Review Question Ans - Final Exam

Question 54

The fluid has decreased the apparent depth. Now the camera is too close and must back up a distance of 1.5 cm. This is the amount by which the apparent depth has decreased. Hence the apparent depth is now 4.5 cm. Use the single glass surface equation with the radius of curvature, r, at infinity. Then the ratio of the depth and the apparent depth become a ratio of the two indices of refraction.

Question 92

This is a Brewster's angle problem. The incoming light is polarized equally in all directions, i.e. unpolarized. The light reflected from the surface is mostly polarized perpendicular to the incident plane, which is the plane determined by the incident light ray and the reflected light ray. At Brewster's angle ALL the reflected light is polarized perpendicular to the incident plane.

Question 26

An image in a mirror appears the same distance behind the mirror as the object is in front of the mirror. Then take the first image and apply it to the second mirror using an object distance equal to the image distance plus the mirror separation distance. Then repeat the process on the first mirror using the image in the second mirror as the object.

Question 44

An erect image, of a real object, in front of the lens, is a virtual image. It's distance from the lens, s', is therefore -40 cm. Use the magnification formula to find the object distance, s = -m/s'. Then use the lens equation to find the power of the lens (=1/f).

Question 47

The object is at infinity - "parallel light" will form a virtual image at the front focal point of the negative lens. This will yield a real object at s = 15 + 25 = 40 cm for the positive lens.

Question 53

The image distance from the positive lens is +4 cm. The negative lens is placed 2 cm to the left of the image. This makes that image a virtual object for the negative lens (because the object is to the left of the lens). The object distance is then s = -2. The distance between the lenses never really enters the problem, it is only distance from the lens to the image or object that matter.

Question 74

You can draw a small vertical arrow at point "O" and then trace it through the lens the usual way. Or you can notice that point "O" is 2.5f units away from the lens and use the lens formula to find the object distance s' = 5f/3, which is point 3.

Question 92

Use the lens equation. Image distance is fixed at the nominal lens to retina distance of 2.5 cm. The 25 cm distance, using the lens equation, fixes this person's lowest lens power at 44.0D. To see an object at infinity (s = infinity) requires a lens power (1/f) of 40.0D. Therefore a negative lens is needed to reduce this persons lens power by -4.0D (a diverging lens).

Question 95

Same equations as above. See previous hints
A person with a hypermetropic eye is far-sighted. For the problem to make sense that person would not be able to see anything CLOSER than 225 cm.
Distinct vision means being able to focus an object at the near point, 25 cm object distance, on the retina at the back of the eye (2.5 cm). Distinct vision then requires a lens power of 44D. Using the object distance of 225 cm shows that this person's lens only had a power of 40.44D. To allow the object to move closer; from 225 to the near point of 25 cm would require more lens power. The needed extra amount is 44.0D - 40.44D = 3.56D or +3.6D which is choice C.).

Question 103

Same as #92, replace 25 cm with 150 cm. Lowest power of this person's lens is 40,67D. For distant viewing (object at infinity) a lens power of 40.0D is needed. Therefore a diverging lens of -0.67D must be added to bring the lens power down to the desired level.

Question 119

The magnification = objective focal length / eyepiece focal length. This is also equal to the angular ratio Θ_e / Θ_o.

Question 19

The interference is between the rays reflected from the front and backside of the soap film. The front ray is phase shifted by 180^o so the back ray needs a total optical path length of 1/2 wavelength to be in phase with the front ray to produce a red band. Thickness is "t." $2t = \lambda'/2$; $t = \lambda/(4n) = 170$nm

Question 24

The interference arises from the reflection from the top and bottom surfaces of the magnesium difluoride. Both the top and bottom rays are reflected from a more optically dense material and therefore they both under goes 180^o change of phase. To cancel the bottom ray needs and extra optical path length equivalent to a half-wavelength. $2t = \lambda'/2$; $t = \lambda/(4n)$.

Question 44

You need to use $I = 4Io*\cos^2(\delta/2)$. The 300nm path difference needs to be expressed in radians as a fraction of the wavelength (500nm). This gives $\delta = 3.77$ rad. Include the factor of 4 and the answer is $0.382I_o$.

Question 50

You need to use $I = 4Io*\cos^2(\delta/2)$ again. A fringe is the name of a peak in the I curve. The phase change to shift by one fringe is $\delta = 2\pi$. The glass plate has an index of refraction of 1.58. That will shrink the wavelength of 680 nm in air to 430 nm in the glass. If we place a glass plate of thickness 430 nm in front of one of the slits it will contain exactly one wavelength of the light and will reduce the path length of the ray from that slit by 36.8% of a wavelength. This is the missing wavelength (250 nm) due to the wavelength compression in the glass divided by the wavelength in air. So 430 nm of glass causes a phase shift of 0.367 of a wavelength. Divide this into 35 (the number of fringes shifted) to find the number of these 430 nm glass plates are needed for the total shift. This gives 95.3 times 430 nm yield a total glass thickness of 41 microns or $4.1x10^{-5}$m.

Question 54

The single slit diffraction pattern has the big central peak. The width is the distance between the first zeros of intensity on each side. The ratio of half this length divided by the screen distance is the tangent of Θ. This will give you the value of Θ . Then use the equation $W*\sin \Theta = \lambda$ and solve for the slit width w.