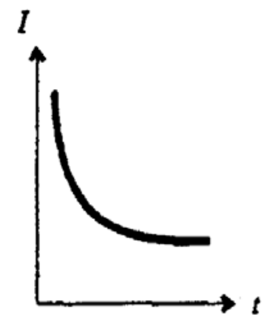
The following description and figure are to be used for the question below, question 7



7. Given three identical light bulbs connected with a switch and ideal emf as shown.
When the switch is closed, the brightness ___ .
A) of A decreases and of B decreases
B) of A increases and of B is unchanged
C) of A increases and of B increases
D) of A increases and of B decreases
E) of A and of B does not change

The following description and figures are to be used for the question #8





8. Given two concentric horizontal wire circles as shown. There is a clockwise current in the outer wire. The current is decreasing exponentially with time. As a result, a current is induced in the inner circle. The induced current is __

A) in the clockwise direction and increasing
B) in the counterclockwise direction and increasing
C) in the clockwise direction and decreasing
D) in the counterclockwise direction and decreasing
E) --- no current is induced ---

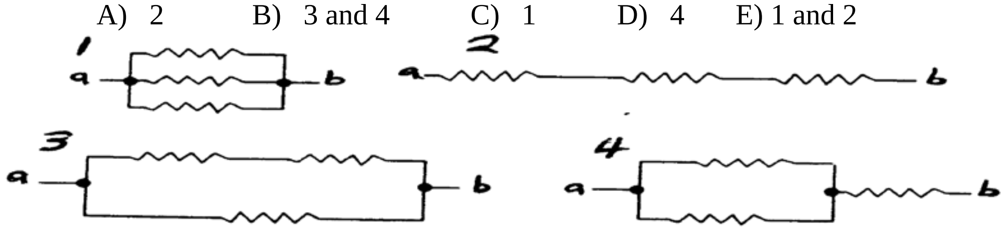
9. Given two parallel plate capacitors with a vacuum between the metal plates. The plates are squares with equal sides. Capacitor one, C1, has a plate separation half the plate separation between the plates of capacitor 2, C2 . Equal charges are placed on the capacitors. The potential difference across the plates of capacitor one is___ times the potential difference across the plates of capacitor two.

A) 4 B) 2 C) 1 D) 0.5 E) 0.25

The following description and figures are to be used for the question below, question 10

10. Given three identical resistors arranged in different circuits. If an ideal emf is applied across points a and b in each circuit, for which of the four arrangement(s) of the three resistors shown below will the potential difference be the same across each resistor in the circuit? Only circuit(s) ___

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



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

11, 12 Given three thin walled hollow metal spheres. Sphere one, S1, has a radius of 0.04 m. Sphere two, S2, has a radius of 0.08m, Sphere three, S3, has a radius of 0.12 m . They are in contact and charged so that each has a potential difference of V volts. The charge on S1 is Q . The spheres are separated.

11 At a point 0.04 m from the center of sphere two the potential difference is ___ Volts .

A) zero B) V/4 C) V/2 D) V E) 2V

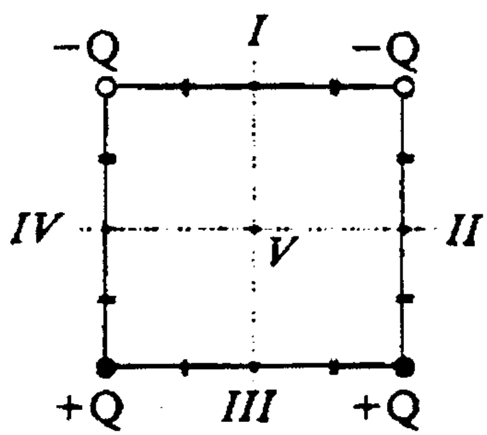
12. Determine the electric field strength 0.06 m from the center of each sphere. Rank order in descending order the magnitudes of the electric field strength, E1, E2, E3,of spheres S1, S2, S3, respectively, placing the largest first. Indicate a tie with an equals sign (=)

A) E1, E2, E3 B) E1 = E2 = E3 C) E1, E2 = E3 D) E1 = E2, E3 E) E2 = E3, E1

13. Two charged particles held close to each other are released. As they move, the force on each particle decreases. Therefore, the charges on the particles __

A) must both be positive
B) must both be negative
C) must both have the same sign, either both positive or both negative
D) must have opposite signs
E) could have opposite signs or only one is charged

The following description and figure are to be used for question #14 below,

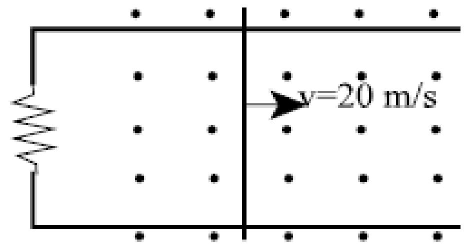


14. Given a square with charges of equal magnitude at its corners. The charges at the lower corners are positive, while those at the upper corners are negative. Given five points as shown. Four are at the midpoint of the sides of the square. Point V is at the center of the square.
Rank order in descending order the magnitude of the electric field strength at each of the five points, placing the largest first. Indicate a tie with an equals sign (=)

A) V, IV, III , II, I B) IV = II, V, I = III

C) IV = III, V, I = II D) V, IV = II, III = I E) I = II = III = IV, V

The following description and figure are to be used for ques. 15 and 16



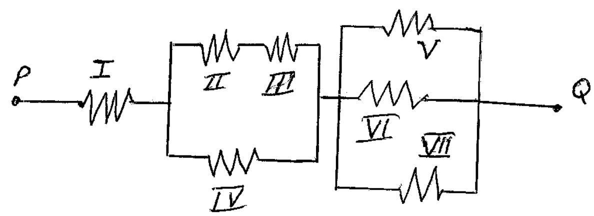
15, 16 Given a wire sliding to the right at a constant speed of 20 m/s. The wire lays across a pair of horizontal frictionless wires serving as "tracks" which are separated by 0.20 m. The wire is moving perpendicular to a vertical constant magnetic field of 2.5 Tesla pointing upward perpendicular to the page. **All** of the apparatus is in the magnetic field. The resistor in the circuit to the left is 10.0 ohms

15. The power dissipated by the 10 ohm resistor is ___ W .
A) 22 B) 10 C) 6 D) 2 E) 0.5

16. If the rails were twice as far apart and the wire joining them were twice as long, the power dissipated by the resistor would be ___ times as large as when the separation was 0.20 m .
A) 4 B) 2 C) 1 D) one-half E) one-quarter

The figure and description to the right are for questions 17 and 18

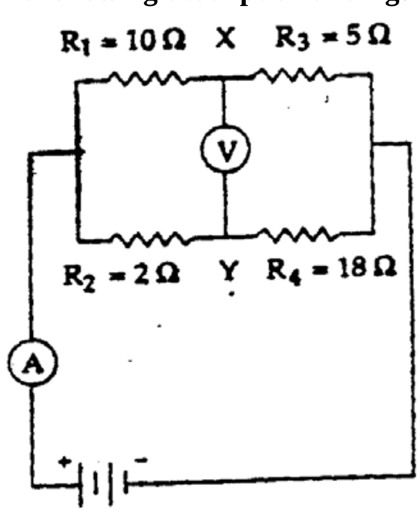
17 and 18 Given 7 resistors arranged as shown to the right. Resistors numbered 1 through 4 are ten ohm resistors. Resistors numbered 5 through 7 are twenty ohm resistors. An ideal emf of 140 volts is attached across the ends (across P and Q).of the arrangement of 7 resistors



17**.** The current from the emf is ___ A .
A) 3/140 B) 3/70 C) 1.4 D) 4.0 E) 6.0

18. If the potential difference across resistor IV (10 ohms) were 40 volts, the power dissipated by resistor VI, (20 ohms) would be ___ Watts.
A) 20 B) 40 C) 60 D) 80 E) 100

The following description and figure are to be used for the question below, question 19



19. Given four resistors joined in two parallel branches as shown. The voltmeter, V, reads 8.5 volts with point Y the plus or higher end. The current in the 2 ohm resistor is ___ A .

A) 0.5 B) 0.75 C) 1.0 D) 1.5 E) 2.0

The following description is used for questions 20, 21, and 22

20, 21, and 22 Given a vertical parallel plate capacitor. The plates are metal, square (0.05 m on a side) , and 0.02 m apart. The left plate is positive. The right plate is negative. There is a potential difference between the plates of 250 volts. Consider the field between the plates uniform and ignore any fringing at the edges. A tiny particle with a charge of 8 X 10^{-19} Coulomb and mass 10^{-20} kg and is initially at rest very near the left plate.

20. Under the effect of the field the particle moves from the left plate to the right and "crashes" into the right plate with a kinetic energy of approximately ___ J .

A) 10^{-6} B) 10^{-9} C) 10^{-12} D) 10^{-16} E) 10^{-19}

21. The magnitude of the electric field between the plates is ___ N/ Coul .

A) 12,500 B) 500 C) 120 D) 5.0 E) 0.5

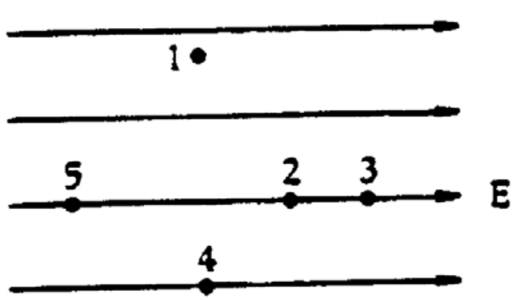
22. A proton is projected into the space between the plates. It is moving vertically downward and is perpendicular to the electric field. It enters the field just to the right of the left plate (positive) and exits the field just to the left of the negative plate. In its vertical path it descends 0.05 m while traveling a horizontal distance of 0.02 m. The proton enters the field moving at a minimum speed to achieve the path. Its speed is approximately ___ m/s The mass of the proton is 1.67 x 10^{-27} kg .

A) 10^{+7} B) 10^{+6} C) 10^{+5} D) 10^{+4} E) 10^{+3}

23. A proton and an electron are accelerated from rest by a potential difference of 1000 V.

A) The proton gains more energy than the electron and has a higher speed
B) The electron gains more energy than the proton and has a higher speed
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 amount of energy and the electron has the higher speed
E) The proton and the electron gain the same amount of energy and the proton has the higher speed.

The figure and description below are to be used for question 24



24. Given a uniform electric field pointing from left to right, as shown in the figure. At point one, P1, there is a mass m. At point two, P2, there is a mass of 2m. At point three, P3, there is a mass of 3m. At point four , P4,there is a mass 4m. At point five, P5, there is a mass 5m. There is a charge q on each mass. Rank order the points on the basis of the electric force on the mass at a given point, placing largest first. Indicate a tie with an equals sign.

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

25. Given a small metal sphere with a positive electric charge on it. A negatively charged rod is held near the sphere. A hand is placed on the sphere. The rod is removed. The hand is removed. The charge on the sphere is ___.

A) more positive than originally B) as positive as originally C) neutral
D) negative but equal in magnitude to the original positive
E) negative, but less in magnitude than the original positive

SECOND YEAR PHYSICS TEST – MARCH 2012

Answer Key

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

***PHYSICS II 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

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

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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.**

SECOND - YEAR PHYSICS EXAM APRIL 2012

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 **3.00×10^8 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. When light in medium 1 reflects from the surface of a second material (material 2), light has an 180 degree phase change ___ .
   - A) under all conditions
   - B) only when the light is red, orange, or yellow
   - C) only if the angle of incidence is less than the critical angle of the material
   - D) only if the index of refraction of medium 1 exceeds the index of med. 2
   - E) only if the index of refraction of med. 1 is less than the index of med. 2

2. Sunlight at ___ degrees above the horizon is observed to be totally polarized when reflected from a horizontal flat glass with an index of refraction of 1.5 .

   A) 56.3 B) 45 C) 33.7 D) 30 E) 28.6

3. You are standing 2.0 m from a wall mirror. You approach the mirror at a speed v. You observe the image in the mirror approaching you at a speed of ___ .

   A) 4v B) 2v C) v D) v/2 E) v/4

4. A pilot is flying an airplane. Looking out of the cabin window, the pilot sees a rainbow. The maximum possible rainbow arc that the pilot could see is ___ degrees.

   A) 45 B) 90 C) 180 D) 270 E) 360

5. Given an object 0.10 m from a spherical mirror. It is on the mirror's principal axis. The magnitude of the mirror's magnification is 2 . From this information, which one of the following statements **could be true**?
   - A) the magnitude of the mirror's focal length is 0.30 m
   - B) the image is real
   - C) the image is half as tall as the object
   - D) the mirror cannot form an image

6. A person is standing on a sidewalk. An emergency vehicle approaches and the person hears a sound of 550 Hz . The vehicle proceeds past and the person now hears a sound of 450 Hz. The speed of sound in air is 340 m/s . The speed of the vehicle was ___ m/s .

   A) 38.6 B) 34 C) 29 D) 25 E) 20

The following description is for questions 7, 8, 9, and 10

7,8,9,10 Given a 2.5 kg mass attached to a "mass less spring" and executing simple harmonic motion on a frictionless horizontal flat surface. The mass oscillates between a minimum position of – 0.20 m to a maximum position of + 0.20 m . The constant of proportionality for the motion (spring constant) is 250 N/m .

7. The frequency of the motion is approximately ___ Hz .

A) 0.6 B) 1.6 C) 2.2 D) 2.5 E) 3.1

8. When x equals 0.05 m, the acceleration of the mass is ___ m/s^2 .

A) 400 B) 10 C) 5 D) 2.5 E) 1.25

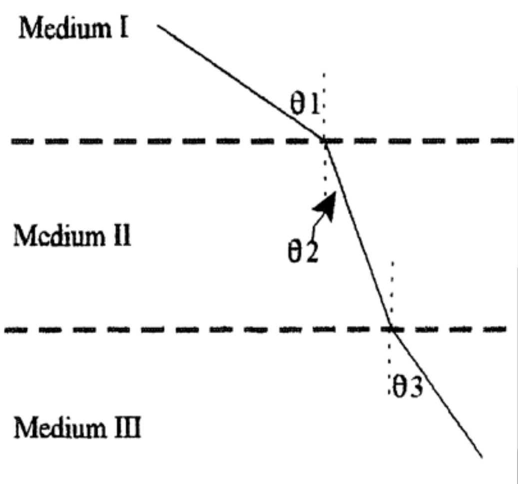
9. When time was zero, the motion was started. The mass was at the 0.10 m mark and given an initial speed of ___ m/s .

A) 5.0 B) 2.5 C) 2.0 D) 1.73 E) 1.41

10. If the amplitude for the simple harmonic motion were doubled, the frequency for the motion would be __ the original value.

A) 0.7 times B) the same as C) 1.4 times D) double E) four times

The following description and figure are for question 11 below



11. Given three homogeneous media with plane horizontal interfaces. A beam of monochromatic light passes from medium I through medium II and then into medium III, as shown to the left. The sequence which best relates the speed of light in each medium is ___ .

A) $V_I > V_{II} > V_{III}$

B) $V_{III} > V_{II} > V_I$

C) $V_I > V_{II}$, $V_{III} > V_{II}$, $V_{III} > V_I$

D) $V_I < V_{II}$, $V_{III} > V_{II}$, $V_I > V_{III}$

E) $V_I > V_{II}$, $V_{III} > V_{II}$, $V_I > V_{III}$

12. The sky appears blue because ___ .

A) the upper atmosphere has only blue molecules

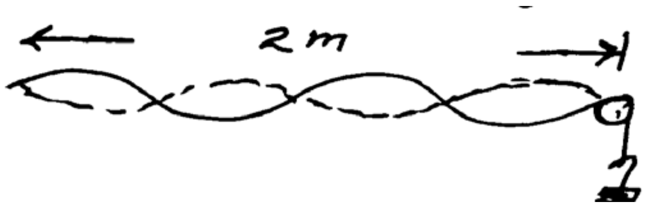
B) refraction in the atmosphere varies with temperature

C) the sun emits mostly blue light

D) the earth revolves clockwise

E) the scattering of light is greater for shorter wavelengths

The following figure and description are used for ques. 13, 14, and 15,
Given a very light taut string 2.0 m long stretched horizontally. The left end is attached to a vibrator and the right end has a mass attached. The frequency of the vibrator is 120 Hz. The linear density of the string is 1.20×10^{-4} kg/m. The speed of sound in the room is 340 m/s .



There is a standing wave with four loops on the string.

13. The wavelength of the wave on the string is ____ the wavelength of the sound which it produces in the air.
A) much less than B) approximately one-third C) the same as
D) approximately three times E) much more than double

14. The speed of the wave on the string is ___ m/s .
A) 169 B) 141 C) 120 D) 96 E) 60

15. The tension in the string is changed. It is now four times the original tension. The frequency of the vibrator remains 120 Hz . The new standing wave on the string would have ___ loop(s) .
A) one B) two C) four D) eight E) none is formed

The following description is for questions 16 and 17.
16, 17 Given two thin lenses and a small object (a small arrow pointing upward). The small object is placed 0.20 m to the left of a thin positive lens of focal length 0.30 m . A negative thin lens with a focal length of - 0.30 m is placed 0.60 m to the right of the positive 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 line.

16. 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

17. The magnitude of the distance of the final image from the negative lens is___ m .
A) none is formed B) 0.90 C) 0.60 D) 0.45 E) 0.24

18. The index of refraction of glass varies with the wavelength of light. The result of this variation is ___
A) the twinkling of stars
B) a mirage
C) chromatic aberration
D) total internal reflection
E) polarization

The following description is for questions 19 and 20.

19, 20 Given a Young's double slit apparatus. The light used consists of only one frequency. The double slit is 2.0 m from the screen. The interference pattern on the screen has maximums separated by 0.02 m . The center-to-center separation of the slits is 0.00004 m. Each slit is 0.00001 m wide.

19. The wavelength of the light is ___ x 10^{-7} m .

A) 50 B) 5 C) 4 D) 2.5 E) 2

20. If the width of a slit were doubled, the separation of the interference maximums on the screen would be ___ times the original separation.

A) 4 B) 2 C) 1 D) 0.5 E) 0.25

The following description is for questions 21 and 22

21, 22. Given an isotropic "point" sound source radiating a single frequency in all directions. At a distance of 4.0 m from the source, the intensity of the source's sound is 0.06 W/m^{+2} .

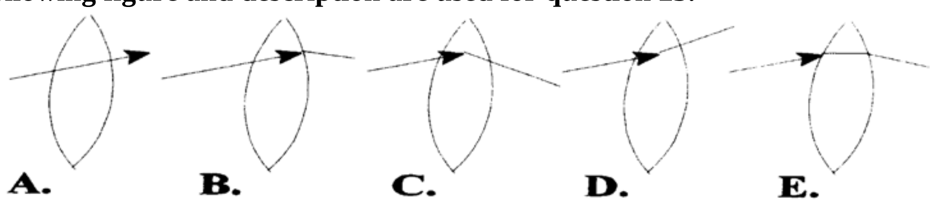
21. The dB level at that point is ___ dB .

A) 108 B) 86 C) 68 D) 62 E) 58

22. The power of the source is approximately ___ W .

A) 21 B) 18 C) 15 D) 12 E) 0.01

The following figure and description are used for question 23.



23. Given a homogeneous glass lens in air. Of the five diagrams above which diagram best represents the actual path of a ray of light through the lens and back into air? ___

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

The following description is for questions 24 and 25

24, 25. Given a transmission diffraction grating in an optical spectrometer that is set for Fraunhofer conditions. The grating produces a first order maximum at 29 degrees (to the left and to the right of the forward direction) for a wavelength of 6.0 X 10^{-7} m·

24. The second order maximum for this wavelength would be formed at approximately ___ degrees.

A) 90 B) 75 C) 60 D) 50 E) 45

25. If the grating area were doubled by adding more lines, but using the same slit width and the same separation between lines, the first order maximum would occur ___ .

A) at 58 degrees B) at approximately 43 degrees
C) at 29 degrees D) at approximately 15 degrees
E) at 7.5 degrees

SECOND YEAR PHYSICS TEST – APRIL 2012

Answer Key

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

PHYSICS II 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

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