a) No, we don't have enough information. In order to estimate the surface normal we need images with lighting coming from multiple directions. However, assuming the sphere is positioned perfectly centred w.r.t. The pinhole camera we can infer that the surface normal at the sphere must be equal to the viewpoint direction of the camera. For points B and C, the surface normals will be affected by the geometry of the sphere, and we cannot obtain them unless we have multiple images with lighting coming from different directions.

b) No, we cannot derive the intensity of the object at the points B and C because we have no knowledge about the geometry of the object, which might affect the light intensity at those points.

c) No, we cannot derive the intensity because even under lambertian reflection it might be the case that due to shading (as arising from the objects geometry) might result in differences in intensity between points A and B and C.

d) If the sphere material is ideally glossy, i.e. a mirror, then the intensity at both point B and C will be 255, assuming the entire frontal surface of the sphere is being illuminated by a powerful enough light source.

e) If the albedo is known and uniform then we can perform intrinsic image decomposition, i.e. we can decompose the image into its albedo and shading components, and thereby estimate the intensity at points B and C based on the intensity at A

f)

g) f) with 4 bits we only have 16 values per pixel. Therefore we have to divide I_a, I_b and I_c by 16 to compress the image to 4 bits for storage, i.e.

   100/16 = 6
   80/16 = 5
   60/16 = 4
   (rounding upward)
   The decompressed I_a, I_b and I_c can be found by multiplying back to the 8 bit range.

   6 * 16 = 96
   5 * 16 = 80
   4 * 16 = 64

g) The human eye is not sensitive to 1100 nm wavelengths, therefore we cannot detect the object.

h), yes, since the wavelength of 400 nm falls within the bounds of human vision. Therefore humans can see the sphere directly.

We cannot tell the color because we can only see the reflection of the object w.r.t. To the light source for that particular wavelength as opposed to e.g. white light which is a distribution over all wavelengths. So we cannot tell the color of the object.

i)
The translation matrix for a translation in the x-direction is:
1 0 t_x
0 1 0
0 0 1
If we only want to translate w.r.t. the x-axis we can drop the y-axis by setting it to zero.

j)
A mirror transformation over the x-axis can be found by
[[1 0]
[0 -1]]

k)
Yes, since we know the coordinates of A, B and C, we have enough information to compute the transformation matrix between the original set of points and the new set of points. We could attempt estimation via RANSAC.