Modern Physics (PHY 3305) Lecture Notes

HomeworkAssignment006

SteveSekula, 4 March 2010 (created 1 March 2010)

Expectations for the quality of your handed-in homework are available at http://www.physics.smu.edu/sekula/phy3305/homework.pdf. Failure to meet these guidelines will result in loss of points as detailed in that document. This assignment covers material from Harris Ch. 6.1-6.3, 8.1-8.3. It is worth 100 points.

no tags

NOTE: This homework is due on March 18, 2010.

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"Vacations are for undergraduates." (Robert Jastrow, 1953)
"Get lots of homework done, but remember the advice of mathematician J.E. Littlewood to use vacations to refresh your creativity." (A paraphrasing of Professor Loyal Durand from the University of Wisconsin-Madison)

HARRIS *CH6-1* (5 Points)
HARRIS *CH6-2* (5 Points)
Problem *SS-9* (See Below)
HARRIS *CH8-25* (20 Points)
HARRIS *CH8-35* (10 Points)
HARRIS *CH8-41* (20 Points)

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Problem *SS-9* (40 Points)

1. While on Spring Break, you find yourself in a sunny location with time to kill (relaxation is SO boring). You are enjoying a university-sanctioned, non-alcoholic, fruity drink, cooled in the hot sun by an

ice cube. One of the ice cubes, moving at a leisurely pace of about 1.0 cm/s, strikes a wall of the glass. When the flat side of the ice cube clinks against the flat side of the glass, a thought occurs to you. Stopping one of the passing waiters, you ask, "Excuse me, but what is the weight of your ice cubes?" "Why," he replies, "we pride ourselves on the fact that every ice cube is, in fact, a perfect cube (3.0cm on a side) weighing EXACTLY 27.0 grams." "And what is the breaking strength of your drinking glasses?" The waiter seems puzzled as to why this matters. "Why, I checked the company's specifications this morning and I can state unequivocally that each glass, whose walls are 0.50cm thick, requires 50.0 mega-pascals of pressure before it will break completely." You use this information to determine the probability that an ice cube will tunnel through the glass and appear unharmed on the table next to the glass. What probability did you find? *HINT: Simplify the problem by treating the ice cube as a single particle. HINT: compute the penetration depth of the ice cube wave function into the glass and determine if the glass represents a thin or a thick barrier. HINT: You can treat the inside and outside of the glass as "zero-potential" regions but you need to compute the potential barrier represented by the glass wall, remembering that $U = F \cdot \Delta x$. HINT: you will encounter some "interestingly sized" numbers in this problem. Feel free to take advantage of the fact that $ln(Ae^B) = ln(A) + B$ to quote your answer.*

2. How big would Planck's Constant have to be to make the probability of passing through the glass wall be 50.0%?