The 63rd Annual
Merck State Science Day Competition
May 23, 2013

Physics

Directions:

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 $Area_{sphere} = 4\ \pi R^2$

The Periodic Table of the Elements

1 **H** Hydrogen 1.00794																	2 **He** Helium 4.003
3 **Li** Lithium 6.941	4 **Be** Beryllium 9.012182											5 **B** Boron 10.811	6 **C** Carbon 12.0107	7 **N** Nitrogen 14.00674	8 **O** Oxygen 15.9994	9 **F** Fluorine 18.9984032	10 **Ne** Neon 20.1797
11 **Na** Sodium 22.989770	12 **Mg** Magnesium 24.3050											13 **Al** Aluminum 26.981538	14 **Si** Silicon 28.0855	15 **P** Phosphorus 30.973761	16 **S** Sulfur 32.066	17 **Cl** Chlorine 35.4527	18 **Ar** Argon 39.948
19 **K** Potassium 39.0983	20 **Ca** Calcium 40.078	21 **Sc** Scandium 44.955910	22 **Ti** Titanium 47.867	23 **V** Vanadium 50.9415	24 **Cr** Chromium 51.9961	25 **Mn** Manganese 54.938049	26 **Fe** Iron 55.845	27 **Co** Cobalt 58.933200	28 **Ni** Nickel 58.6934	29 **Cu** Copper 63.546	30 **Zn** Zinc 65.39	31 **Ga** Gallium 69.723	32 **Ge** Germanium 72.61	33 **As** Arsenic 74.92160	34 **Se** Selenium 78.96	35 **Br** Bromine 79.904	36 **Kr** Krypton 83.80
37 **Rb** Rubidium 85.4678	38 **Sr** Strontium 87.62	39 **Y** Yttrium 88.90585	40 **Zr** Zirconium 91.224	41 **Nb** Niobium 92.90638	42 **Mo** Molybdenum 95.94	43 **Tc** Technetium (98)	44 **Ru** Ruthenium 101.07	45 **Rh** Rhodium 102.90550	46 **Pd** Palladium 106.42	47 **Ag** Silver 107.8682	48 **Cd** Cadmium 112.411	49 **In** Indium 114.818	50 **Sn** Tin 118.710	51 **Sb** Antimony 121.760	52 **Te** Tellurium 127.60	53 **I** Iodine 126.90447	54 **Xe** Xenon 131.29
55 **Cs** Cesium 132.90545	56 **Ba** Barium 137.327	57 **La** Lanthanum 138.9055	72 **Hf** Hafnium 178.49	73 **Ta** Tantalum 180.9479	74 **W** Tungsten 183.84	75 **Re** Rhenium 186.207	76 **Os** Osmium 190.23	77 **Ir** Iridium 192.217	78 **Pt** Platinum 195.078	79 **Au** Gold 196.96655	80 **Hg** Mercury 200.59	81 **Tl** Thallium 204.3833	82 **Pb** Lead 207.2	83 **Bi** Bismuth 208.98038	84 **Po** Polonium (209)	85 **At** Astatine (210)	86 **Rn** Radon (222)
87 **Fr** Francium (223)	88 **Ra** Radium (226)	89 **Ac** Actinium (227)	104 **Rf** Rutherfordium (261)	105 **Db** Dubnium (262)	106 **Sg** Seaborgium (263)	107 **Bh** Bohrium (262)	108 **Hs** Hassium (265)	109 **Mt** Meitnerium (266)	110 (269)	111 (272)	112 (277)	113	114				

58 **Ce** Cerium 140.116	59 **Pr** Praseodymium 140.90765	60 **Nd** Neodymium 144.24	61 **Pm** Promethium (145)	62 **Sm** Samarium 150.36	63 **Eu** Europium 151.964	64 **Gd** Gadolinium 157.25	65 **Tb** Terbium 158.92534	66 **Dy** Dysprosium 162.50	67 **Ho** Holmium 164.93032	68 **Er** Erbium 167.26	69 **Tm** Thulium 168.93421	70 **Yb** Ytterbium 173.04	71 **Lu** Lutetium 174.967
90 **Th** Thorium 232.0381	91 **Pa** Protactinium 231.03588	92 **U** Uranium 238.0289	93 **Np** Neptunium (237)	94 **Pu** Plutonium (244)	95 **Am** Americium (243)	96 **Cm** Curium (247)	97 **Bk** Berkelium (247)	98 **Cf** Californium (251)	99 **Es** Einsteinium (252)	100 **Fm** Fermium (257)	101 **Md** Mendelevium (258)	102 **No** Nobelium (259)	103 **Lr** Lawrencium (262)

1995 IUPAC masses and Approved Names from http://www.chem.qmw.ac.uk/iupac/AtWt/
masses for 107-111 from C&EN, March 13, 1995, p. 35
112 from http://www.gsi.de/z112e.html

Merck State Science Day 2013 PHYSICS

Multiple Choice
Identify the letter of the choice that best completes the statement or answers the question, and enter it in the answer window on the computer screen, then ***SUBMIT.***
Treat all questions as non-relativistic. Unless otherwise indicated ignore friction with the air. Figures are not drawn to scale

1.Given: a diffraction grating with a grating spacing of 3.0×10^{-6} m, and a Young's experiment double slit apparatus that has the same center to center slit separation. Of the following four statements, ___ is (are) true.

I. The maximums formed by the grating will be sharper
II. The principal maximums formed by the grating are farther apart than those formed by the double slit.
III. The principal maximums formed by the grating are closer than those formed by the double slit.
IV. There are thousands of secondary maximums formed by the grating, essentially too faint to be seen.

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

2. Given a rectangular box with perpendicular sides. The sides of the box are measured. Expressed to the correct number of significant figures, the sides are: length 3.02 m, width 0.90 m, and height 10.00 m , has a volume expressed to the correct number of significant figures of ___ m^{+3} .

A) 27.18 B) 27.20 C) 27.2 D) 27. E) 30.

3. Given 5 spark traces (dots) for a rectilinear motion. The trace which best represents "an object with constant acceleration" is ___ .

A) 

B) 

C) 

D) 

E) 

4. Given a spherical concave mirror and a biconvex (equal magnitude radii of curvature faces) spherical thin lens. The lens is made from glass with an index of refraction of 1.50. The mirror and the lens have the same focal length. The magnitude of the radius of curvature of the lens' faces is ____ the magnitude of the radius of curvature of the mirror.

A) less than half B) half C) equal to D) double E) more than double

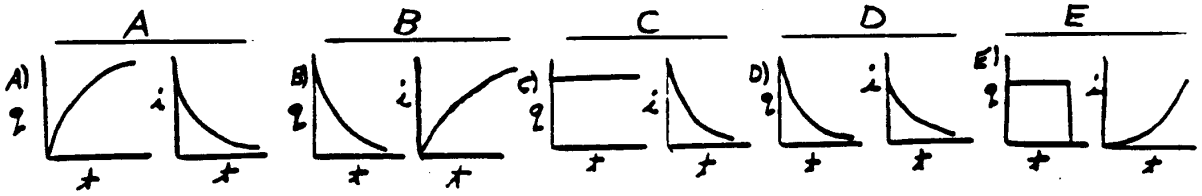
The following discussion is for questions 5, 6, and 7
5, 6, 7 Given a circular coil of closely wound turns or loops of wire. It is rotating at a rate of 100 Hertz in a magnetic field. The axis of rotation is perpendicular to the magnetic field. A sinusoidal potential difference is induced in the coil. The signal's peak voltage is 20.0 volts.

5. The frequency of the induced potential difference is ___ Hz .
A) 50 B) 71 C) 100 D) 144 E) 200

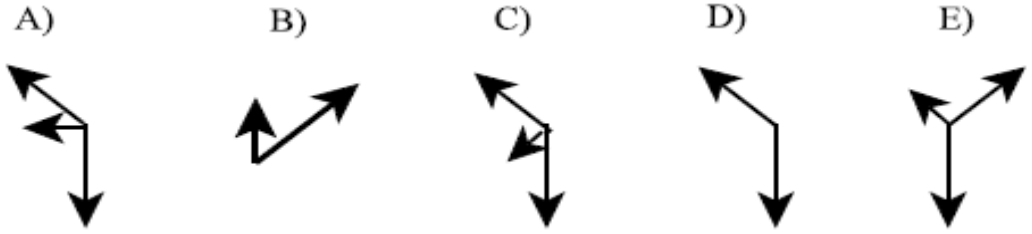
6. If the rotation rate had been 200 Hz, double the original, the peak of the induced potential difference would have been ___ V .
A) 80 B) 40 C) 20 D) 10 E) 5

7. If the area of the loops were increased by 10%, the peak voltage would ___
A) increase by 10% B) remain the same C) decrease by 10%
D) increase by almost 5% E) decrease by almost 5%

8. A capacitor and a resistor are joined in a series circuit. The capacitor was charged to a potential difference V and discharged through the resistor. The charge on the capacitor, q, and the current through the resistor during discharge are best represented by figure set ___ below.

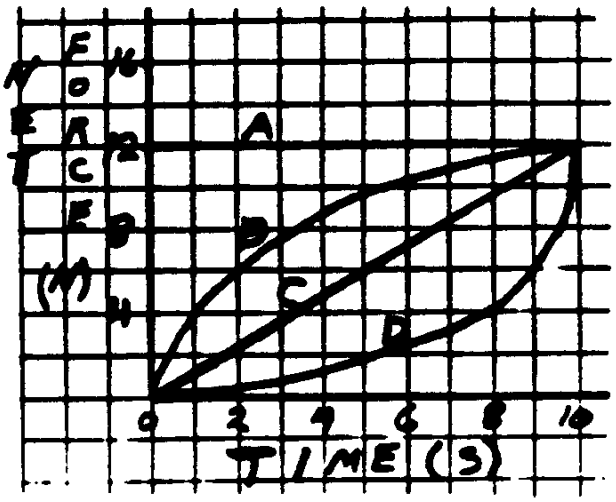


9. Given a block sliding up a frictionless inclined plane. The plane is inclined at approximately 45 degrees to the horizontal. Of the five force diagrams below, diagram ___ best represents the forces on the block.



10. Given a solid metal cube. In air its mass is 0.40 kg. It is suspended in water in a container by a very light string so that it is entirely below the surface but not touching the sides nor bottom of the container. Its apparent mass is 0.30 kg. When suspended in another liquid its apparent mass is 0.32 kg. The density of this other liquid is ___ kg/m^3 . A) 1000.0 B) 800.0 C) 400.0 D) 0.80 E) 0.40

The following graph and discussion are for questions 11, 12, and 13

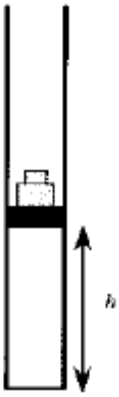


11, 12, 13 Given graphs of "Net Force in Newtons vs Time in seconds" for four different net forces, A, B, C, D, on a 2.0 kg object. (maximum force involved is 12 newtons; maximum time involved is 10 seconds)

11. The Net Force for which the object received the largest impulse was force ___ .
A) A B) B C) C
D) D E) both A and C

12. For Force C, if the 2.0 kg object was initially at rest, its kinetic energy when time is 10.0 s is approximately ___ J .
A) 122 B) 225 C) 450 D) 600 E) 900

13. Given a transmission diffraction grating that is set for Fraunhofer conditions. The grating produces a first order maximum at 25.0 degrees from the forward direction for a wavelength of 7.0×10^{-7} m. The second order maximum occurs at ___ degrees.
A) 70.5 B) 57.7 C) 50 D) 37.6 E) 13.6



The following figure and discussion are for question 14.
14, Given a vertical cylinder filled with gas. It has a frictionless piston. Weights are placed on the piston. The piston is in equilibrium at height h above the base of the cylinder when the gas is at a temperature of 27.0 degrees Celsius, as shown in the figure. With the same weights on the piston, for the piston to be in equilibrium at 2h, double the original value, the temperature must be changed to ___ degrees Celsius .

A) 38 B) 54 C) 76 D) 112 E) 327

Measured values	
Time (s)	Position (m)
0.00	6.00
1.00	5.50
2.00	12.00
3.00	31.50
4.00	70.00
5.00	133.50
6.00	228.00
7.00	359.50

The following figure and discussion are for questions 15, 16, and 17.
Given a table which is a record of position in meters as a function of time in seconds for a 4.0 kg object in rectilinear motion.

15. When time was 2.00 s , the number of significant figures in the position value is __ .
A) 1 B) 2 C) 3 D) 4 E) 5

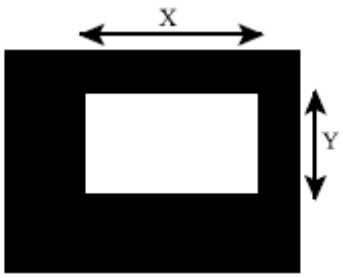
16. The object's average velocity during the time interval 0.00 s through 5.00 s was ___ m/s , to the correct number of significant figures.
A) 26 B) 26.7 C) 25.5 D) 26.0 E) 25.50

17. As indicated by the table, the acceleration of the object was ___ .
A) negative but getting more negative B) negative and getting less negative
C) positive and increasing D) positive and constant E) positive and decreasing

18. A pitcher throws a ball from an elevation above the ground of 2.0 m that initially is traveling horizontally at a speed of 40.0 m/s . The distance between the pitcher and the catcher is 20.0 m . When caught the elevation of the ball is approximately __ m .
A) hits the ground, doesn't make it B) 0.8 C) 1.0 D) 1.2 E) 1.4

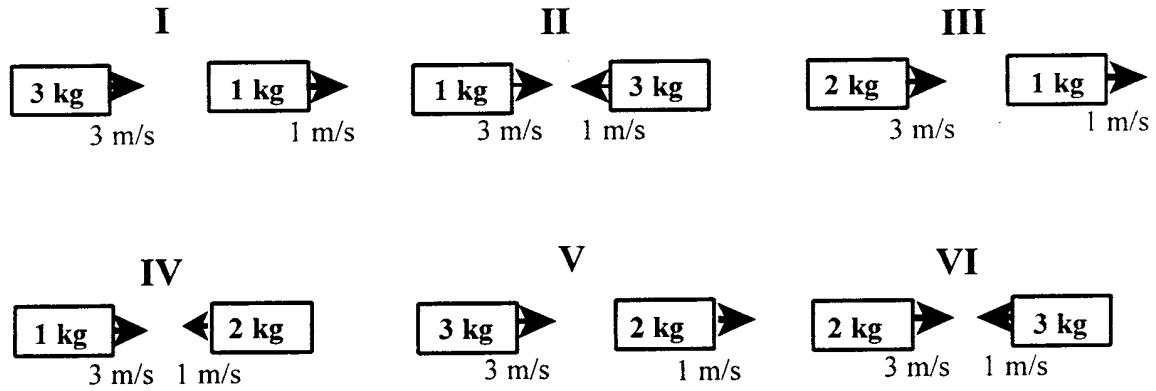
19. If the motion in question 18 had taken place on the moon, the time for the ball to travel from pitcher to catcher on earth would have been ___ the time required on the moon.
A) 36 times B) 6 times C) equal to D) 1/6 E) 1/36

20. Given a 1.0 kg mass thrown vertically upward at 30.0 m/s . In this question resistance with the air is not negligible. Assume the resistance with the air has a magnitude proportional to the velocity and a direction opposite to the direction of the velocity. At its highest point the acceleration of the mass has a magnitude of ___ m/s^2 .
A) 0 B) much less than 9.8 C) 9.8 D) 19.6 E) much greater than 9.8



The following figure and discussion are for question 21.
21. Given a rectangular brass plate in which there has been cut a rectangular hole of dimensions X and Y . If the plate were heated uniformly ___ .
A) both X and Y will decrease
B) X will decrease and Y will increase
C) X will increase and Y will decrease
D) X and Y will both increase
E) X and Y will remain the same

The following figure and discussion are for questions 22 and 23.
Given six pairs of masses which are moving on a horizontal frictionless surface. Each pair has an inelastic collision and stick together.



22. Rank order each pair on the basis of the magnitude of the speed each pair has as a result of the collision. Put them in descending order with the largest first.
A) I, III, V, IV, VI, II B) I, V, III, VI, IV, II C) V, I, VI, III, IV, II
D) V, I, VI, III, IV, II E) I, III, V, VI, IV, II

23. Rank order each pair on the basis of their kinetic energy as a result of the collision. Put them in descending order with the largest first.
A) I, III, V, VI, IV, II B) V, I, III, VI, IV, II
C) I, V, VI, III, II, IV D) V, I, VI, III, IV, II E) I, V, III, VI, IV, II

24. Given a monochromatic sound in air with frequency 400 Hz . The sound passes through a medium in which it has a speed that is half its original speed. It continues and enters air that is at a higher temperature than the original air. The frequency of the sound in the warmer air is ___ Hz .
A) slightly more than 800 B) slightly less than 800 C) 400
D) slightly more than 400 E) slightly less than 400

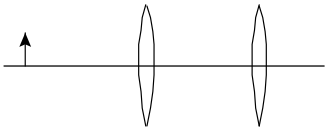
The following discussion is for questions 25, 26, and 27.
Given two hollow thin-walled metal spheres. The smaller sphere has a radius of 0.10 m and is charged to 100.0 volts. The larger sphere has a radius of 0.20 m.

25. The charge on the smaller sphere is approximately ___ coulomb.
A) 10^{+9} B) 10^{+6} C) 10^{-6} D) 10^{-9} E) 10^{-10}

26. If the larger sphere had the same charge on it as the smaller sphere, the potential difference for the larger sphere would be ___ V .
A) 400 B) 200 C) 140 D) 50 E) 25

27. If the smaller sphere were of solid metal and charged to 100.0 volts, inside the sphere at 0.05 m from the center the electric potential would be ___ V .
A) zero B) 25.0 C) 50.0 D) 70.7 E) 100.0

The following figure and discussion are for questions 28, 29, and 30.
Given two thin double convex lenses positioned so that the principal axis passes through their vertices and the centers for the radii of their faces. The lenses are 0.15 m apart. The focal length for the lens to the left, lens 1, is 0.60 m. For the lens to the right, lens 2, it is 0.45 m. A small object 0.04 m tall is positioned 0.50 m to the left of lens 1 . The figure to the left is not to scale but indicates the general location of the lenses and object.

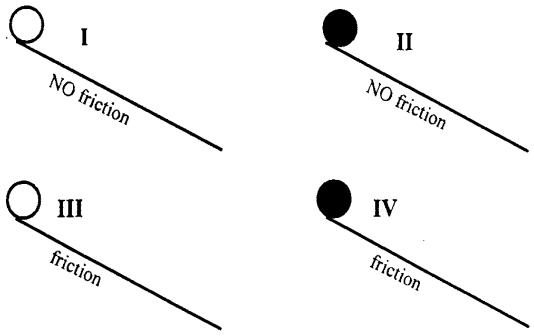


28. The location for the image formed by lens 2 is approximately __ m from lens 2.
A) 0.66 B) 0.52 C) 0.39 D) 0.25 E) 0.15

29. In order for the light leaving lens 2 to be a parallel beam, the object should be placed ___ m to the left of lens 1 .
A) 0.20 B) 0.35 C) 0.50 D) 0.60 E) not possible

30. If the two lenses were placed in contact to form a compound lens, its focal length would be approximately ___ m .
A) 1.80 B) 0.52 C) 0.26 D) 0.20 E) 0.13

The following figure and discussion is for questions 31 and 32
Given four disks of equal mass and the same outer radius. The disks are at the top of planes 3.0 m long and inclined at 30.0 degrees to the horizontal. Disks I and III are thin-walled and disks II and IV are solid . Disks I and II are on frictionless planes and slide down the plane without rolling. Disks III and IV are on planes with friction between the disks and the plane and roll without slipping. All four are released from rest at the same time.

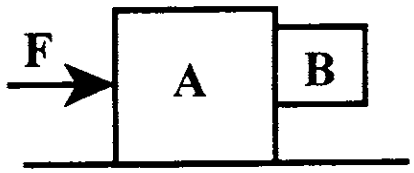


31. Rank order the disks on the basis of their reaching the bottom, with first to reach it first, second for the second to reach the bottom as second, etc. A tie is indicated by an equals sign.

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

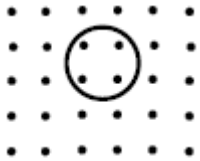
32. Rank order the disks on the basis of the magnitude of their linear momentum upon reaching the bottom of the plane. Rank the linear momentum in descending order, largest first. A tie is indicated by an equals sign.
A) I, II, III, IV
B) I = II, III = IV C) I, III, II, IV D) I = II, III, IV E) I = II, IV, III

The following figure and discussion are for question 33



33. Given a system of two blocks sliding on a frictionless horizontal surface. A force F is exerted on a large block, A, with a weight of 40.0 N . The large block in turn pushes on a smaller block, B, with a weight of 10.0 N . Friction between the two blocks prevents block B from sliding down. The coefficient of static friction between the blocks is 0.25 . The minimum force, F, necessary so that the smaller block does not slide down is ___ N .

A) 244 B) 200 C) 176 D) 150 E) 75



The following figure and discussion are for question 34

34. Given a loop of wire in a uniform magnetic field that points upward out of the page. The plane of the loop is perpendicular to the magnetic field, as shown to the left. The field is increasing. The current induced in the loop is ___ .

A) counterclockwise B) clockwise C) no current is induced in the loop

35. Given a horizontal pipe with a radius of 0.08 m . While remaining horizontal, the pipe reduces in radius to 0.04 m . An incompressible ideal liquid fills the pipe and flows from the larger radius region to the smaller radius region. The flow rate in the larger radius region is 0.002 m^3/s . The flow rate in the smaller radius region is ___ m^3/s .

A) 0.008 B) 0.004 C) 0.002 D) 0.001 E) 0.0005

The following discussion is for question 36, 37, and 38

A "massless spring" is mounted horizontally on a horizontal frictionless surface. The left end is attached to a rigid vertical support. A 0.40 kg mass is attached to the right end of the spring. The mass is stretched 0.045 m and released while traveling at a speed of 0.20 m/s, away from the support. The mass oscillates horizontally in a good approximation to Simple Harmonic Motion. The spring constant for the spring is 10.0 N/m .

36. The maximum speed of the mass is approximately ___ m/s .

A) 0.30 B) 0.45 C) 0.60 D) 0.71 E) 1.4

37. The period for the motion is ___ s .

A) 0.79 B) 0.89 C) 1.11 D) 1.26 E) 1.41

38. If the amplitude for the motion were doubled, the period for the motion would ___ .

A) be 1/4 the original B) be 1/2 the original

C) be unchanged D) double E) be 4 times the original value

The following discussion is for question 39, and 40 .
Given a 6.0 m uniform ladder leaning against a smooth wall. The ladder is inclined at 60.0 degrees with the floor, the horizontal. The ladder has a weight of 150.0 N . The coefficient of static friction between the ladder and the floor is 0.40 . Four meters up the ladder (3.5 m above the floor) a weight of 100.0 N is attached to the ladder.

39. The frictional force due to friction on the bottom of the ladder is ___ N .
A) 82 B) 100 C) 123 D) 142 E) ladder slips and falls

40. If the 100.0 N weight were attached at the upper end of the ladder, the force due to friction at the bottom of the ladder would be ___ N .
A) 100 B) 125 C) 175 D) 200 E) ladder slips and falls

41. Heat flow occurs between two objects in thermal contact when the objects differ in ___ .
A) density B) mass C) specific heat D) temperature E) none of these

42. Given 1.0 kg of ice. It is placed in 1.0 kg of water. When equilibrium is reached, 2.0 kg of ice at zero degrees Celsius has been formed. The specific heat of water is 4,186 J/kg Celsius degree. Its latent heat of fusion is 3.3×10^5 J/kg. The specific heat of ice is 2,090 J/kg Celsius degree . The original temperature of the water was zero degrees Celsius. The original temperature of the ice was ___ degrees Celsius below zero

A) a few B) about 40 C) about 80 D) 160 E) 200

43. Given the earth's radius is 6.4×10^6 m . The atmospheric pressure at the surface of the earth is 10^5 N/m^2 . The mass of the earth is 6×10^{24} kg . The earth's orbit is almost circular with a radius of 1.5×10^{11} m . The weight of the earth's atmosphere is approximately ___ N .
A) 1×10^{17} B) 5×10^{19} C) 1×10^{20} D) 5×10^{22} E) 1×10^{24}

The following discussion and equation are for questions 44, and 45.
Given the following equation which represents a transverse traveling wave on a long very light (massless) string, as a function of position, X, in meters and time, T, in seconds.
$Y = (0.04\ m) \cos (2\pi (2.0\ X/m - 2.0\ T/s))$

44. When T = 3.0 s and X = 3.0 m , the value of Y will be __ m .
A) 0.08 B) 0.04 C) 0.02 D) 0.01 E) 0

45. The speed of the waveform on the string is ___ m/s .
A) 1/4 B) 1/2 C) 1.0 D) 2.0 E) 4.0

46. To say that one wave is out of phase with another is to say that the waves are ___ .

A) of different wavelengths B) of different frequencies
C) of different amplitudes D) out of step E) none of these

47. Given a spherical planet P of radius R . It has uniform density. A mass M is in a circular orbit about the planet. At rest on the surface of the planet the mass weighs 200.0 N The radius of the orbit of M about the center of the planet is 1.5R The gravitational force on the mass M while in orbit is ___ N ,
A) 141.0 B) 100.0 C) 88.9 D) 70.7 E) 50.0

The following description is used for questions 48, 49, and 50.
Given a 14.0 m tall cylindrical water tank resting on the ground. It is filled with water to a height of 10.0 m . The upper end of the tank is open to the atmosphere. The tank is 6.0 m in radius. There is a round hole 0.04 m in diameter in the side of the tank 4.0 m below the water surface.

48. The speed of the water as it exits the hole is ___ m/s .
A) 10.8 B) 8.9 C) 7.7 D) 6.3 E) 5.

49. If there were a second hole in the side of the tank, the second hole directly in line vertically with the first. The water from the two holes hits the ground at the same spot. The second hole would be ___ m below the surface of the water.
A) none, water not deep enough B) 7.5 C) 6.6 D) 6.0 E) 4.2.

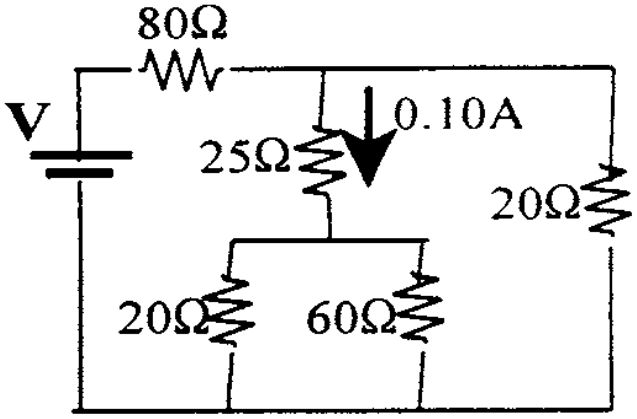
50. If the tank were placed on a support so that the bottom of the tank were 10.0 m above the ground, the speed of the water as it exited the tank would be ___ times the original exit speed when it did not have the support.
A) 1.6 B) 1.4 C) 1 D) 0.6 E) 0.4

51. Given a heat engine. When operating, the heat engine takes in 4000 J of heat energy. It sends 1600 J to a "cold reservoir". The efficiency of the engine is __ % .
A) 40 B) 60 C) 71 D) 75 E) 112

52. Given four containers, I, II, III, and IV, similar to cylinders. They have different heights but water is placed in all of them to the same height, R.. At their upper ends all four are open to the atmosphere. I and II are right circular cylinders. The radius of I is R. The radius of II is 2R. III is shaped like the lower portion of a flask. It has a circular bottom. Its radius tapers from R at the bottom to 0.05 R at the upper end. IV is shaped like a cube, R on a side. The force on the bottom of ___ is (are) the largest.
A) II B) I and II C) IV D) I, and IV E) -all have the same pressure-

53. The phenomenon of beats occurs for two sound waves when the two superimposed waves have ___ .
A) frequencies that are a little different
B) the same frequency and amplitude but different phases
C) the same frequency but different amplitudes
D) frequencies where one has to be twice the other frequency.
E) none of the previous answers is correct.

The following figure and description are used for questions 54, 55, and 56.



.
Given a circuit of five resistors connected to a potential difference, V . The current through the 25 ohm resistor is 0.1 ampere, as shown.

54. The power dissipated by the 80 ohm resistor is ___ watts.

A) 0.08 B) 0.4
C) 1.2 D) 5.0 E) 7.2

55. If the potential difference of V is 30.0 volts, the internal resistance of V is ___ ohms .
A) 1.0 B) 3.3 C) 6.7 D) 7.3 E) 8.2

56. If the 20.0 ohm resistor in parallel with the 60.0 ohm resistor burns out leaving an open branch, the current through the 25 ohm resistor will ___ .
A) decrease slightly (few percent) B) increase slightly (few percent)
C) will remain 0.1 A D) will decrease E) will increase

The following description is used for questions 57, 58, 59, and 60.
Given a very light taut string that is stretched horizontally and attached at its ends to rigid supports. The taut string is displaced a few centimeters downward at its center and released. The string vibrates at its fundamental frequency, 100 Hz . The length of the string that vibrates is 1.0 m (Distance between supports is 1.0 m). The sound speed in the air is about 340 m/s.

57. The speed of a transverse wave on the vibrating string is ___ m/s .
A) 40 B) 80 C) 100 D) 141 E) 200

58. If the string were displaced downward at a point about 0.25 m from its left end, the wavelength for the string's fundamental would be ___ the original value.
A) one fourth B) half C) the same as D) 1.4 times E) double

59. If the tension in the string were four times the original value, the fundamental frequency would have been ___ Hz .
A) 50 B) 71 C) 100 D) 140 E) 200

60. The frequency of the note produced by the string is __ the frequency of the note in the air.
A) 1/4 B) 1/2 C) the same as D) double E) four times

	MERCK		PHYSICS		TEST	2013	
1	C		26	D		51	B
2	D		27	E		52	A
3	E		28	B		53	A
4	B		29	A		54	E
5	C		30	C		55	C
6	B		31	E		56	D
7	A		32	E		57	E
8	D		33	B		58	C
9	D		34	B		59	E
10	B		35	C		60	C
11	A		36	A			
12	E		37	D			
13	B		38	C			
14	E		39	A			
15	D		40	E			
16	C		41	D			
17	C		42	D			
18	B		43	B			
19	C		44	B			
20	C		45	C			
21	D		46	D			
22	E		47	C			
23	E		48	B			
24	C		49	D			
25	D		50	C			