Answer all three questions in the bluebook provided. 60 min, closed book/notes.

1. Consider the "parking lot surveillance problem," where a computer vision system is used to watch a large parking lot overnight and set off an alarm if an individual is detected who remains on foot in the parking lot for more than 3 minutes.

   (a) Explain clearly why a design based on the Marr paradigm will very likely cost more and perform less well than one based on the newer paradigms of active or animate vision.

   (b) How consistent is the Goad algorithm with the Marr paradigm? Give it a letter grade A-F on consistency with the Marr approach , explaining your reasoning.

   (c) The active/animate approach is not always better than the Marr approach . Describe a specific vision application for which a Marr approach is likely to succeed as well as or better than an active/animate approach. Also, point out some general attributes of a vision application that would make the Marr approach well suited.

2.
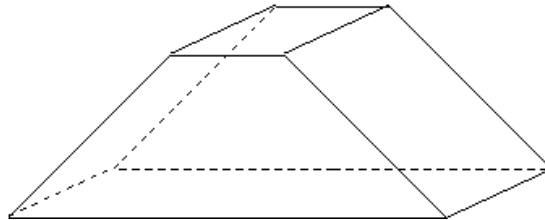
The front and back faces of this 6-sided object are trapezoids, the other 4 are rectangles. The top and bottom faces are parallel, also the front and back faces are parallel.

   (a) Consider the aspect from which you can see only the front face. Sketch all the adjacent aspects, ie. all aspects connected to the front-face aspect in the aspect graph.

   (b) How many topologically distinct characteristic views are there? Justify.

   (c) How many nodes are there in the entire aspect graph for this object? HINT: Count all the nodes corresponding to aspects in which you see 1 face, then 2 faces, then 3 faces, etc.

3. You are in car driving in the x-direction, you point your camera out the window in the z-direction and take a picture of a stationary scene (no independent object motion in the scene) at time t. The brightness $E_1(x,y)$ recorded on this image is found to $E_1(x,y) = cos^2x$, that is, its image plane brightness does not vary in the vertical y-direction, and varies in the horizontal direction with x as cosine-squared. Then one second later at time t+1 you take another image $E_2(x,y)$, and find that at $x=\pi/4$, $y=1$ the image has brightness $E_2(\pi/4,1)=1/4$.

   (a) Find the normal component of optical flow at the point $x=\pi/4$, $y=1$.

   (b) The normal component and the total optical flow at the point $x=\pi/4$, $y=1$ at time t are the same. Explain why.