Physics 31B Final Part I (75 pts)
Spring, 2003

1. If 100 W/m² of natural white light impinges on two ideal linear polarizers held one behind the other with their transmission axes parallel, the amount of light emerging will be (a) 100 W/m² (b) 50 W/m² (c) 25 W/m² (d) 200 W/m² (e) none of these.
2. *P*-state light parallel to the interface impinges on an air-water boundary at the polarization angle. The reflected beam will be (a) linearly polarized perpendicular to the plane-of-incidence (b) nonexistent (c) partially polarized (d) unpolarized (e) none of these.
3. Coherent lightwaves never arise from (a) two lasers (b) two pinholes (c) two candles (d) two slits (e) any of these.
4. A small aperture is located some distance from an observation screen. As the wavelength of the illumination is gradually decreased, the far-field diffraction pattern seen on the screen (a) remains unchanged (b) changes to a near-field pattern (c) changes to a Fraunhofer pattern (d) stays as a far-field pattern but gradually expands (e) none of these.
5. A grating diffracts red light through an angle that is (a) greater than the angle for blue light (b) independent of frequency (c) less than the angle for blue light (d) the same as the angle the angle for blue light (e) none of these.
6. A clock is moving at a uniform velocity with respect to an observer. The latter, comparing things to her clock, reports that the time on the moving clock is (a) perfectly accurate (b) fast (c) slow (d) running backward (e) none of these.
7. How long will a vertical meter stick appear to someone moving horizontally with respect to it at a speed of 0.99c? (a) 99 cm (b) 100 cm (c) 0 cm (d) 0.01 cm (e) none of these.
8. An astronaut heading out toward a star at a constant high speed can determine that he is in motion by (a) the contraction of on-board meter sticks (b) the slowing down of time on his clocks (c) the increase of his mass (d) the speeding up of his heart (e) none of these.
9. A typical atom has a diameter of roughly (a) 0.2 mm (b) 0.2 pm (c) 0.2 m (d) 0.2 nm (e) none of these.
10. We learned from electrolysis that one atom of a univalent substance carries a charge (a) equal to F (b) equal to F/N_A (c) equal to $2F/N_A$ (d) equal to N_A/F (e) none of these.
11. The magnitude of the charge of the electron is (a) equal to F (b) equal to F/N_A (c) equal to $2F/N_A$ (d) equal to N_A/F (e) none of these.
12. The largest Bragg angle through which a beam of X-rays can be bent is (a) 0^o (b) 45^o (c) 90^o (d) 180^o (e) none of these.
13. Naturally occurring radioactive atoms can spontaneously emit (a) δ-, γ-, ξ-rays (b) α-, β-, γ-rays (c) N-rays (d) X-rays (e) none of these.
14. Gamma-ray emissions can (a) be distinguished from β-ray emissions using a magnetic field (b) not be distinguished from β-ray emissions (c) not be distinguished from α-ray emissions using a magnetic field (d) be distinguished from a neutron beam by bending the latter's path via a *B*-field (e) none of these.

15. In reference to the Balmer series, the longest wavelength line (a) is associated with the smallest n, namely, 1 (b) is associated with the smallest n, namely, 3 (c) is associated with the largest n^2, namely, 9 (d) is associated with the largest n, namely, ∞ (e) none of these.
16. The magnitude of the charge-to-mass ratio of the electron (a) is zero (b) is less than that for the proton (c) is greater than that for the proton (d) equals that of the neutron (e) none of these.
17. The neutron (a) has a mass slightly greater than that of the proton (b) has a charge slightly greater than that of the proton (c) has a mass slightly greatly than that of the electron (d) has a mass slightly less than that of the proton (e) none of these.
18. In order to escape from the surface of a metal, an electron must overcome a potential barrier at the metal-vacuum interface, which requires (a) a high-temperature $T=hf/k_B$ (b) an energy equal to ϕ (c) a stopping potential (d) a photon of energy $h\lambda$ (e) none of these.
19. In the photoelectric effect, if $f > f_0$ and the irradiance of the incident beam is doubled, the photocurrent (a) is unchanged (b) decreases by a factor of 4 (c) doubles (d) is halved (e) none of these.
20. As the hydrogen atom goes from one Bohr orbit to another, increasing in radius, the (a) electron's speed increases (b) electron's speed decreases (c) electron's speed remains unaltered (d) proton's speed increases (e) none of these.
21. A population inversion means that (a) there are more atoms in one gas than in another (b) there are more atoms in some excited state than in a lower state (c) there are more states populated than unpopulated (d) the lower states are filled rather than the higher ones (e) none of these.
22. Doubling the total energy of a meson has the effect of (a) doubling its momentum (b) doubling its wavelength (c) quartering its frequency (d) doubling its frequency (e) none of these.
23. The principal quantum number of the sixth excited state of hydrogen is (a) 6 (b) 5 (c) 4 (d) 7 (e) none of these.
24. The size of the space in which an electron is confined determines the uncertainty in its (a) linear momentum (b) maximum angular momentum (c) spin angular momentum (d) its mean lifetime (e) none of these.