Question 1

Original Audio Signal	Quantized Audio Signal	Quantized Bucket
1.8	1.75	22
2.2	2.25	24
2.2	2.25	24
3.2	3.25	28
3.3	3.25	28
3.3	3.25	28
2.5	2.5	25
2.8	2.75	26
2.8	2.75	26
2.8	2.75	26
1.5	1.5	21
1.0	1.0	19
1.2	1.25	20
1.2	1.25	20
1.8	1.75	22
2.2	2.25	24
2.2	2.25	24
2.2	2.25	24
1.9	2.0	23
2.3	2.25	24
1.2	1.25	20
0.2	0.25	16
-1.2	-1.25	10
-1.2	-1.25	10
-1.7	-1.75	8
-1.1	-1.0	11

-2.2	-2.25	6
-1.5	-1.5	9
-1.5	-1.5	9
-0.7	-0.75	12
0.1	0.0	15
0.9	1.0	19

- 160 bits.

Question 2

- Bitrate (1920x1080)x24x18 = 895.7952 Mbps
  Minimal compression ratio must be done with minimal through put in account. This is 895.7952/(12*8) = 9.331.
- New bitrate is (352x288)x24x18 = 43.794 Mbps which is less than 12*8 needed for writing. So, no compression is needed.
- Original image aspect is 1.7777, which changes to 1.22222. With the aspect reducing, the original square (1:1) pixels will appear stretched vertically. So, the changed PAR will be 1:1.454 OR the reciprocal 0.6875:1. Remember PAR is w:h of pixel, and h will be more.

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)

- Frame rate of projection is 24pfs > 15 fps. Hence the tire will appear to rotate at 7.5 rot/s
- At 8 Fps < 15 fps – there is temporal aliasing. The film photographs the wheel turning 7.5*360 degrees rotation in 8 frames, Therefore the degree of turn per frame = 7.5*360/8 = 337.5, which makes the wheel falls short by 22.5 degrees.
  Hence a total turn if falls short by 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 opposite direction of ACTUAL travel)
- At 24 fps, max rotation speed of tire with no temporal aliasing is 12 rotations per second. At 180 km/hr or 50 m/s, the tire can cover 12 rotations. So each rotation must be 50/12 meters. Hence diameter of the tire must be 50/(12*pi) = 1.326 meters.