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xph232s0 **Section 33**

Physics 232 Final Exam Monday May 1, 2000

Possibly useful information (in SI units):

$c = 3.00 \times 10^8$, $h = 6.626 \times 10^{-34}$, $e = 1.6 \times 10^{-19}$

$k = 9.0 \times 10^9$, something $= 13.6\,\mathrm{eV}$

1. [3pt] A beam of light with frequency $6.742 \times 10^{14}\,Hz$ enters a block of glass whose index of refraction is 1.60 . Find the wavelength (in m) of the light inside the glass.

A) 1.18×10^{-7} B) 1.57×10^{-7} C) 2.09×10^{-7} D) 2.78×10^{-7}
E) 3.70×10^{-7} F) 4.92×10^{-7} G) 6.54×10^{-7} H) 8.70×10^{-7}

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2. [3pt] When a hydrogen atom emits a photon of energy $4.32 \times 10^{-1}\,eV$, it loses an amount of mass (in kg) equal to

A) 6.56×10^{-37} B) 7.67×10^{-37} C) 8.98×10^{-37} D) 1.05×10^{-36}
E) 1.23×10^{-36} F) 1.44×10^{-36} G) 1.68×10^{-36} H) 1.97×10^{-36}

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3. [3pt] A certain star is 30 light-years away. How many years will it take a spacecraft travelling at 0.60 c to reach that star, as measured by the crew of the ship?

A) 1.70×10^{1} B) 1.92×10^{1} C) 2.17×10^{1} D) 2.45×10^{1}
E) 2.77×10^{1} F) 3.13×10^{1} G) 3.54×10^{1} H) 4.00×10^{1}

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4. [3pt] Two space ships are racing in the same direction. Judy's ship is travelling at $2.60 \times 10^8\,m/s$ and Bob's ship is travelling at $1.90 \times 10^8\,m/s$. When Judy passes Bob, how fast (in m/s) does her ship appear to be travelling according to Bob?

A) 9.52×10^{7} B) 1.08×10^{8} C) 1.22×10^{8} D) 1.37×10^{8}
E) 1.55×10^{8} F) 1.75×10^{8} G) 1.98×10^{8} H) 2.24×10^{8}

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5. [3pt] An electron (mass $= 9.11 \times 10^{-31}\,kg$, charge $= 1.60 \times 10^{-19}\,C$) is moving with velocity 0.83 times the speed of light. Calculate its kinetic energy (in J).

A) 4.15×10^{-14} B) 5.19×10^{-14} C) 6.49×10^{-14} D) 8.12×10^{-14}
E) 1.01×10^{-13} F) 1.27×10^{-13} G) 1.58×10^{-13} H) 1.98×10^{-13}

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6. [3pt] The electron configuration of an argon atom in its ground state is $1s^2 2s^2 2p^6 3s^2 3p^6$. How many of the electrons have orbital angular momentum equal to zero?

A) 1 B) 2 C) 3 D) 4
E) 5 F) 6 G) 7 H) 8

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7. [3pt] A hydrogen atom makes a transition from the n=5 energy level to the n=3 energy level. Find the wavelength (in nm) of the photon that is emitted.

A) 8.02×10^{2} B) 9.38×10^{2} C) 1.10×10^{3} D) 1.28×10^{3}
E) 1.50×10^{3} F) 1.76×10^{3} G) 2.06×10^{3} H) 2.41×10^{3}

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8. [3pt] How many neutrons are there in the nucleus that is left over after a ${}^{238}_{94}$Pu nucleus has undergone alpha decay?

A) 136 B) 137 C) 138 D) 139
E) 140 F) 141 G) 142 H) 143

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9. [3pt] The fraction of ${}^{14}C$ in a sample of ancient cloth is 0.728 times what would be expected from a present day sample. Estimate the age of the cloth in years, assuming the half-life of ${}^{14}C$ is 5730 years.

A) 2.62×10^{3} B) 3.07×10^{3} C) 3.59×10^{3} D) 4.20×10^{3}
E) 4.92×10^{3} F) 5.75×10^{3} G) 6.73×10^{3} H) 7.88×10^{3}

(over)

10. [3pt] An electron and a $^{92}_{36}$Kr nucleus are separated by a distance of 4.1×10^{-9} meters. Find the magnitude of the Coulomb force on the electron. (Answer in N)

A) 7.71×10^{-11} B) 1.12×10^{-10} C) 1.62×10^{-10} D) 2.35×10^{-10}
E) 3.41×10^{-10} F) 4.94×10^{-10} G) 7.16×10^{-10} H) 1.04×10^{-9}

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11. [3pt] Two electrons are very far apart. Find the amount of work required, as a result of the Coulomb force, to bring them to a distance of 5.40×10^{-9} meters apart. (Answer in J)

A) 2.05×10^{-20} B) 2.32×10^{-20} C) 2.62×10^{-20} D) 2.96×10^{-20}
E) 3.35×10^{-20} F) 3.78×10^{-20} G) 4.27×10^{-20} H) 4.83×10^{-20}

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12. [3pt] Which one of the following is the major difficulty associated with using nuclear fusion to generate electric power commercially? (Only ONE answer is correct.)

A) Fusion reactions produce large amounts of radioactive waste.
B) The nuclei that can undergo fusion reactions are too difficult to obtain.
C) Fusion reactors are prohibited by government regulations.
D) It is hard to get nuclei to undergo fusion because of the Coulomb force.
E) Fusion reactors are too likely to explode.

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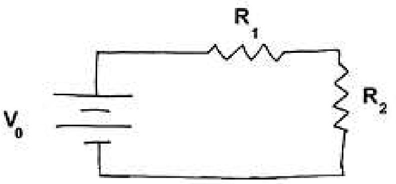
13. [3pt] A light bulb has a resistance of 3 ohms. How much energy (in J) comes out of this light bulb in the form of light and heat if it is connected to an ideal 6 volt battery for 10 seconds?

A) 9.60×10^{1} B) 1.20×10^{2} C) 1.50×10^{2} D) 1.87×10^{2}
E) 2.34×10^{2} F) 2.93×10^{2} G) 3.66×10^{2} H) 4.58×10^{2}



14. [3pt] Two resistors, R_1=80 Ω and R_2=75 Ω, are connected to a 60 volt battery as shown. How many Coulombs of charge pass through R_2 in 25 seconds?

A) 7.07 B) 8.27 C) 9.68 D) 1.13×10^{1}
E) 1.32×10^{1} F) 1.55×10^{1} G) 1.81×10^{1} H) 2.12×10^{1}

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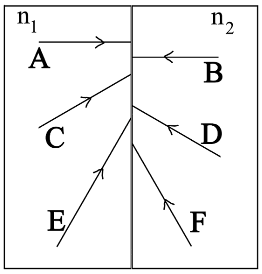
15. [3pt] Archeologists use carbon dating to estimate the age of old artifacts. The method relies on the radioactive isotope $^{14}_{6}C$ which is (Only one answer is correct)

A) produced by living cells.
B) produced in the atmosphere by cosmic rays.
C) produced by alpha decay of $^{238}_{92}U$.
D) produced by irradiating the sample in the laboratory.
E) produced by radioactive decay of $^{12}_{6}C$ in the ground.
F) produced by cells after they are dead.



16. [3pt] Two flat pieces of glass, with index of refraction n_1 =1.67 and n_2 =1.39 as labeled, are touching each other. Rays of light approach the boundary between them from the six directions shown. Which one of these rays will undergo total internal reflection? (Only one answer is correct.)

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

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17. [3pt] An object is placed 14 cm in front of a convex mirror that has a focal length of -33 cm. Find the magnification.

A) 3.59×10^{-1} B) 4.49×10^{-1} C) 5.62×10^{-1} D) 7.02×10^{-1}
E) 8.78×10^{-1} F) 1.10 G) 1.37 H) 1.71

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18. [3pt] A white light is placed 49 cm to the left of a converging lens whose focal length is 32 cm. The image is (only one statement is correct)

A) to the left of the lens and inverted
B) to the right of the lens and upright
C) to the right of the lens and inverted
D) to the left of the lens and upright