Here are some samples from the question bank I will use to make up the first midterm exam.

Electron mass = $m_e = 9.1 \times 10^{-31}$ kg; $m_e c^2 = 0.511$ MeV

Proton mass = $m_p = 1.673 \times 10^{-27}$ kg; $m_p c^2 = 938.3$ MeV

Neutron mass = $m_n = 1.675 \times 10^{-27}$ kg; $m_n c^2 = 939.6$ MeV

Planck's constant = $h = 6.63 \times 10^{-34}$ Js; $hc = 1240$ eV nm

1. The maximum kinetic energy of electrons ejected from barium (whose work function is 2.50 eV) when it is illuminated by light of wavelength 350 nm is
   a) 0.20 eV
   b) 0.41 eV
   c) 0.63 eV
   d) 0.95 eV
   e) 1.05 eV

2. The speed of an electron whose de Broglie wavelength is 0.0010 m is approximately
   a) $7.3 \times 10^{-7}$ m/s
   b) $7.3 \times 10^{-4}$ m/s
   c) 0.73 m/s
   d) 0.51 km/s
   e) $5.1 \times 10^5$ m/s

3. The wave function of a single electron $\Psi$ tells us
   a) where the particle is.
   b) where the wave is.
   c) where the particle is likely to be.
   d) where the wave is likely to be.
   e) the strength of the electric field of the wave.

4. A particle is in the ground state of an infinite square-well potential. The probability of finding the particle in the region $0 < x < 3L/4$ is
   a) 0.86
   b) 0.25
   c) 0.50
   d) 0.91
   e) 0.09
5. A phase shift of 180º occurs when a light wave
   a) is transmitted through a boundary surface into a medium that is more dense than the medium from which the wave came.
   b) is transmitted through a boundary surface into a medium that is less dense than the medium from which the wave came.
   c) reflects from the boundary surface of a medium that is less dense than the medium in which the wave is traveling.
   d) reflects from the boundary surface of a medium that is more dense than the medium in which the wave is traveling.
   e) Both c and d are correct.

6. Diffraction of sound waves is more readily observable than that of light waves because
   a) sound waves are longitudinal and not transverse.
   b) sound waves have a higher frequency than light waves.
   c) sound waves have a lower velocity than light waves.
   d) sound waves have longer wavelengths than do light waves.
   e) interference occurs more readily for longitudinal waves.

7. Two side-by-side coherent light sources radiate at 600 nm. The phase difference between these two sources at a point in space is 0.582 radians. The path difference between the two sources could be
   a) 43.5 nm
   b) 55.6 nm
   c) 62.4 nm
   d) 75.9 nm
   e) 87.4 nm

8. The minimum path difference that will produce a phase difference of 180º for light of wavelength 600 nm is
   a) 600 nm
   b) 500 nm
   c) 300 nm
   d) 200 nm
   e) 100 nm
9. You dip a wire loop into soapy water \((n = 1.33)\) and hold it up vertically to look at the soap film in white light. The soap film looks dark at the top because it has sagged, and its thickness there is nearly zero, causing the reflected wavelengths to interfere destructively. Part way down the loop you see the first red band of the reflected white light. What is the thickness of the soap film there? (Take the wavelength of red light to be 680 nm.)
   a) 130 nm  
   b) 170 nm  
   c) 220 nm  
   d) 250 nm  
   e) 340 nm

10. The distance between the slits in a double-slit experiment is increased by a factor of 4. If the distance between the fringes is small compared with the distance from the slits to the screen, the distance between adjacent fringes near the center of the interference pattern
   a) increases by a factor of 2.  
   b) increases by a factor of 4.  
   c) depends on the width of the slits.  
   d) decreases by a factor of 2.  
   e) decreases by a factor of 4.

11. You illuminate two slits 0.50 mm apart with light of wavelength 555 nm and observe interference fringes on a screen 6.0 m away. What is the spacing between the fringes on the screen?
   a) 4.5 mm  
   b) 3.3 mm  
   c) 6.7 mm  
   d) 10 mm  
   e) 5.0 mm

12. Light of wavelength 650 nm is incident on a slit of width 25.0 µm. At what angle is the second diffraction minimum observed?
   a) 0.052°  
   b) 1.5°  
   c) 2.2°  
   d) 3.0°  
   e) 3.7°
13. The pupil of the human eye has a diameter of about 5 mm. When the wavelength of light incident on the pupil is 500 nm, the smallest angular separation of two resolvable sources is approximately
   a) 1"
   b) 1'
   c) 1°
   d) 10°
   e) 1 radian

14. The white circles in the figure represent minima of the diffraction pattern formed when a bright point-source object is viewed through a small circular opening. In accordance with Rayleigh's criterion, the closest central maximum of another point source that could lie in this pattern and still be barely resolvable
   a) would be at point A.
   b) would be at point B.
   c) would be at point C.
   d) would be at point D.
   e) must lie outside all discernible diffraction rings.

15. The dependent variable in the Schrödinger equation is
   a) the wave function $\psi$.
   b) the position variable $x$.
   c) the time variable $t$.
   d) the potential energy function $U$.
   e) None of these is correct.
16. The wave function for a particle in a one-dimensional box of length $L$
   a) is constrained by the boundary conditions $\psi(0) = 0$ and $\psi(L) = 0$.
   b) must be zero everywhere outside of the box.
   c) is given by $\psi(x) = A \sin kx$, where $A$ is a constant.
   d) restricts the possible energy of the particle to $E = \frac{U^2 k^2}{2m}$.
   e) All of these are correct.

17. The energy in the ground state of an electron confined to a one-dimensional box of length $L = 0.2$ nm is
   a) 1.88 eV
   b) 4.47 eV
   c) 6.25 eV
   d) 9.40 eV
   e) None of these is correct.

18. The graph that shows the second state for a particle in a finite square well is
   a) 1
   b) 2
   c) 3
   d) 4
   e) None of these is correct.
19. The wave function shown in the figure represents the $n = \underline{}$ energy state of the harmonic oscillator.
   a) 0
   b) 1
   c) 2
   d) 3
   e) 4

20. An electron confined to a one-dimensional box of length $L = 0.2$ nm makes a transition from state $n = 4$ to state $n = 3$. The wavelength of the photon emitted is
   a) 19.0 nm
   b) 17.2 nm
   c) 14.6 nm
   d) 12.5 nm
   e) 10.8 nm