The 62nd Annual
Merck State Science Day Competition
May 22, 2012

PHYSICS

Directions:
PLEASE DO NOT OPEN THE EXAM BOOKLET UNTIL DIRECTED.

Be sure to fill in your name on the answer sheet both by printing it in the correct space, and by filling in the corresponding letter in the provided spaces.

Use a #2 pencil only.

Carefully erase any errors, and do not make any extraneous marks on the answer sheet. You may write on the test but all answers must be recorded on the Scantron answer sheet.

The test has 60 items that will be scored. You have **90** minutes in which to answer them.

There is only one correct answer per question. Do not spend too much time on any one question. Do the items you find easier first, and then go back to those you find more difficult or time consuming during the time you have remaining. Your individual score will be computed on the basis of the number of correctly answered items. Each question counts the same. No question is weighted. (There is no penalty for guessing)

There are important subject-specific items below that you may find useful in answering certain questions. Be sure to read them before you begin the test.

Proton mass	$m_p = 1.67 \times 10^{-27}$ kg
Electron mass	$m_e = 9.11 \times 10^{-31}$ kg
Magnitude of electron charge	$q_e = 1.60 \times 10^{-19}$ C
Speed of light	$c_{\text{in a vacuum}} = 3.00 \times 10^{8}$ m/s
Coulomb's law constant	$k = 9.0 \times 10^{9}$ Nm^2/C^2
Universal gravitation constant	$G = 6.67 \times 10^{-11}$ m^3/kg-s^2
Gravitational field near Earth	g = 9.8 N/kg
	1 mile = 1.609 km
atmosphere pressure	1 atm= 1.0×10^{5} N/m^2 = 1.0×10^{5} Pa = 14.7 lb/in^2
Mean radius of the earth	$R = 6.371 \times 10^{6}$ m
Mass of the earth	$m = 5.98 \times 10^{24}$ kg
Vol of sphere	$Vol_{sphere} = 4/3\ \pi R^3 = 1.33\ \pi R^3$
Surface area of a sphere	Surface $Area_{sphere} = 4\ \pi R^2$

Merck State Science Day 2012 **PHYSICS**

Multiple Choice

Identify the letter of the choice that best completes the statement or answers the question and ***place your selection ON THE ANSWER SHEET***

Treat all questions as non-relativistic. Unless otherwise indicated ignore friction with the air. Figures are not drawn to scale.

1. Given a rectangular box with perpendicular sides, similar to a room in which the walls meet at right angles. The box with sides, length 3.20 m, width 0.80 m, and height 10.00 m , has a volume expressed to the correct number of significant figures of ____ m^{+3} .

A) 25.60 B) 25.00 C) 25.6 D) 26**.** E) 30.

The following description is to be used for questions 2, 3, and 4

Given a uniform ladder resting against a vertical smooth (frictionless) wall. The ladder has a weight of 600.0 N, is 6.0 m long, and touches the wall 4.8 m off the ground. The coefficient of static friction between the ladder's base and the ground is 0.40 . There is a 500.0 N person on the ladder. The person is 2.0 m up the ladder (1.6 m off the ground).

2. The horizontal force due to friction on the ladder is ___ N .

A) 310 B) 350 C) 400 D) 440 E) 467

3. The angle with the horizontal that is made by the force from the ground on the ladder is ___ degrees. A) 72 B) 68 C) 60 D) 53 E) 30

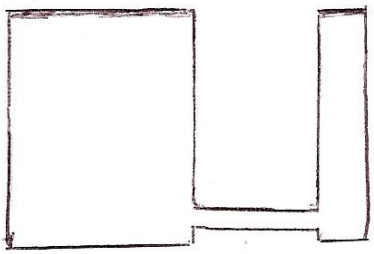
4. The person very slowly moves up the ladder. The maximum distance along the ladder that the person can move before the ladder slips and falls is __ m along the ladder.

A) 4 (all the way to the top) B) another 2 C) about another 1.4
D) another 1 E) zero, (the person is at max.)

5. Given an iceberg floating in the ocean. (The density of the ice is about 0.9 the density of the water.) Assume the upper tenth of the iceberg (the part above the water) were cut off and a reduced iceberg is formed floating in the water. The ___ .

A) the buoyant force on the iceberg would increase
B) iceberg would sink to the bottom
C) iceberg's density would decrease
D) the pressure on the bottom of the iceberg would decrease
E) the pressure on the bottom of the iceberg would increase

The following description is used for questions 6 and 7.

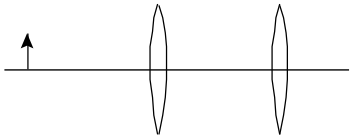


Given a Pascal's Principle device, a hydraulic lift. Two circular cylinders of equal height stand next to each other and are joined near their bottoms by a small tube. The tube is 0.02 m in diameter. The cylinders are 0.40 m tall. The cylinders and the tube are filled with water. They each have essentially friction free "massless" pistons at their tops. The diameter of the cylinder on the left is 0.20 m . It has a weight of 64.0 N placed on the piston. The diameter of the cylinder on the right is 0.05 m . To set the system in equilibrium, it has a weight on it to offset the weight placed on the left.

6. The weight placed on the piston of the smaller cylinder is ___ N .
A) 16.0 B) 12 C) 8 D) 4 E) 2

7. Because of the addition of the weights, the increase in pressure in the larger cylinder 0.01 m above the bottom is approximately ___ Pa .
A) 2000 B) 1000 C) 500 D) 250 E) 125

The following description and figure are for questions 8, and 9.
Given two thin positive lenses positioned so that their centers of curvature fall on a straight line. The focal length of lens 1, (the left lens) is 0.20 m and the focal length of lens 2, (the right lens) is 0.50 m. The lenses are 0.20 m apart. A small object is located 0.10 m to the left of lens 1. It is located on the principal axis of the lenses and is 0.01 m tall. It is erect.



8. Compared with the original object, the image formed by lens 2 is ___ .
A) real and erect B) real and inverted
C) virtual and erect D) virtual and inverted E) no image is formed

9. The image formed by lens 2 is ___ m tall.
A) no image formed B) 0.10 C) 0.45 D) 0.90 E) 1.20

10. Given a moving observer and a stationary sound source. The observer is moving toward the source at a speed of 26.8 m/s (60 miles per hour). The source is emitting a 3,000 Hz sound (as heard on the source). The speed of sound in the air is 343 m/s. The moving observer hears a frequency of approximately ____ Hz .
A) 3800 B) 3700 C) 3500 D) 3200 E) 2800

The following description and figure are for question 11.

11. Given three identical uncharged hollow metal spheres of radius 0.10 m positioned so that their centers are 2.0 m apart. A charge +Q is placed on sphere I. Spheres I and II touch, and are separated. Spheres II and III touch and are separated. The electric field strength is determined at a distance 0.04 m from the center of each sphere. (EI, EII, and EIII for spheres I, II, and III respectively**.** Rank order the field strength values in descending order, putting largest first. Indicate a tie with an equals sign, = . A) EIII, EII, EI B) EI, EII, EIII
C) EI, EII = EIII D) EI = EII = EIII E) EII = EIII, EI

The following description and table are for questions 12 and 13.

object #	1	2	3	4	5	6	7	8
mass, kg	1.0	2.0	3.0	4.0	1.0	2.0	3.0	4.0
force, N	4.0	3.0	2.0	1.0	1.0	2.0	3.0	4.0

Given 8 objects at rest on a horizontal frictionless surface when time is zero. Each mass then has a single horizontal force acting on it as shown in the table above. The force acts long enough to move each mass a distance of 10 m.

12. Rank order the objects in descending order on the basis of their kinetic energy after moving the 10 m, putting the largest first. Indicate a tie with an equals sign, =
A) 1 = 8, 2 = 7, 3 = 6, 4 = 5 B) 1, 2, 5 = 6 = 7 = 8, 3, 4 C) all are equal
D) 1, 2, 5 = 6 = 7 = 8, 3, 4 E) 4 = 8, 3 = 7, 2 = 6, 1 = 5

13. Rank order the objects in ascending order on the basis of the time required to move each mass the 10 m distance, putting the shortest time first and the longest time last. Indicate a tie with an equals sign, =
A) 8, 2 = 7, 3 = 6, 4 = 5 B) 1, 2, 5= 6 = 7 = 8, 3, 4 C) all are equal
D) 1 = 8, 5 = 6 = 7, 3, 4 E) 4 = 8, 3 = 7, 2 = 6, 1 = 5

14. A monochromatic beam of light, perpendicular to the plane of a single slit, shines on the slit. One does not observe any diffraction pattern as a result. A correct explanation for this is that the size of the slit width is ___ .
A) approximately 10 wavelengths B) approximately 5 wavelengths
C) about equal to the wavelength D) much smaller than the wavelength

15. Given an isotropic point sound source. At a distance of 9.0 m from the source the sound level intensity caused by the source is 60 dB. At a distance of 3.0 m, one-third the original distance, the dB reading caused by the source would be about ___ dB .

A) 180 B) 90 C) 70 D) 63 E) 20

16. According to the ideal gas law a one liter volume of a gas at a gauge pressure of 15 pounds per square inch and a temperature of 27 degrees Celsius will have a volume of ___ liters if the gauge pressure becomes 30 pounds per square inch and the temperature becomes 54 degrees Celsius.

A) 1.4 B) 1.2 C) 1.0 D) 0.73 E) 0.54

17. Given four double slit arrangements, -- I, II, III, and IV -- illuminated by plane light waves in a typical Fraunhofer set-up. Using monochromatic beams of light, interference patterns with uniformly spaced maxima are formed on screens that are 2 meters from the slits. The maxima in each pattern have essentially the same intensity (brightness). The slit width is the same for all four. The center-to-center separation of the slits is either d or 2d (double). The frequency of the light used is either f or 1.5f (one and one half times the original frequency). The table below summarizes which separation and which light frequency is used for a particular double slit.

Double Slit	Slit Separation	Frequency of Light Used
I	d	f
II	d	1.5f
III	2d	f
IV	2d	1.5f

Rank order the double slits on the basis of the center-to-center separation of the maxima in the interference patterns putting the largest first. Indicate a tie (equal values) with an = sign.

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

18. A 0.200 kg piece of metal is heated to 600 degrees Celsius and placed in 0.500 kg of water. The temperature of the water rises from 18 degrees Celsius to 24 degrees Celsius. Assume no heat is gained nor lost to the environment. The experiment is repeated with a second, but different 0.200 kg metal sample and a 0.500 kg of water rises in temperature from 18 to 30 degrees. The specific heat of the second metal is __ times that of the first metal.

A) 2.2 B) 2.0 C) 1.41 D) 1.1 E) 0.50

19. Given: a spherical positive mirror (concave) with a 0.01 m tall object placed 0.30 m in front of the mirror on the principal axis of the mirror. The mirror forms a virtual image of the object a distance of 0.45 m from the mirror. The magnitude of the radius of curvature of the mirror is ___ m

A) 0.36 B) 0.67 C) 0.90 D) 1.2 E) 1.8

20. Given two transmission diffraction gratings which are used to produce Fraunhofer diffraction images. One has a line density of a few hundred lines per centimeter and is used first to produce a spectrum of a beam of light. Then it is replaced with a second grating that has a line density of a few thousand lines per centimeter. Examining the line pattern formed one would note that ___ .

A) the number of secondary maxima decreases
B) the width of the principal maxima increases
C) the grating spacing increases
D) the lines in the pattern change color
E) the angular positions of the maxima change

21. An astronaut on earth with gear weighs 180 pounds. In orbit around the earth in a typical orbit of $3.2 \text{ X } 10^{+5}$ m (200 miles) above the earth, the astronaut floats about in the spaceship cabin. The radius of the earth is about $6.4 \text{ X } 10^{+6}$ m (4000 miles). The gravitational pull on the astronaut from the earth is about ___ pounds.

A) 0 B) 10 C) 100 D) 160 E) 179

22. Given a tube open at both ends. It resonates with a fundamental frequency f1 . The tube is now closed at one end and open at the other. It resonates with a fundamental frequency f2. f1 is ___ f2 .

A) 4 times B) twice C) 1.41 times D) the same as E) half

The equation below and the description are for questions 23 and 24

Given the equation: $Y = (0.03 \text{ m}) \cos (2 \pi (0.5 \text{ x/m} – 0.5 \text{ t/s}))$

which represents a transverse traveling wave on a long, very light (massless) string, as a function of position, x, and time , t. m and s stand for meter and second, respectively.

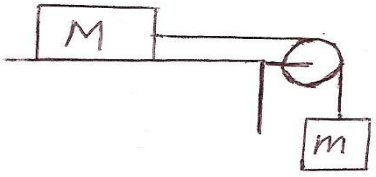
23. When x = 6.5 m and t = 4.0 s , then the magnitude of Y equals ___ m.

A) 0.06 B) 0.045 C) 0.03 D) 0.015 E) 0

24. The speed of the waveform along the string is ___ m/s.

A) 14.2 B) 10 C) 1.0 D) 0.05 E) 0.004

The following description and figure are to be used for questions 25 and 26.



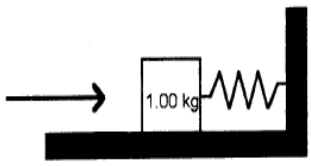
Given two masses, M, of 30.0 kg and m of 15.0 kg, attached to the ends of a very light cord which passes over a pulley as shown to the left. M is on a flat horizontal surface. The cord passes from M horizontally over the pulley and then vertically downward to the mass m. The axle of the pulley is frictionless. Neglect the mass of the cord. The pulley acts as a circular solid disk that may be neglected except that it changes the direction of the tension The disk has a radius of 0.10 m and a moment of inertia about its axis of rotation of 0.15 kg-m^2. At time equals zero the pulley and masses are released from rest. Mass m descends and M moves to the right. Mass m descends with an acceleration of 2.0 m/s^2 .

25. The tension in the cord is approximately ___ N.
A) 3 B) 82 C) 120 D) 144 E) 147

26. The coefficient of friction between the block M, 30.0 kg, and the plane is ___
A) 0.1 B) 0.2 C) 0.3 D) 0.4 E) 0.5

27. Given two lamps connected in series, one with a resistance R and the other a resistance half that, R/2 . The current in the high resistance lamp is ___ times the current in the low resistance lamp.
A) 4 B) 2 C) 1 D) 1/2 E) 1/4

The description and figure below are for question 28.



Given a 1.0 kg block at rest on a horizontal frictionless surface. The block is attached to one end of a horizontal "massless" spring. The other end of the spring is attached to a rigid vertical support. A small mass is fired horizontally and is embedded into the block. The mass of the small mass is 0.010 kg .The speed of the mass when it enters the block is 20.0 m/s. The spring constant is 100 N/m .

28. The maximum amount the spring compresses is ___ m .
A) 1.2 B) 0.8 C) 0.4 D) 0.2 E) 0.02

29. Given an ideal incompressible liquid flowing in a horizontal pipe that has a larger diameter of 0.45 m and then reduces to a smaller diameter of 0.15 m, while remaining horizontal. The liquid fills the pipe. In the smaller area section of the pipe the speed of the fluid is 0.03 m/s . In the larger area section the speed of the liquid is __ m/s

A) 0.27 B) 0.09 C) 0.03 D) 0.01 E) 0.003

Use the following information for # 30, and 31.

A 0.4 kg object is projected at 100 m/s in a vertical plane at an angle of approximately 30 degrees above the horizontal (50 m/s vertically and 86.6 m/s horizontally). It follows a parabolic path with a maximum vertical height of Y_{max}. On its way back down it strikes a target located at one-third of Y_{max} off the original launch elevation (descended two-thirds Y_{max} from Y_{max})

30. The acceleration of the object from after launch until just before it hits the target ___ .

A) decreases on the way up but is constant on the way down
B) is constant on the way up, but decreases on the way down
C) decreases on the way up and decreases on the way down
D) increases on the way up and increases on the way down
E) is constant while in the air

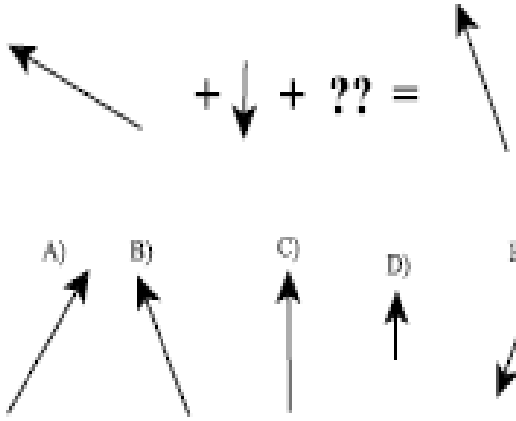
31. When the object strikes the target, its horizontal travel is approximately ___ m

A) 1000 B) 800 C) 600 D) 400 E) 200

32. Given a hollow thin walled spherical container with a volume of 4.0 liters and weighing 100 N. 350 N of a metal is sealed in the container. The container is completely submerged in water. A liter of water weighs 10 N .The buoyant force on the container is __ N . The density of the metal is $12000\ kg/m^{+3}$

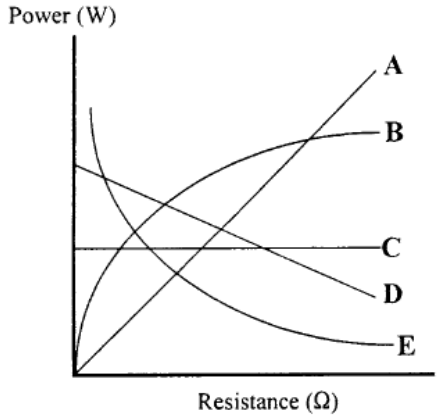
A) 450 B) 350 C) 250 D) 40 E) 0, the container sank

The description and figures below are for question 33



33. Given three forces which add to equal a fourth force. Two of the three forces are shown, as is the sum. Which of the five options best represents the third force (**??**) of the three forces? ___ Arrows are drawn to scale.

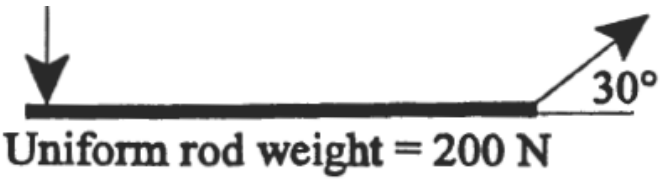
A) A B) B C) C D) D E) E



The description and figure to the left are for question 34

34. A variable ohmic or linear resistor is connected to an ideal source of potential difference, emf . The resistance is increased and the corresponding power dissipated by the resistor is determined. Which of the five graphs best represents a graph of power dissipated (in Watts) as a function of resistance (in ohms)? __

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



The figure to the left and the description are for questions 35

35. Given a 4.0 m long horizontal uniform rod which has a weight of 200 N . The left end is point 0.0 m and the right end is point 4.0 m . A force of 200 N acts at the 0.10 m point. It points vertically downward. A 200 N force acts at the right end of the rod, point 4.0 m, pointing upward at an angle 30 degrees above the horizontal as shown. The magnitude of the additional force, F, that would be required to put the rod in translational equilibrium would be approximately ___ N .

A) 380 B) 350 C) 300 D) 250 E) 200

36. Given two identical uncharged hollow metal masses 0.01 m in diameter and 0.05 kg in mass. Each is attached to a 0.50 m long thread, and suspended from the same point, as two simple pendula. A charge of +Q is placed on one and a charge twice +Q is placed on the other. They repel each other. The +Q charge forms an angle of 20 degrees with the vertical. The +2Q charge forms an angle of ___ degrees with the vertical.
A) 40 B) between 25 and 35 C) 20 D) 15 E) < 15

37. Two masses are moving on a frictionless horizontal surface and have a "head-on" collision. Mass I has a mass of 4.0 kg and is moving to the right at 4.0 m/s. Mass II has a mass of 2.0 kg and is moving to the right at 3.0 m/s. At time equals zero mass II is 15 m to the right of mass I . The two masses hit and stick together. After the collision the magnitude of the velocity of the masses is ___ m/s .
A) 4.4 B) 3.7 C) 3.0 D) 1.7 E) 0.33

The description and figures below are for questions 38 and 39.
Given a small object, a positive (convex) lens, and a screen. The object is 0.30 m to the left of the lens. A sharp image with the arrow pointing upward is formed on the screen, which is located 0.60 m to the right of the lens.

38. If the top half of the lens were removed, the image formed would be ___ .
A) no image is formed
B) half the original image, the top half
C) half the original image, bottom half
D) the same as the original image, but half the size
E) the same as the original image

39. If there were a full lens but the screen were removed, the image formed by the lens would be ___ .
A) no image is formed
B) half the original image, the top half
C) half the original image, bottom half
D) the same as the original image, but half the size
E) the same as the original image

The description below is for questions 40 and 41.
A force of 200 N is exerted on a 400 N block sliding from rest 10 m downward along an inclined plane. The 200 N force is parallel to the plane. The ending point for the block is 5 m below the elevation of the starting point. In pushing the block down the plane there is a force due to friction of 100 N .

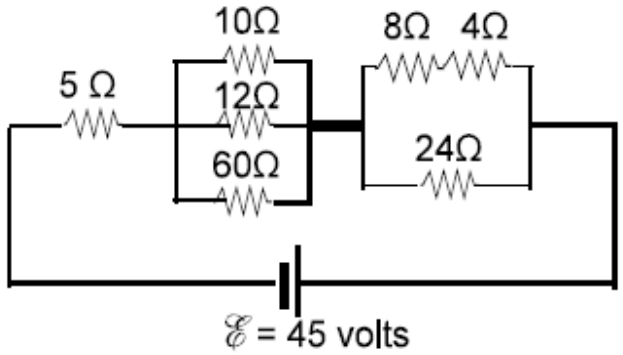
40. The coefficient of friction between the block and the plane is approximately __
A) 0.20 B) 0.25 C) 0.3 D) 0.4 E) 0.45

41. The speed of the block at the end of its slide of 10 meters is approximately ___ m/s .
A) 12 B) 9 C) 7 D) 5 E) 3

42. Given a small metal sphere at a temperature of 200 degrees Celsius. It radiates at 30 W. If the temperature were raised to 400 degrees Celsius, the sphere would radiate at approximately ___ W .
A) 4800 B) 240 C) 200 D) 120 E) 60

43. Steam enters a turbine. It enters at a temperature of 750 degrees Celsius and exits at a temperature of 250 degrees Celsius. The maximum thermal efficiency of the turbine is ___ % .
A) 89 B) 67 C) 49 D) 33 E) 26

The figure below and the description are for questions 44, and 45



Given seven resistors arranged as shown to the left, 5, 10, 12, 60, 8, 4, and 24 ohms. They are connected to an emf listed as 45 volts.

44. The emf only supplies 1.8 A . The emf's internal resistance is ___ ohms A) 7 B) 5 C) 3 D) 1.8 E) < 1

45. Assume the 60 ohm resistor "burns out" leaving an "open circuit". Further, assume the emf is changed and now delivers a current of 1.0 A . The maximum power consumed by any of the resistors will be approximately ___ W .
A) 3 B) 3.5 C) 5 D) 6 E) 7

The description below is for questions 46, and 47
Given a planet P with uniform density in circular orbit about the sun. Planet P has a circular orbit about the sun, but at a distance from the center the sun that is 4 times the orbital radius of the earth. Planet P has a mass that is half the mass of earth and a radius twice that of earth.

46. An object at rest on the surface of the earth weighs 200 N. At a point 3 times the radius of planet P from the center of planet P, the gravitational force on the object from planet P would be approximately ___ N .
A 24.0 B) 12.0 C) 6.0 D) 4.0 E) 3.0

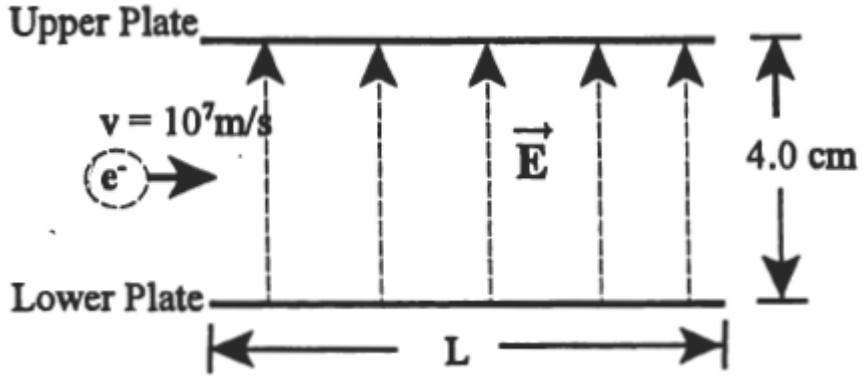
47. Calling the period of the earth's revolution about the sun one year, then the period for planet P about its sun would be ___ years.
A) 8 B) 2.8 C) 1 D) 0.25 E) 0.12

48. Given a circular cylindrical water tank. The diameter of the tank is 7.0 m. The tank is 15.0 m tall. It is used to store water and is filled to a depth of 12.0 m. The tank is supported. The bottom of the tank is 15.0 m above the ground. The upper end of the tank is open to the atmosphere. There is a round hole in the side of the tank 2.0 m above the bottom. The hole is 0.04 m in diameter. The speed of the water as it exits through the hole is ___ m/s .
A) 9.1 B) 9.9 C) 12.9 D) 14.0 E) 15.3

The figure below and the description are for questions 49 and 50
A light string is firmly attached at both ends to rigid supports. A frequency of 60 Hz is applied to the string and it vibrates in a standing wave with three loops as shown to the left. Assume the string's length, and linear density do not change.
49. A vibrator of frequency ___ Hz could NOT also produce a standing wave pattern. A) 100 B) 80 C) 40 D) 20 E) 10

50. If the tension were doubled, the wavelength of the fundamental frequency would be ____ times the original.
A) 4 B) 2 C) 1.41 D) 1 E) 0.71

The figure below and the description are for questions 51, 52, and 53



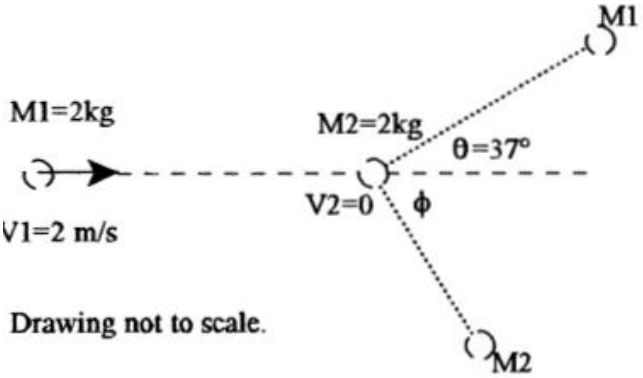
Given an electron moving horizontally at 10^{+7} m/s. It enters a uniform electric field at the middle of the field formed by a parallel plate capacitor. The plates are horizontal. They are thin and square, with a side, L, of 0.10 m. The plate separation is 0.04 m. The electric potential across the plates is 160.0 volts.

51. The acceleration of the electron in the field is approximately ___ m/s^2 .
A) 10^{+6} B) 10^{+8} C) 10^{+11} D) 10^{+13} E) 10^{+15}

52. A uniform magnetic field, B, is placed across the region of the electric field so the electron is not deflected but travels straight through undeflected. If the mass of the negative particle had been 2000 times as much as the original, the magnetic field required for it to be undeflected would be ___ B .
A) 2000 B) 45 C) 1 D) 0.02 E) 0.0005

53. The potential difference that accelerated the electron from essentially at rest to 10^{+7} m/s was approximately ___ volts.
A) 1700 B) 300 C) 170 D) 17 E) 0.30

The following description and figure are to be used for question 54 .



54. Mass one, M1, a 2.0 kg mass is moving to the right at 2.0 m/s on a horizontal frictionless surface. It has a perfectly elastic collision with another 2.0 kg mass, mass two, M2, that is originally at rest. As a result of the collision, mass one, M1, goes off with a path 37 degrees from its original path, as shown. The final speed of mass one is 1.6 m/s . The speed of the second mass as a result of the collision is ___ m/s .

A) 2.4 B) 2.0 C) 1.6 D) 1.2 E) 0.8

The following description is used for questions 55, 56 and 57
Given a small 0.600 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 200.0 N/m The mass is initially in equilibrium and at rest. Then, the mass is displaced from rest a distance of 0.30 m to the right and released with an initial speed of 3.0 m/s back toward the left (toward the support). It oscillates in simple harmonic motion.

55. When the mass is at the 0.15 m mark, its speed will be approximately ___ m/s
A) 5.5 B) 4.0 C) 3.9 D) 3.5 E) 3.0

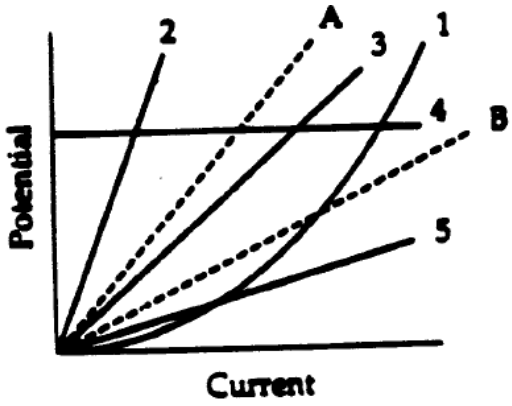
56. The amplitude for the motion is __ m .
A) 0.34 B) 0.28 C) 0.22 D) 0.16 E) 0.10

57. If this had taken place in "deep space", far away from any large gravitational mass, the period would be ___ that on earth.
A) zero (no oscillation) **B)** many, many times **C)** the same as
D) 8 times **E)** 32 times

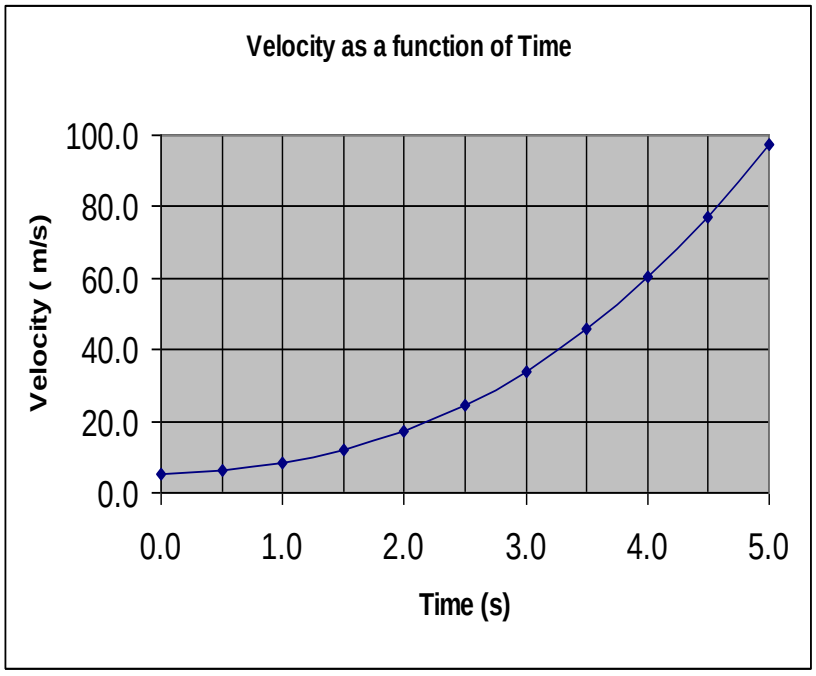
The figure below and the description are for question 58.

58. Given graphs of "Potential Difference as a Function of Current" for two resistors A and B. The dashed lines represent the data for A and B individually. If resistors A and B were placed in series, which of the 5 solid lines would represent the data for the series combination? __ .

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



The following description, table, and graph are to be used for questions 59 and 60.



Time s	Velocity m/s
0.0	5.0
0.5	6.0
1.0	8.3
1.5	12.0
2.0	17.4
2.5	24.7
3.0	34.1
3.5	45.9
4.0	60.2
4.5	77.3
5.0	97.5

The table and graph represent the speed of a 2.0 kg "point mass" whirling in a circle with a fixed radius of 1.0 m about a fixed point.

59. In the 5.0 s interval represented, the point mass went through an angle of approximately ___ rad .

A) 220 B) 195 C) 170 D) 145 E) 120

60. When time was two seconds the required centripetal force was approximately ___ N .

A) 350 B) 400 C) 600 D) 900 E) 1200

Merck State Science Day 2012 **PHYSICS**
Answer Section

MULTIPLE CHOICE

1. D
2. B
3. A
4. C
5. D
6. D
7. A
8. C
9. B
10. D
11. D
12. A
13. B
14. D
15. C
16. D
17. A
18. B
19. E
20. E
21. D
22. B
23. E
24. C
25. C
26. B
27. C
28. E
29. E
30. E
31. B
32. D
33. A
34. ~~A~~ E
35. B
36. C
37. B
38. E
39. E
40. C
41. A
42. D
43. C
44. A
45. C
46. E
47. A
48. D
49. E
50. D
51. E
52. C
53. B
54. D
55. A
56. A
57. C
58. B
59. C
60. C