**Sample FINAL EXAM**--**Physics 8**--Dr. Petersen

1. The emissivity of tungsten is 0.35. A field-emission cylindrical needle of radius .025 cm and length 0.500 cm is made out of tungsten and suspended by non-conducting supports in a vacuum. The walls of the evacuated chamber are at 300 K, and 300 watts of power are radiated from the cylinder (exclusive of the ends). What is the needle’s temperature in Kelvins?

 σ = 5.67 x 10-8 W/m2K4. A. 442 K, B. 1583 K, C. 6600 K, D. 9387 K.

2. How much heat (in kcalories) is needed to change a 1.5 kg cube of ice at -20o C completely

 to water at 0o C if the specific heat of ice is 0.50 kcal/kgoC and the latent heat of fusion, L, is 80 kcal/kg? A. 15 kcal, B. 120 kcal, C. 135 kcal, D. 194 kcal.

3. The input temperature of a Carnot engine is 677oC and its efficiency is 37%. What is its exhaust temperature in Kelvins? A. 326 K, B. 425 K, C. 599 K, D. 647 K.

4. What is the entropy change in heating water by applying 5 Joules of heat energy as the

 temperature raises over a range with average temperature 37o C? A. 0.0161 J/K,

 B. .0823 J/K, C. 7.4 K/J.

5. Three polarizers are stacked with a successive change in angle of 30O. If the initial intensity of

 the incident unpolarized light is 20 W/m2, what is the intensity transmitted?

 A. 5.06 W/m2, B. 5.63 W/m2, C. 11.26 W/m2. (Drawing on board.)

6. A coin in water (n= 1.33) appears to be 3.00 cm below the surface, viewed at normal incidence. What is actual depth of the coin? A. 0.41 cm, B. 2.00 cm, C. 3.99 cm.

7. An object is placed 20.0 cm from a thin lens and a **virtual** image is formed at 5.0 cm from the lens. What is the focal length of the lens? A. 4.0 cm, B. -6.7 cm, C. -15 cm, D. 20 cm.

8. For a diffraction grating with spacing, d = 0.01 mm, at what angle off axis will the first order maximum be located for light of wavelength 550 nm? A. 3.2, B. 7.3, C. 10.2, D. 15.5 o.

9. Uranium 238 absorbs a neutron and splits to Barium 137 and an unknown nuclide. What are the

 A, Z, and element symbol for that nuclide? (This is natural fission.)

10. Consider Fraunhofer single slit diffraction. Compare the distance between the two minima on either side of the central maximum for the apparatus immersed in air versus immersed in water, i.e., find yair/ywater.

 The index of refraction of water is 1.33.

 A. 0.75, B. 1.33, C. 1.88.

11. A. Write down the full electronic configuration of neutral magnesium in the ground state.

 B. What are the allowed quantum numbers for n = 4 in the hydrogen atom?

12. What percent of it’s original length will an object be, moving at 0.99c?

 A. 3.2 %, B. 14 %, C. 38 %, D. 92 %.

13. Calculate the wavelength of a photon whose energy is equivalent to the rest mass energy of an electron of mass 9.11 x 10-31 kg. A. 3.3 x 10-11 m, B. 1.15 x 10-12 m, C. 2.4 x 10-12 m.

14. Calculate the DeBroglie wavelength of a proton moving at 0.900c. The proton mass is 1.67 x 10-27 kg. A. 8.82 x 10-12 m, B. 6.68 x 10-16 m, C. 9.25 x 10-18 m (choose closest).

15. A black dwarf star (cooled white dwarf) is essentially a monatomic crystal of carbon. A carbon atom has mass 2.00 x 10-26 kg. We observe a vibrational spectral line at 512 μm which we suspect to be a transition between adjacent levels in the vibrational spectrum of the crystal. What is the spring constant k for the crystal? A. 0.115 N/m, B. .272 N/m, C. 1.88 N/m.