PRACTICE TESTS for PHYSICAL SETTING REGENTS PHYSICS

STUDENTS

The purpose of this book is to give you an aid to review for the Physical Setting/ Physics Regents exam, or your school physics exam. You will find answers and explanations to the questions from four previous exams. Take your time in going through each exam. Try to answer each question on your own before checking the answer and the accompanying explanation. Concentrate on those that you have trouble with. Do not wait until the last minute to start your review. Start well before the Regents exam and do 20 to 25 questions at a sitting. By the time you finish the four exams in this booklet, you should have a good understanding of the wording and types of questions to expect on the Regents, or school physics exam.

Good luck on the exam.

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PHYSICAL SETTING
REGENTS
PHYSICS

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EXAM **PAGE**

June 2017
Part A

Answer all questions in this part.

***Directions* (1–35): For *each* statement or question, choose the word or expression that, of those given, best completes the statement or answers the question. Some questions may require the use of the *2006 Edition Reference Tables for Physical Setting/Physics*. Record your answers in the space provided.**

1. A unit used for a vector quantity is
(1) watt (2) newton (3) kilogram (4) second 1_____

2. A displacement vector with a magnitude of 20. meters could have perpendicular components with magnitudes of
(1) 10. m and 10. m (3) 12 m and 16 m
(2) 12 m and 8.0 m (4) 16 m and 8.0 m 2_____

3. A hiker travels 1.0 kilometer south, turns and travels 3.0 kilometers west, and then turns and travels 3.0 kilometers north. What is the total distance traveled by the hiker?
(1) 3.2 km (2) 3.6 km (3) 5.0 km (4) 7.0 km 3_____

4. A car with an initial velocity of 16.0 meters per second east slows uniformly to 6.0 meters per second east in 4.0 seconds. What is the acceleration of the car during this 4.0-second interval?
(1) 2.5 m/s^2 west (3) 4.0 m/s^2 west
(2) 2.5 m/s^2 east (4) 4.0 m/s^2 east 4_____

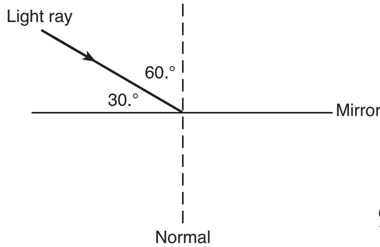
5. On the surface of planet *X*, a body with a mass of 10. kilograms weighs 40. newtons. The magnitude of the acceleration due to gravity on the surface of planet *X* is
(1) 4.0×10^3 m/s^2 (2) 4.0×10^2 m/s^2 (3) 9.8 m/s^2 (4) 4.0 m/s^2 5_____

6. A car traveling in a straight line at an initial speed of 8.0 meters per second accelerates uniformly to a speed of 14 meters per second over a distance of 44 meters. What is the magnitude of the acceleration of the car?
(1) 0.41 m/s^2 (2) 1.5 m/s^2 (3) 3.0 m/s^2 (4) 2.2 m/s^2 6_____

7. An object starts from rest and falls freely for 40. meters near the surface of planet *P*. If the time of fall is 4.0 seconds, what is the magnitude of the acceleration due to gravity on planet *P*?
(1) 0 m/s^2 (2) 1.3 m/s^2 (3) 5.0 m/s^2 (4) 10. m/s^2 7_____

8. If a block is in equilibrium, the magnitude of the block's acceleration is
(1) zero (3) increasing
(2) decreasing (4) constant, but not zero 8_____

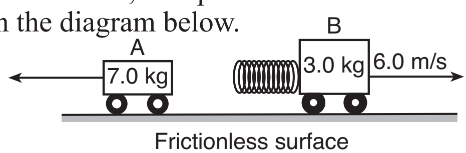
9. The diagram shows a light ray striking a plane mirror. What is the angle of reflection?
(1) 30.° (3) 90.°
(2) 60.° (4) 120.°



9_____

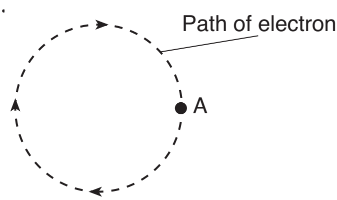
10. An electric field exerts an electrostatic force of magnitude 1.5×10^{-14} newton on an electron within the field. What is the magnitude of the electric field strength at the location of the electron?
(1) 2.4×10^{-33} N/C (3) 9.4×10^{4} N/C
(2) 1.1×10^{-5} N/C (4) 1.6×10^{16} N/C 10_____

11. A 7.0-kilogram cart, *A*, and a 3.0-kilogram cart, *B*, are initially held together at rest on a horizontal, frictionless surface. When a compressed spring attached to one of the carts is released, the carts are pushed apart. After the spring is released, the speed of cart *B* is 6.0 meters per second, as represented in the diagram below.

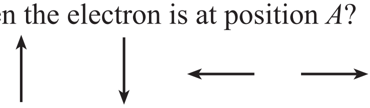


What is the speed of cart *A* after the spring is released?
(1) 14 m/s (2) 6.0 m/s (3) 3.0 m/s (4) 2.6 m/s 11_____

12. An electron in a magnetic field travels at constant speed in the circular path represented in the diagram.



Which arrow represents the direction of the net force acting on the electron when the electron is at position *A*?



(1) (2) (3) (4) 12_____

13. The potential difference between two points, *A* and *B*, in an electric field is 2.00 volts. The energy required to move a charge of 8.00×10^{-19} coulomb from point *A* to point *B* is
(1) 4.00×10^{-19} J (3) 6.25×10^{17} J
(2) 1.60×10^{-18} J (4) 2.50×10^{18} J 13_____

14. Which statement describes the gravitational force and the electrostatic force between two charged particles?
(1) The gravitational force may be either attractive or repulsive, whereas the electrostatic force must be attractive.
(2) The gravitational force must be attractive, whereas the electrostatic force may be either attractive or repulsive.
(3) Both forces may be either attractive or repulsive.
(4) Both forces must be attractive. 14____

15. An electrostatic force exists between two $+3.20 \times 10^{-19}$-coulomb point charges separated by a distance of 0.030 meter. As the distance between the two point charges is *decreased*, the electrostatic force of
(1) attraction between the two charges decreases
(2) attraction between the two charges increases
(3) repulsion between the two charges decreases
(4) repulsion between the two charges increases 15____

16. What is the energy of the photon emitted when an electron in a mercury atom drops from energy level *f* to energy level *b*?
(1) 8.42 eV (2) 5.74 eV (3) 3.06 eV (4) 2.68 eV 16____

17. An observer counts 4 complete water waves passing by the end of a dock every 10. seconds. What is the frequency of the waves?
(1) 0.40 Hz (2) 2.5 Hz (3) 40. Hz (4) 4.0 Hz 17____

18. Copper is a metal commonly used for electrical wiring in houses. Which metal conducts electricity better than copper at 20°C?
(1) aluminum (2) gold (3) nichrome (4) silver 18____

19. A motor does 20. joules of work on a block, accelerating the block vertically upward. Neglecting friction, if the gravitational potential energy of the block increases by 15 joules, its kinetic energy
(1) decreases by 5 J
(2) increases by 5 J
(3) decreases by 35 J
(4) increases by 35 J 19____

20. When only one lightbulb blows out, an entire string of decorative lights goes out. The lights in this string must be connected in
(1) parallel with one current pathway
(2) parallel with multiple current pathways
(3) series with one current pathway
(4) series with multiple current pathways 20____

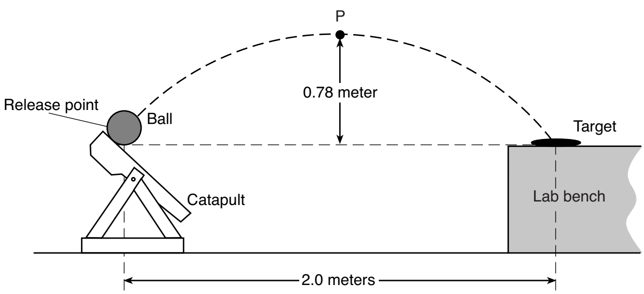
Part C

Answer all questions in this part.

***Directions* (66–85): Record your answers in the spaces provided. Some questions may require the use of the *2006 Edition Reference Tables for Physical Setting/Physics*.**

Base your answers to questions 66 through 70 on the information and diagram below and on your knowledge of physics.

A group of students constructs a catapult that launches a ball at a target placed on a lab bench. The students measure 0.80 second from the time the ball is released until it strikes the target, located a horizontal distance of 2.0 meters from the release point. The ball reaches a maximum height at point *P*, which is 0.78 meter above the ball's release point. The target is at the same height as the release point. [Neglect friction.]



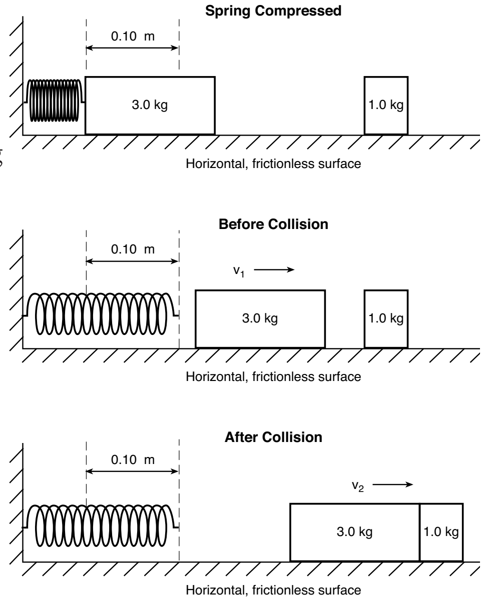
66–67. Calculate the horizontal component of the ball's initial velocity. [Show all work, including the equation and substitution with units.] [2]

68–69. Calculate the vertical component of the ball's initial velocity. [Show all work, including the equation and substitution with units.] [2]

70. On the diagram above, draw an arrow originating at point *P* that represents the direction of the ball's acceleration at point *P*. [1]

Base your answers to questions 71 through 75 on the information and diagram below and on your knowledge of physics.

A spring with a spring constant of 2600 newtons per meter is compressed 0.10 meter from its unstretched position. The spring is released, propelling a 3.0-kilogram block along a horizontal, frictionless surface. This block then collides with a stationary 1.0-kilogram block. The blocks remain joined and move together as shown in the accompanying diagram.



71. Determine the total amount of elastic potential energy stored in the spring when the spring is compressed 0.10 meter. [1]

______________ J

72–73. Assuming all of the spring's energy is transferred to the 3.0-kilogram block, calculate the speed, v_1, of the 3.0-kilogram block immediately after it is propelled by the spring. [Show all work, including the equation and substitution with units.] [2]

74–75. Calculate the speed, v_2, of the two blocks after the collision. [Show all work, including the equation and substitution with units.] [2]

Base your answers to questions 76 through 80 on the information below and on your knowledge of physics.

A mercury atom emits a photon when an electron in the atom moves from energy level *f* to energy level *d*.

76. Determine the energy of the emitted photon, in electronvolts. [1]

_____________ eV

77. Determine the energy of the emitted photon, in joules. [1]

_____________ J

78–79. Calculate the frequency of the emitted photon. [Show all work, including the equation and substitution with units.] [2]

80. Based on your calculated value of the frequency of the emitted photon, determine its classification in the electromagnetic spectrum. [1]

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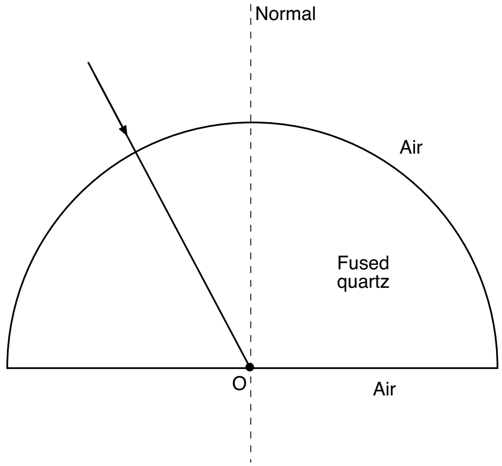
Base your answers to questions 81 through 85 on the information and diagram below, and on your knowledge of physics.

The diagram represents the path followed by a ray of light ($f = 5.09 \times 10^{14}$ Hz) as it strikes a semicircular block of fused quartz perpendicular to its curved surface.



81. Use a protractor to determine the angle of incidence of the light ray at point *O*. [1] __________ °

82–83. Calculate the angle of refraction as the light ray leaves the fused quartz at point *O* and enters the air. [Show all work, including the equation and substitution with units.] [2]

84. Starting at point *O* and using a protractor and ruler, draw the refracted ray at the appropriate angle of refraction on the diagram above. [1]

85. Compare the frequency of the light in fused quartz to the frequency of the light in air. [1]

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June 2022

PHYSICAL SETTING PHYSICS
Answers and Explanations
June 2017
Part A

1. 2 A vector is a quantity having both magnitude (size) and direction. A force has both magnitude and direction and is therefore a vector. The MKS unit for force is the newton. The other units (watt, kilogram and second) are for power, mass and time, respectively, which are scalar quantities, possessing magnitude only.

2. 3 The 20. m displacement is the resultant of the two perpendicular components. In a vector diagram, it would be the hypotenuse of the triangle formed by the two components. Under Geometry and Trigonometry - Right Triangle - find the equation $c^2 = a^2 + b^2$. Substituting the values of the components given as choices for a and *b*, only choice 3 yields a 20. m resultant.

3. 4 Distance is a scalar quantity, having only magnitude (size). The total distance traveled is the arithmetic sum of the individual distances.

4. 1 Under Mechanics, find the equation $a = \Delta v/t$. Δv may be expressed as $v_f - v_i$. Substitution and solving gives $a = (6.0 \text{ m/s} - 16 \text{ m/s})/(4.0 \text{ s})$. Solving, $a = -2.5 \text{ m/s}^2$. The negative value indicates that the acceleration is in the opposite direction of the velocity and the car is slowing down.

5. 4 The force of gravity acting on an object is the weight of the object. Under Mechanics, find the equation $g = F_g/m$. Substitution and solving gives $g = (40. \text{ N})/(10. \text{ kg}) = 4.0 \text{ m/s}^2$.

6. 2 Under Mechanics, find the equation $v_f^2 = v_i^2 + 2ad$. Substitution gives $(14 \text{ m/s})^2 = (8.0 \text{ m/s})^2 + 2(a)(44 \text{ m})$. Solving, $a = 1.5 \text{ m/s}^2$.

7. 3 Under Mechanics, find the equation $d = v_i t + ½at^2$. Since the object starts from rest, $v_i t = 0$. Substitution gives $40. \text{ m} = ½(a)(4.0 \text{ s})^2$, where *a* is the acceleration due to gravity. Solving, $a = 5.0 \text{ m/s}^2$.

8. 1 An object is in a state of equilibrium when it is a rest or moving with a constant velocity. In either case, the acceleration of the object is zero.

9. 2 In reflection, the angle of incidence (the angle between the incident ray and the normal) and the angle of reflection (the angle between the reflected ray and the normal) are equal.

10. 3 Under Electricity, find the equation $E = Fe/q$. The charge on an electron (the elementary charge) is found on the List of Physical Constants. Substitution and solving gives
$E = (1.5 \times 10^{-14} \text{ N}) / (1.60 \times 10^{-19} \text{ C}) = 9.4 \times 10^4 \text{ N/C}$.

11. 4 Under Mechanics, find the equations $p = mv$ and $p_{before} = p_{after}$.
Since the carts are initially at rest, $p_{before} = 0$. Substitution gives
$0 = (7.0 \text{ kg})(v) + (3.0 \text{ kg})(6.0 \text{ m/s})$. Solving, $v = -2.6$ m/s.
The negative sign indicates that cart *A* is moving in the opposite direction relative to cart *B*.

12. 3 In circular motion, the force acting on the object (centripetal force) acts toward the center of the circle.

13. 2 Under Electricity, find the equation $V = W/q$. Work and energy are equivalent quantities. Substitution gives $(2.00\ V) = W/(8.00 \times 10^{-19}\ C)$. Solving, $W = 1.6 \times 10^{-18}$ J.

14. 2 The gravitational force between two objects is always one of attraction. The electrical force between two charges may be one of attraction (between two unlike charges) or one of repulsion (between two like charges).

15. 4 Since the two charges are both positive, the force is one of repulsion. Under Electricity, find the equation $F = kq_1q_2/r_2$. This indicates that the force varies indirectly with the square of the distance between the charges. Therefore, as the distance between the charges decreases, the force between the charges increases. See 4d under Helpful Hints for Physics in the back of this book.

16. 3 Under Modern Physics, find the equation $E_{photon} = E_i - E_f$. Find the Energy Level Diagram for Mercury. $E_i = -2.68$ eV and $E_f = -5.74$ eV. Substitution and solving gives $E_{photon} = (-2.68\ eV) - (-5.74\ eV) = 3.06$ eV.

17. 1 The frequency of a wave is defined as the number of waves occurring per unit time. For this wave, the frequency would be $f = (4\ waves)/(10.\ s) = 0.4\ waves/s = 0.4$ Hz.

18. 4 Find the table of Resistivities at 20°C. For a metal to conduct electricity better than copper at 20°C, it must have a lower resistivity than copper. The only choice with a lower value is silver.

19. 2 Under ideal conditions (neglecting friction), during any change in energy of an object, the total amount of energy remains constant (Law of Conservation of Energy). Work and energy are equivalent quantities. If the motor does 20. J of work on the block, its energy must increase by 20. J. If the gravitational potential energy of the block increases by 15 J, the kinetic energy must increase by 5 J.

20. 3 When devices are connected in series in a circuit, there is only one path for current. Therefore, when one lightbulb blows out, all the rest of the bulbs in that circuit will go out.

21. 4 Under Electricity, find the equation $W = Pt$. Work and energy are equivalent quantities. Substitution and solving gives $W = (1200\ W)(30.\ s) = 3.6 \times 10^4$ J.

22. 1 The rate at which work is done or energy is expended is power. Under Mechanics, find the equations $g = F_g/m$ and $P = F\overline{v}$. The force needed to lift the block is the weight of the block. Solving the first equation for F_g gives $F_g = mg$. The second equation may then be written as $P = mg\overline{v}$. The value of g is found on the List of Physical Constants in the RT. Substitution gives $P = (35\ kg)(9.81\ m/s^2)(5.0\ m/s)$. Solving, P =1700 W.

23. 2 A wave transfers energy from one point to another. If transmitted through a material medium, the particles vibrate about the rest or equilibrium positions but do not travel along with the wave.

24. 3 Resonance is the response of an object to impressed vibrations of the same natural frequency of vibration of the object. If the vibrations are strong enough, the glass will shatter.

25. 3 Sound requires a material medium for transmission. The other choices are electromagnetic waves, which do not require a material medium for transmission.

26. 4 Electromagnetic waves are produced by moving charged particles. Electrons are negatively charged particles.

27. 1 Once produced, the frequency of a wave remains constant.

28. 1 Under Waves, find the equation $n = c/v$. Solving for v, $v = c/n$. This shows that the speed of light in a medium varies inversely with the index of refraction of the medium. If the index of refraction of the medium doubles, the speed is halved. See 4*c* under Helpful Hints for Physics in the back of this book.

29. 2 In a transverse wave, the particles of the medium vibrate at a right angle to the direction of propagation or travel of the wave. At the point shown in the diagram, point *P* is moving upward toward the top of the approaching crest.

30. 4 Opposite charges attract when placed near each other. A charged object will attract a neutral object.

31. 1 Examples of baryons are protons and neutrons. Therefore they are positive or neutral, respectively. Find the table of Classification of Matter. This shows that baryons are composed of 3 quarks. The possible charges of quarks are given in the table of Particles of the Standard Model. The sum of the charges given in the choices must be either +1 or 0. The sum of the charges given in the choices are +1 e, +2/3 e, –2 e and +4/3 e, respectively.

32. 3 The force needed to start the motion must overcome the force of friction between the two surfaces. Under Mechanics, find the equation $F_f = \mu F_N$. The value of μ is found on the table of Approximate Coefficients of Friction. Since the block is starting from rest, the coefficient of static friction must be used. The normal force is the weight of the block. Substitution and solving gives $F_f = (0.85)(60.\text{ N}) = 51\text{ N}$.

33. 4 Inertia is measured quantitatively by the mass of an object. The greater the mass, the greater the inertia of the object.

66. Answer:

$$d = v_i t + \frac{1}{2}at^2$$

$$\overline{v} = \frac{d}{t} \qquad \text{or} \qquad v_i = \frac{d - \frac{1}{2}at^2}{t}$$

$$\overline{v} = \frac{2.0\text{ m}}{0.80\text{ s}}$$

$$v_i = \frac{2.0\text{ m} - \frac{1}{2}(0\text{m/s}^2)(0.80\text{ s})^2}{0.80\text{ s}}$$

Explanation: Under Mechanics find the equation $\overline{v} = d/t$. The horizontal distance (d) is 2.0 m and the time needed to travel that distance is 0.80 s. Substitution gives $\overline{v}$ = (2.0 m)/(0.80 s).

67. Answer: v = 2.5 m/s

Explanation: Solve the equation in question 66.

68. Answer: $v_f = v_i + at \quad v_i = v_f - \text{at} \quad v_i = 0 - (-9.81\text{ m/s}^2)(0.40\text{ s})$

or

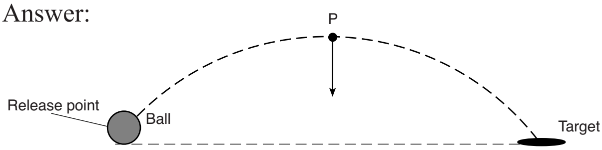
$v_f = v_i + at \quad -v_i = v_1 + (-9.81\text{ m/s}^2)(0.40\text{ s})$

Explanation: Under Mechanics find the equation $v_f = v_i + at$. In the vertical, the initial speed of the object is greater than zero and decreases to zero at the top of the path due to the deceleration of gravity (–g). It took 0.80 s to travel the full path, to reach the top of the path (½ way) it takes 0.40 s. Substituting in gives $0 = v_i + (-9.8\text{ m/s}^2)(0.40\text{ s})$ and $v_i = 0 - (-9.81\text{ m/s}^2)(0.40\text{ s})$.

69. Answer: v_i =3.9 m/s

Explanation: Solve the equation in question 68.

70. Answer:



Explanation: The acceleration at point P is the downward acceleration of gravity. The arrow should point downward at point P.

71. Answer: 13 J

Explanation: The elastic potential energy stored in the compressed spring is equal to the work done on the spring in compressing it. Under Mechanics, find the equation $PE_s = ½kx^2$. Substituting and solving gives PE_s = ½(2600 N/m)(0.1 m)^2 = 13 J.

72. Answer: $KE = \frac{1}{2}mv^2$

$$v = \sqrt{\frac{2KE}{m}}$$

$$v = \sqrt{\frac{2(13\text{ J})}{3.0\text{ kg}}}$$

Explanation: As the spring expands, the energy of the spring is converted into kinetic energy, producing motion. Under Mechanics, find the equation $KE = ½mv^2$ and substitute values as shown in the answer.

73. Answer: $v = 2.9$ m/s

Explanation: Solve the equation in question 72.

74. Answer: $P_{before} = P_{after}$

$$m_1v_1 = (m_1 + m_2)v_2$$
$$v_2 = m_1v_1/m_1 + m_2$$
$$v_2 = (3.0 \text{ kg})(2.9 \text{ m/s})/3.0 \text{ kg} + 1.0 \text{ kg}$$

Explanation: Under Mechanics in the RT, find the equations $p = mv$ and $P_{before} = P_{after}$. Before the collision, the momentum of mass m_1 is m_1v_1 and that of mass m_2 is 0 since it is at rest. After the collision, the momentum of mass m_1 is m_1v_2 and that of mass m_2 is m_2v_2.
Substitution into the second equation gives $m_1 + 0 = m_1v_1 + m_2v_2$.
Solving for v_2: $v_2 = (m_1v_1)/(m_2 + m_2)$.

75. Answer: $V_2 = 2.2$ m/s

Explanation: Solve the equation in question 74.

76. Answer: 2.27 eV

Explanation: Under Energy Level Diagrams, find the one for mercury. The energy emitted is the difference between the two energy levels, level *f* (–2.68 eV) and level *d* (–4.94 eV).
Emitted energy = (–2.68 eV) – (–4.95 eV) = 2.27 eV. The positive energy value indicates that energy is released during this transition.

77. Answer: 3.63×10^{-19} J

Explanation: Under the List of Physical Constants, find 1 eV = 1.60×10^{-19} J.
Converting eV to J: 2.27 eV × (1.60 z 10^{-19} J/1 eV) = 3.63×10^{-19} J

78. Answer: $E_{photon} = hf$ $\quad f = E_{photon}/h$ $\quad f = 3.63 \times 10^{-19}\text{ J}/(6.63 \times 10^{-34}\text{ J•s})$

Explanation: Under Modern Physics, find the equation $E_{photon} = hf$.
Under List of Physical Constants, find the value of *h* (Planck's constant).
Substitute in the value of *h* and the energy of the emitted photon as calculated in question 77.

79. Answer: $f = 5.48 \times 10^{14}$ Hz

Explanation: Solve the equation in question 78.

80. Answer: green *or* visible light

Explanation: Find the frequency 5.48×10^{14} Hz in The Electromagnetic Spectrum chart. This frequency is in the green area.

81. Answer: 28° ± 2°

Explanation: The angle of incidence is the angle between the incident ray and the perpendicular (the normal) at the point of incidence. As measured with a protractor, the angle of incidence is 28°.

82. Answer: $n_1 \sin \theta_1 = n_2 \sin \theta_2$

$\sin \theta_2 = n_1 \sin \theta_1 / n_2$

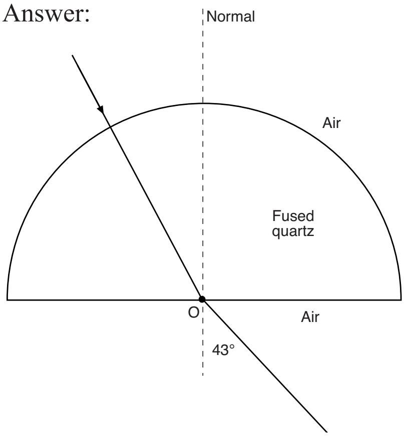
$\sin \theta_2 = 1.46 (\sin 28°)/1.00$

Explanation: Under Waves, find the equation $n_1 \sin \theta_1 = n_2 \sin \theta_2$ (Snell's Law). The indices of refraction of air and fused quartz are found on the table of Absolute Indices of Refraction.

83. Answer: $\theta_2 = 43°$ *or* 44°

Explanation: Solve the equation in question 82.

84. Answer:



Note: Credit is awarded if the refracted ray is drawn 43° ± 2° to the normal.

Explanation: The angle of refraction is the angle between the refracted ray and the normal at the point of refraction. Since the ray is exiting the fused quartz and entering air, from a higher to lower index of refraction, its speed increases and it will be refracted away from the normal. Draw a line at a 43° angle away from the normal.

85. Answer: The frequency does not change. *or* The frequencies are the same.

Explanation: The frequency of the light does not change during refraction. Only the wavelength and direction of travel changes.

Helpful Hints for Physics

Physics is a science that uses many equations to arrive at a solution to a problem. To help you learn physics, here are a few helpful hints.

1. For a numerical problem, do your "bookkeeping". Read the problem through once. Now read it again and write down in list form the information given with the correct symbols and units along with the unknown. This is the "bookkeeping" part. Look at what you have written down and select the equation that relates to all of the variables. In some problems, two equations may have to be used. Drawing a labeled diagram can be especially helpful in problems such as those dealing with vectors or projectile (two dimensional) motion. Do this whenever you think a diagram will help you "see" the problem more clearly.

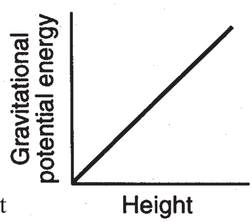
2. Use units in your equation setup and solution. Do the same algebra with the units as you do with the number in solving the problem. The correct unit for the unknown quantity should come from the units used in the setup. Arriving at an answer with the correct unit is a strong indication that your solution is correct. Dimensional analysis is a process of using units to solve a problem or make a conversion.

3. Know the physics reference table (RT) well. Know the type of information and its location in the RT. Many questions can be answered simply by looking in the right place in the RT. Commonly used equations along with the meaning of the symbols are in the RT, listed under the topic to which they refer.

4. Graphs are a convenient and useful way to show the relationship between variables in an equation. The following types occur frequently in physics:

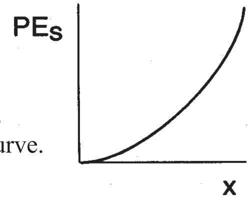
   a) Direct relationship – mathematically, this is represented by $y = kx$, where k is a constant. In a simple direct relationship, as x increases, y increases at the same rate. If x doubles, y doubles. It is said that y varies directly with x. The graph is a straight line.

   Example: $\Delta PE = mg\Delta h$ where (mg) is constant



   b) Direct square relationship – mathematically, this is represented by $y = kx^2$, where k is a constant. In a direct square relationship, as x increases, y increases at a more rapid rate. If x doubles, y quadruples. It is said that y varies directly with the square of x. The graph is a curve.

   Example: $PE_s = \frac{1}{2} kx^2$ where ($\frac{1}{2} k$) is constant



PHYSICAL SETTING
PHYSICS — REFERENCE TABLE
2006 EDITION

Contents

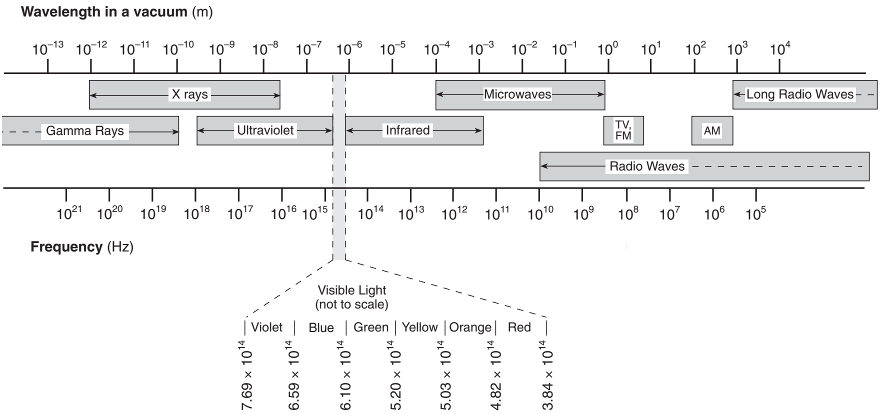
List of Physical Constants

Name	Symbol	Value
Universal gravitational constant	G	6.67×10^{-11} N•m²/kg²
Acceleration due to gravity	g	9.81 m/s^2
Speed of light in a vacuum	c	3.00×10^{8} m/s
Speed of sound in air at STP		3.31×10^{2} m/s
Mass of Earth		5.98×10^{24} kg
Mass of the Moon		7.35×10^{22} kg
Mean radius of Earth		6.37×10^{6} m
Mean radius of the Moon		1.74×10^{6} m
Mean distance—Earth to the Moon		3.84×10^{8} m
Mean distance—Earth to the Sun		1.50×10^{11} m
Electrostatic constant	k	8.99×10^{9} $N \bullet m^2/C^2$
1 elementary charge	e	1.60×10^{-19} C
1 coulomb (C)		6.25×10^{18} elementary charges
1 electronvolt (eV)		1.60×10^{-19} J
Planck's constant	h	6.63×10^{-34} J•s
1 universal mass unit (u)		9.31×10^{2} MeV
Rest mass of the electron	m_e	9.11×10^{-31} kg
Rest mass of the proton	m_p	1.67×10^{-27} kg
Rest mass of the neutron	m_n	1.67×10^{-27} kg

Prefixes for Powers of 10		
Prefix	**Symbol**	**Notation**
tera	T	10^{12}
giga	G	10^{9}
mega	M	10^{6}
kilo	k	10^{3}
deci	d	10^{-1}
centi	c	10^{-2}
milli	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}

Approximate Coefficients of Friction		
	Kinetic	**Static**
Rubber on concrete (dry)	0.68	0.90
Rubber on concrete (wet)	0.58	
Rubber on asphalt (dry)	0.67	0.85
Rubber on asphalt (wet)	0.53	
Rubber on ice	0.15	
Waxed ski on snow	0.05	0.14
Wood on wood	0.30	0.42
Steel on steel	0.57	0.74
Copper on steel	0.36	0.53
Teflon on Teflon	0.04	

The Electromagnetic Spectrum



Absolute Indices of Refraction ($f = 5.09 \times 10^{14}$ Hz)	
Air	1.00
Corn oil	1.47
Diamond	2.42
Ethyl alcohol	1.36
Glass, crown	1.52
Glass, flint	1.66
Glycerol	1.47
Lucite	1.50
Quartz, fused	1.46
Sodium chloride	1.54
Water	1.33
Zircon	1.92