Solutions to Assignment 1- Part 1

Question 1

1. Bit rate = num pixels/frame * numframes/second * avg bits per pixel.
   = (450x520)x25x12 = 70.2 Mbps

2. The only thing that changes because of the re-quantization is the average bits per pixel.
   Average bits per pixel = (6*4+6*1+6*1)/4 = 9 bits/pixel. Bit rate = 450*520*25*9 = 52.65 Mbps
   Disk size = 52.65*60*10/8 = 3.948 GBytes

   Normally, all Y, Cr, and Cb are quantized using the same number of bits. But from the way the question is worded, you may assume that Y is 8 bits and Cr and Cb is 6 bits, then we have another answer

   Average bits per pixel = (8*4+6*1+6*1)/4 = 11 bits/pixel. Bit rate = 450*520*25*11 = 64.35 Mbps
   Disk size = 64.35 *60*10/8 = 4.826 GBytes

Question 2

There are 32 levels (with values from 0 to 31), with 0 corresponding to (0,-3.75] and 31 corresponding to (3.75, 4]. If the input value is x, then the quantized value should be Round (((x – (-3.75)) / 8) * 32) which is round(((x+3.75)/8)*32). This should be a rounding function to minimize error, not a floor or ceil

The intervals thus correspond to - 22, 24, 24, 28, 28, 28, 25, 26, 26, 26, 21, 19, 20, 20, 22, 24, 24, 24, 23, 24, 20, 16, 10, 10, 8, 11, 6, 9, 9, 12, 15, 19

32 intervals; therefore, each value needs 5 bits for each. There are 32 samples, so total bits = 32 x5 = 160 bits.

Question 3

Speed of Car = 10m/s. Diameter of tires = 0.4244m
One rotation covers pi *0.4244 =1.333m and hence One Rotation takes = 0.1333 sec
Hence, speed of rotation = 1/0.1333 = 7.5 rot/s (approx)
Hence, Nyquist sampling Frequency of rotation = 2F =15 rot/sec (Hz)

1. Frame rate of projection is 24pfs > 15 fps. Hence, the tire will appear to rotate at 7.5 rot/s
2. At 8 Fps < 15 fps – there is temporal aliasing. The film photographs the wheel turning 7.5*360 degrees in rotation in 8 frames, Therefore, the degree of turn per frame = 7.5*360/8 = 337.5. The angle is (360>337.5>180). Hence, the wheel appears to turn in a counter-clockwise (backward) direction,
   This means for each frame; the wheel falls short 360-337.5=22.5 degrees.
   Hence, the total turn if it falls short per second is 22.5*8.
   So the apparent rot per second is = 22.5*8/360 rot/sec = 0.5
   Speed of rotation shall be = 0.5 rot/sec (in the opposite direction of ACTUAL travel)
3. At 30fps, the max speed without aliasing occurs at 15 rot/sec. The car travels a distance of 15*pi*0.4244 in one second = 20m/s. So, speed is 72 km/hr