654) C

655) D

656) C

657) A

658) D

659) B

660) B

661) C

662) A

663) D

664) C

665) A

666) C

667) D

668) 0.51 m OR 0.509 m
WORK SHOWN: $v = f\lambda$, $\lambda = \frac{v}{f}$, $\lambda = \frac{331 \text{ m/s}}{650 \text{ hz}}$, $\lambda = 0.51$ m OR 0.509 m

669) C

670) C

671) C

672) B

673) C

674) C

675) B

676) A

677) C

678) B

679) D

680) C

681) C

682) B

683) D

684) C

685) D

686) C

687) A

688) B

689) A

690) D

691) A

692) B

693) D

694) C

695) A

696) D

697) C

698) C

699) D

700) C

701) B

702) A

703) D

704) D

705) D

706) A

707) B

708) C

709) C

710) C

711) A

712) D

713) B

714) B

715) C

716) C

717) C

718) B

719) A

720) B

721) C

722) B

723) C

724) B

725) C

726) D

727) C

728) C

729) D

730) C

731) B

732) C

733) D

734) D

735) C

736) D

737) D

738) B

739) D

740) C

741) D

742) C

743) B

744) B

745) A

746) D

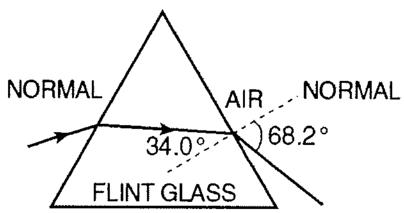
747) D

748) C

749) (a) 68.2° OR 68°

WORK SHOWN: $n_1 \sin \theta_1 = n_2 \sin \theta_2$, $\sin \theta_2 = \frac{n_1 \sin \theta_1}{n_2}$, $\sin \theta_2 = \frac{1.66 \sin 34.0°}{1.00}$, = 68.2° OR 68°;

(b)



750) C

751) A

752) A

753) C

754) A

755) A

756) B

757) C

758) A

759) A

760) D

761) B

762) A

763) C

764) C

765) C

766) D

767) D

768) C

769) A

770) B

771) A

772) C

773) A

774) D

775) D

776) B

777) A

778) D

779) D

780) C

781) C

782) C

783) A

784) B

785) A

786) C

787) C

788) B

789) B

790) C

791) C

792) B

793) C

794) A

795) B

796) A

797) C

798) A

799) B

800) D

801) D

802) A

803) B

804) D

805) (a) 0.20 Hz

WORK SHOWN: $T = \frac{1}{f}, f = \frac{1}{T}, f = \frac{1}{5.0\text{ s}} = 0.20$ Hz;

(b) 0.40 m/s

WORK SHOWN: $v = f\lambda$, $v = (0.20\text{ Hz})(2.0\text{ m}) = 0.40$ m/s OR $\bar{v} = \frac{d}{t}, \bar{v} = \frac{2.0\text{ m}}{5.0\text{ s}} = 0.40$ m/s

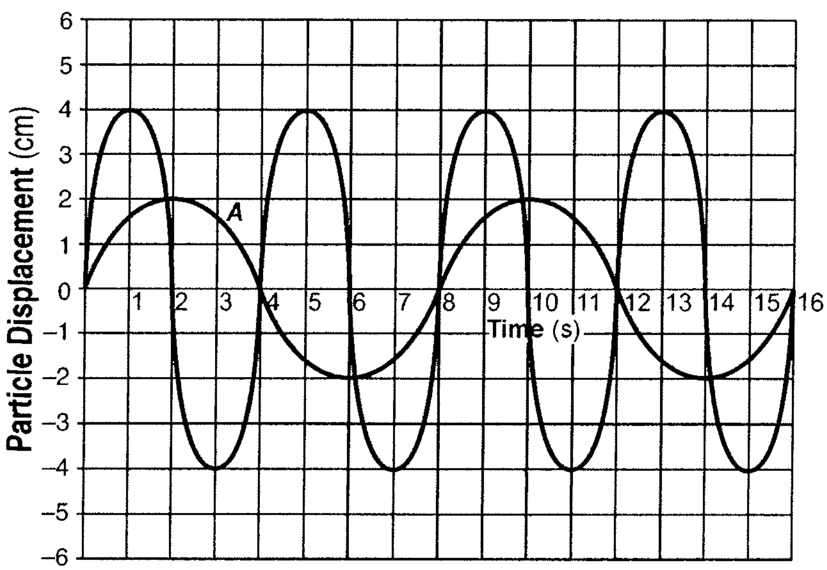
806) 3.28 m OR 3.3 m

807) 1.0 m OR 1 m

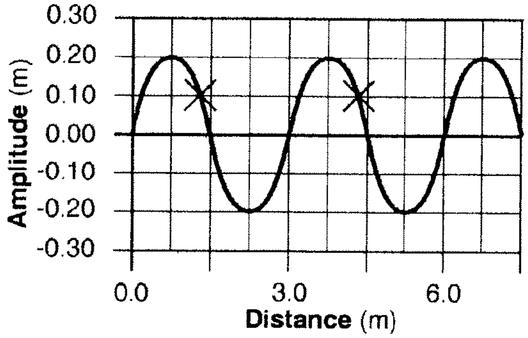
808) 0.50 s OR 0.5 s

809) 6.0 m/s OR 6 m/s

810)



811) SAMPLE ANSWER:



812) 0.75 s or 0.77 s

WORK SHOWN: $v = f\lambda$, $T = \frac{1}{f} = \frac{\lambda}{v} = \frac{3.0\text{ m}}{4.0\text{ m/s}} = 0.75$ s

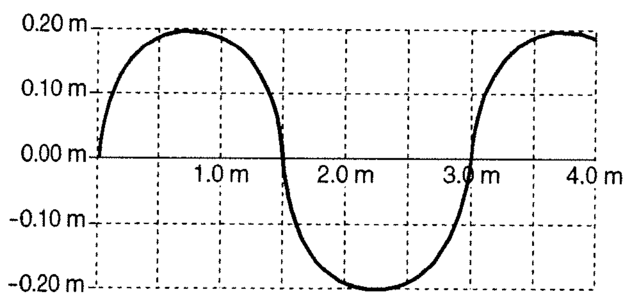
OR

$v = f\lambda$, 4.0 m/sec $= f(3.0$ m$)$, $f = 1.3$ Hz, $T = \frac{1}{f} = \frac{\lambda}{v} = \frac{1}{1.3\text{ Hz}} = 0.77$ s

OR

$\bar{v} = \frac{d}{t}$, $t = \frac{d}{v} = \frac{3.0\text{ m}}{4.0\text{ m/s}} = 0.75$ s

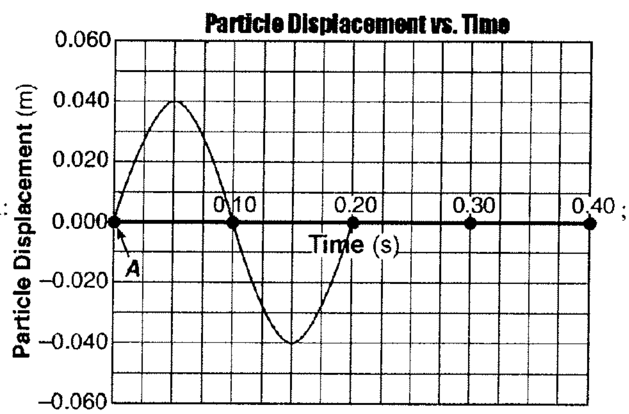
813)



814) A

815) (a) 0.20 s OR $\frac{1}{5}$ s;

(b) SAMPLE ANSWER:



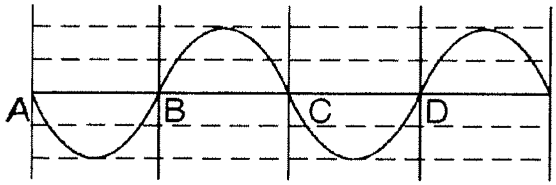
;

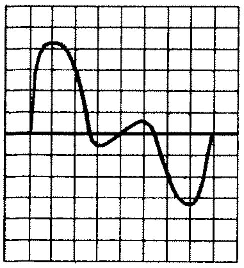
(c) 0.40 m/s

WORK SHOWN: $v = f\lambda$, $v = (5.0\text{ Hz})(0.080\text{ m})$, $v = 0.40$ m/s OR $v = \frac{d}{t}$, $v = \frac{0.080\text{ m}}{0.2\text{ s}}$, $v = 0.4$ m/s

816) SAMPLE ANSWERS: The Doppler effect is the variation in observed frequency when there is relative motion between a wave source and a receiver. OR The Doppler effect is the variation in observed wavelength when there is relative motion between a wave source and a receiver. OR The Doppler effect is the increase or decrease in wave frequency that results from the relative motion of a wave source and an observer.

817) SAMPLE ANSWERS: interference OR destructive interference OR principle of superposition

818) 

819) 

820) SAMPLE ANSWERS: amplitude OR speed

821) SAMPLE ANSWERS: wavelength OR frequency OR period

822) 0.8 cm (±0.2 cm)

823) 3.3 cm (±0.2 cm)

824) SAMPLE ANSWER: The wavelength would decrease.

825) 4

826) SAMPLE ANSWERS: resonance OR standing waves OR sympathetic vibration

827) SAMPLE ANSWERS: correct frequency AND sufficient energy OR amplitude OR loudness OR duration

828) SAMPLE ANSWER: The frequency of the sound is changed by variations in the speed of the tape.

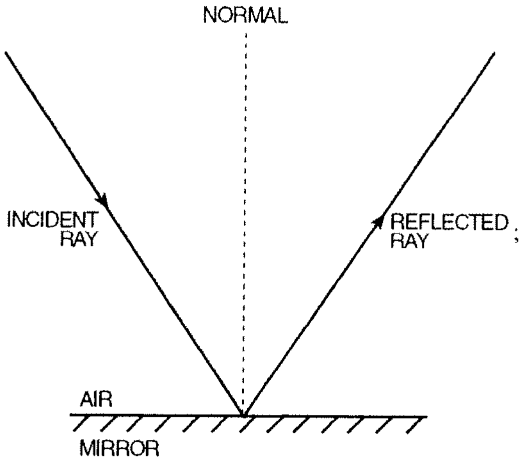
829) 140 m OR 136 m

WORK SHOWN: $v = f\lambda$, $\lambda = \frac{v}{f}$, $\lambda = \frac{3.00 \times 10^8 \text{ m/s}}{2.2 \times 10^6 \text{ Hz}}$, $\lambda = 1.4 \times 10^2$ m, 140 m OR 136 m

830) 2.5×10^9 Hz OR 25×10^8 l/s

WORK SHOWN: $v = f\lambda$, $f = \frac{v}{\lambda}$, $f = \frac{3.0 \times 10^8 \text{ m/s}}{0.12 \text{ m}} = 2.5 \times 10^9$ Hz OR $c = f\lambda$, $f = \frac{c}{\lambda}$, $f = \frac{3.0 \times 10^8 \text{ m/s}}{0.12 \text{ m}} = 25 \times 10^8$ l/s

831) SAMPLE ANSWERS: The wave reflected from the thunderstorm has a higher frequency than the wave emitted by the weather station. OR The frequency of the reflected wave is greater than the emitted wave's frequency. OR The wave reflected from the thunderstorm has a shorter wavelength than the wave emitted by the weather station.

832) (a) 

;

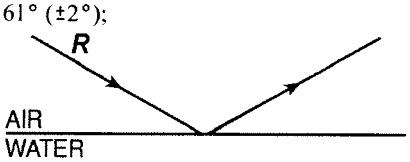
(b) 34° (±2°)

833) 6.00×10^{-7} m OR 0.6×10^{-6} m

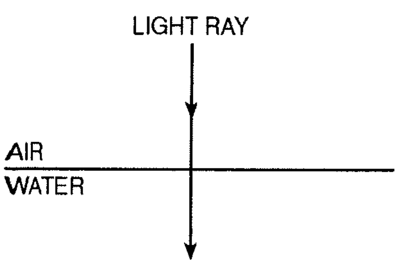
WORK SHOWN: $v = f\lambda$, $\lambda = \frac{v}{f}$, $\lambda = \frac{3.00 \times 10^8 \text{ m/s}}{5.00 \times 10^{14} \text{ Hz}}$, $\lambda = 6.00 \times 10^{-7}$ m

834) orange

835) (a) 61° (±2°);

(b) 

836) $C \rightarrow A \rightarrow B \rightarrow D$

837) 

838) 1.67 OR 1.7

WORK SHOWN: $n = \frac{c}{v}$, $n = \frac{3.00 \times 10^8 \text{ m/s}}{1.80 \times 10^8 \text{ m/s}}$, $n = 1.67$ OR 1.7

839) (a) 1.94

WORK SHOWN: $n_1 \sin \theta_1 = n_2 \sin \theta_2$, $n_2 = \frac{n_1 \sin \theta_1}{\sin \theta_2}$, $n_2 = \frac{1.33 \sin 45}{\sin 29°}$, $n_2 = 1.94$;

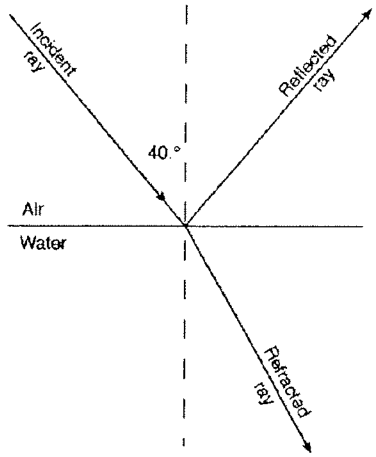
(b) zircon

840) (a) 29° OR 28.9°

WORK SHOWN: $n_1 \sin \theta_1 = n_2 \sin \theta_2$, $\sin \theta_2 = \frac{n_1 \sin \theta_1}{n_2}$, $\sin \theta_2 = \frac{(1.00)(\sin 40.°)}{1.33}$, $\sin \theta_2 = 0.483$, $\theta_2 = 29°$ OR 28.9°

(b) refracted ray at an angle of 29° (±2°), as drawn below

(c) reflected ray at an angle of 40.° (±2°), as drawn below



841) 59° OR 58.7°

WORK SHOWN: $n_1 \sin \theta_1 = n_2 \sin \theta_2$, $\sin \theta_2 = \frac{n_1 \sin \theta_1}{n_2} = \frac{(1.33)(\sin 40.°)}{1.00} = 0.855$, $\theta_2 = 59°$ OR 58.7°

842) 2.26×10^8 m/s

WORK SHOWN: $\frac{n_2}{n_1} = \frac{v_1}{v_2}$, $v_1 = \frac{n_2 v_2}{n_1} = \frac{1.00(3.00 \times 10^8 \text{ m/s})}{1.33} = 2.26 \times 10^8$ m/s

OR

$n = \frac{c}{v}$, $v = \frac{c}{n} = \frac{3.00 \times 10^8 \text{ m/s}}{1.33} = 2.26 \times 10^8$ m/s

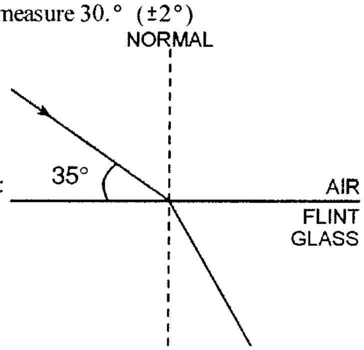
843) (a) 55° (±2°);

(b) 29.6° or 30.°

WORK SHOWN: $n_1 \sin \theta_1 = n_2 \sin \theta_2$, $\sin \theta_2 = \frac{n_1 \sin \theta_1}{n_2}$, $\sin \theta_2 = \frac{(1.00)(\sin 55°)}{1.66} = 0.493$, $\theta_2 = 29.6°$ or 30.°

(c) refracted ray should measure 30.° (±2°)

SAMPLE ANSWER:



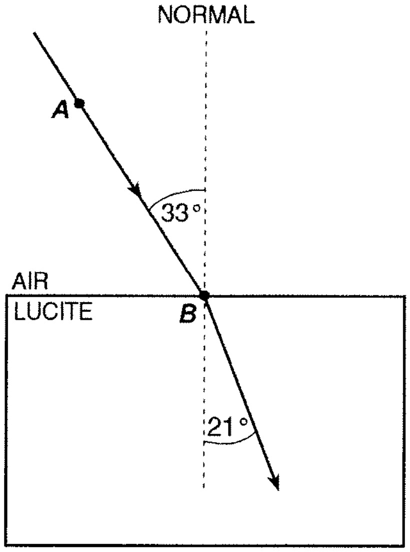
844) SAMPLE ANSWERS: reflected OR scattered

845) (a) 21°

WORK SHOWN: $n_1 \sin \theta_1 = n_2 \sin \theta_2$, $\sin \theta_2 = \frac{n_1 \sin \theta_1}{n_2}$, $\sin \theta_2 = \frac{1.00 \sin 33°}{1.50}$, $\sin \theta_2 = \frac{1.00(0.5446)}{1.50}$, $\sin \theta_2 = 0.363$, $\theta_2 = 21°$ OR

$n_1 \sin i = n_2 \sin r$, (1.00)(sin 33°) = (1.50)sin r, $r = 21°$;

(b)



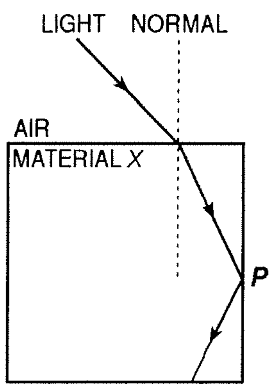
846) SAMPLE ANSWERS: Light travels faster in air than in Lucite. OR Yellow light travels slower in Lucite than in air.

847) (a) angle of incidence = 45° (±2°), angle of refraction = 26° (±2°);

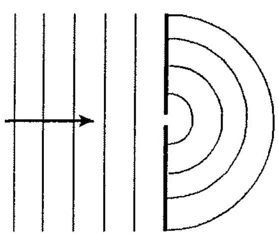
(b) 1.61

WORK SHOWN: $n_1 \sin \theta_1 = n_2 \sin \theta_2$, $n_2 = \frac{(1.00)(\sin 45°)}{\sin 26°} = 1.61$;

(c)



848)



849) orange

850) SAMPLE ANSWERS: Visible light has less energy. OR Visible light has lower frequency. OR Visible light has longer wavelength. OR Ultraviolet has higher energy. OR Ultraviolet has higher frequency. OR Ultraviolet has shorter wavelength. OR Ultraviolet radiation resonates with the cell membrane.

851) SAMPLE ANSWERS: violet OR the one with the greatest frequency

852) SAMPLE ANSWERS: Yellow green has a higher intensity. OR Yellow green is brighter than red.

853) B

854) D

855) D

856) C

857) A

858) C

859) D

860) D

861) C

862) A

863) D

864) B

865) D

866) C

867) B

868) A

869) C

870) A

871) C

872) B

873) C

874) A

875) B

876) D

877) C

878) C

879) C

880) D

881) C

882) C

883) C

884) B

885) B

886) B

887) C

888) B

889) B

890) C

891) B

892) A

893) B

894) C

895) C

896) 0e OR neutral

897) D

898) D

899) C

900) A

901) C

902) D

903) B

904) B

905) 233 MeV

906) -1.6×10^{-19} C

907) 2.21×10^{-16} J

WORK SHOWN: $E = \frac{hc}{\lambda} = \frac{(6.63 \times 10^{-34}\ \text{J}\cdot\text{s})(3.00 \times 10^{8}\ \text{m/s})}{9.00 \times 10^{-10}\ \text{m}} = 2.21 \times 10^{-16}$ J

908) 4.52×10^{14} Hz

909) (a) 4.57×10^{14} Hz OR 4.6×10^{14} Hz

WORK SHOWN: $v = f\lambda, f = \frac{v}{\lambda}, f = \frac{3.00 \times 10^{8}\ \text{m/s}}{6.56 \times 10^{-7}\ \text{m}}, f = 4.57 \times 10^{14}$ Hz OR 4.6×10^{14} Hz;

(b) 3.03×10^{-19} J;

(c) 1.89 eV

910) (a) 1.33×10^{-14} J OR 13.3×10^{-15} J•s•Hz

WORK SHOWN: $E_{photon} = hf$, $E = (6.63 \times 10^{-34}$ J•s)$(2.00 \times 10^{19}$ Hz), $E = 13.3 \times 10^{-15}$ J•s•Hz;

(b) SAMPLE ANSWERS: The energy of the system after the collision is 1.3×10^{-14} J. OR It is the same as the energy of the system before the collision. OR Energy is conserved. OR The energy is the same as before the collision.

911) (a) 4.9×10^{-14} m

WORK SHOWN: $\lambda = \frac{h}{mv}$, $\lambda = \frac{(6.63 \times 10^{-34} \text{ J.s})}{(6.7 \times 10^{-27} \text{ kg})(2.0 \times 10^{6} \text{ m/s})} = 4.9 \times 10^{-14}$ m;

(b) SAMPLE ANSWER: The wavelength of this particle is of the same order of magnitude as gamma rays.

912) 1.64×10^{-13} J

WORK SHOWN: $E = mc^2$, $E = 2(9.11 \times 10^{-31}$ kg$)(3.00 \times 10^{8}$ m/s$)^2$, $E = 1.64 \times 10^{-13}$ J

913) conservation of charge

914) 3.01×10^{-10} J OR 1,860 MeV

WORK SHOWN: $E = mc^2$, $E = 2(1.67 \times 10^{-27}$ kg$)(3.00 \times 10^{8}$ m/s$)^2$, $E = 3.01 \times 10^{-10}$ J OR $\frac{1 \text{ u}}{931 \text{ MeV}} = \frac{2 \text{ u}}{x \text{ MeV}}$, $x = 1{,}860$ MeV

915) SAMPLE ANSWER: The photon's energy must match exactly an energy level transition for the photon to be absorbed.

916) (a) 3.02×10^{-19} J

WORK SHOWN: $E = \frac{hc}{\lambda}$, $E = \frac{(6.63 \times 10^{-34} \text{ J.s})(3.00 \times 10^{8} \text{ m/s})}{6.58 \times 10^{-7} \text{ m}}$, $E = 3.02 \times 10^{-19}$ J;

(b) 1.89 eV;

(c) The n_3 to n_2 transition is also 1.89 eV.

917) (a) 2.03 eV;

(b) SAMPLE ANSWERS: 3.2×10^{-19} J OR (2.03 eV)(1.6×10^{-19} J/eV) = 3.248×10^{-19} J

918) SAMPLE ANSWERS: Nothing will happen. OR The photon will not be absorbed. OR The mercury atom will remain in the ground state.

919) 3.02×10^{-19} J

WORK SHOWN: $E = \frac{hc}{l}$ OR $E = \frac{6.63 \times 10^{-34} \text{ J.s}(3.00 \times 10^{8} \text{ m/s})}{6.58 \times 10^{-17} \text{ m}}$ OR $E = 3.02 \times 10^{-19}$ J

920) 1.89 eV

921) 3 and 2

922) SAMPLE ANSWER: No, it cannot be an x-ray because the wavelength is too long.

923) 1.89 eV

924) (a) 3.02×10^{-19} J;

(b) 4.56×10^{14} Hz

WORK SHOWN: $E = hf$, $f = \frac{E}{h}$, $f = \frac{3.02 \times 10^{-19} \text{ J}}{6.63 \times 10^{-34} \text{ J.s}} = 4.56 \times 10^{14}$ Hz;

(c) 6.59×10^{-7} m OR 6.59×10^{-7} m

WORK SHOWN: $v = f\lambda$, $\lambda = \frac{v}{f}$, $\lambda = \frac{3.00 \times 10^{8} \text{ m/s}}{4.56 \times 10^{14} \text{ Hz}} = 6.58 \times 10^{-7}$ m OR $E = \frac{hc}{\lambda}$, $\lambda = \frac{hc}{E}$, $\lambda = \frac{(6.63 \times 10^{-34} \text{ J.s})(3.00 \times 10^{8} \text{ m/s})}{3.02 \times 10^{-19} \text{ J}} = 6.59 \times 10^{-7}$ m

925) (a) 19.34×10^{-19} J OR 1.934×10^{-18} J;

(b) 2.92×10^{15} Hz OR 2.92×10^{15} l/s

WORK SHOWN: $E = hf, f = \frac{E}{h}, f = \frac{19.34 \times 10^{-19}\ J}{6.63 \times 10^{-34}\ J{\cdot}s}, f = 2.92 \times 10^{15}$ Hz OR $f = 2.92 \times 10^{15}$ l/s

926) (a) 3.02 eV;

(b) 4.83×10^{-19} J;

(c) 7.29×10^{14} Hz

WORK SHOWN: $E = hf, f = \frac{E}{h}, f = \frac{4.83 \times 10^{-19}\ J}{6.63 \times 10^{-34}\ J{\cdot}s}, f = 7.29 \times 10^{14}$ Hz;

(d) No

SAMPLE ANSWERS: The $n = 6$ level can return to any of the 5 lower energy levels. OR The electron can drop to many different energy levels. OR The electron can fall from $n = 6$ to any other level between $n = 5$ and $n = 1$. OR $6 \longrightarrow 5, 6 \longrightarrow 4, 6 \longrightarrow 3, 6 \longrightarrow 1$

927) SAMPLE ANSWER: Mass is converted into energy.

928) (a) 10^{-8};

(b) 10^{-47};

(c) SAMPLE ANSWERS: The electrostatic force is 10^{39} stronger than the gravitational force. OR The gravitational force is smaller than the electromagnetic interaction.

929) strong force OR strong nuclear force

930) SAMPLE ANSWER: The neutron is more massive.

931) SAMPLE ANSWERS: The charge on the electron antineutrino is... zero. OR ...neutral.