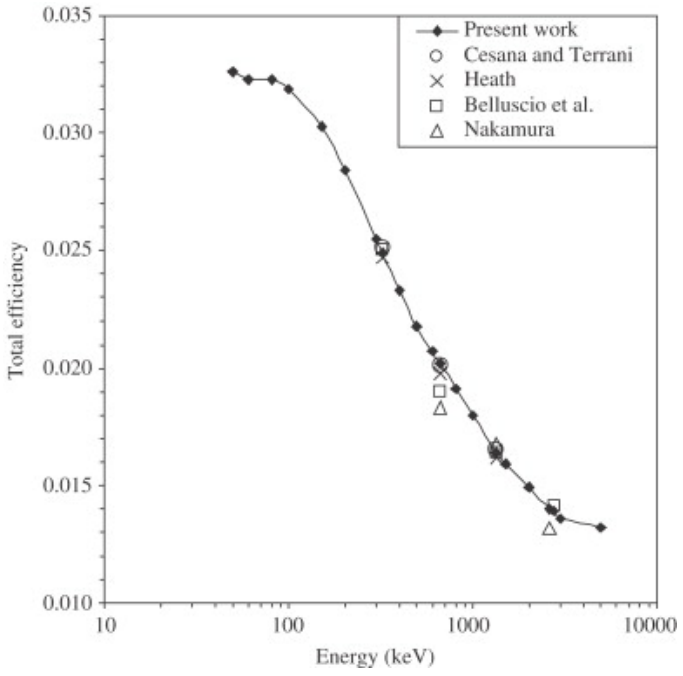
Chemistry 985

Fall, 2o19 Exam # 1 Practice
Distributed: Tues., 1 Oct. 19 Due: ?

1. The measurement of a particular nuclear reaction performed by counting events attained a statistical precision of 5.00% after a 5.0 hour measurement. The professor in charge is impatient and decides that a 7.5% statistical precision is acceptable. How much time would be necessary in a new measurement to attain a statistical precision of 7.50% assuming that the nuclear reaction rate is constant during the measurement?

2. The following figure was shown in a publication describing the *total efficiency* of a certain right-cylindrical photon detector [Appl Rad Iso 65 (2007) 1179]. Estimate the *intrinsic efficiency* of this detector at 1000. keV if the data was taken at a low counting rate with a device that had a 7.6 cm diameter front face and was placed 10 cm from the radioactive source (W(Θ, Φ)=1).



3. Describe the terms, or distinctions between the terms, used to describe vacuum equipment:

   (a) molecular flow

   (b) virtual leak vs. real leak

   (c) closed vs. open vacuum system

   (d) limitation on using a high-compression TMP

4. What is the multiplication factor for a proportional wire that has a 80 μm diameter and is operated at 750 V inside a cylindrical volume 1 cm diameter with propane gas at 100 mbar?

5. Consider the interactions of a 1332 keV photon with a small CsF crystal attached to a R1306 10-stage photomultiplier that has $\eta = 0.25$ and operated with $\delta = 4.5$ The CsF is poorly mounted in a way that only 50% of the photons reach the photocathode. [Note: see NIM **179** (1981) 271 for a discussion of CsF; they suggest that the light yield is only $\approx$4% that from NaI(Tl).]

   Indicate the energy in keV of the following signals associated with the 1332 keV photon:

   (a) The single-escape peak

   (b) The Compton shoulder of the main peak

   (c) Estimate the intrinsic resolution of the full energy peak from the 1332 keV photon that interacts in this CsF based detector (i.e., the resolution based on light collection and before the electronic amplification – that latter calculation will have to wait and may be on the final exam.)