

## Tutorial 2: Shading & Colour

1. A graphics scene is to be made up of a set of triangles. When one of the triangles is in the standard viewing system (viewpoint at the origin) it has vertex coordinates:

Vertex	Coordinates
$P_1$	(-10, 20, 30)
$P_2$	(15, 25, 25)
$P_3$	(5, -20, 50)

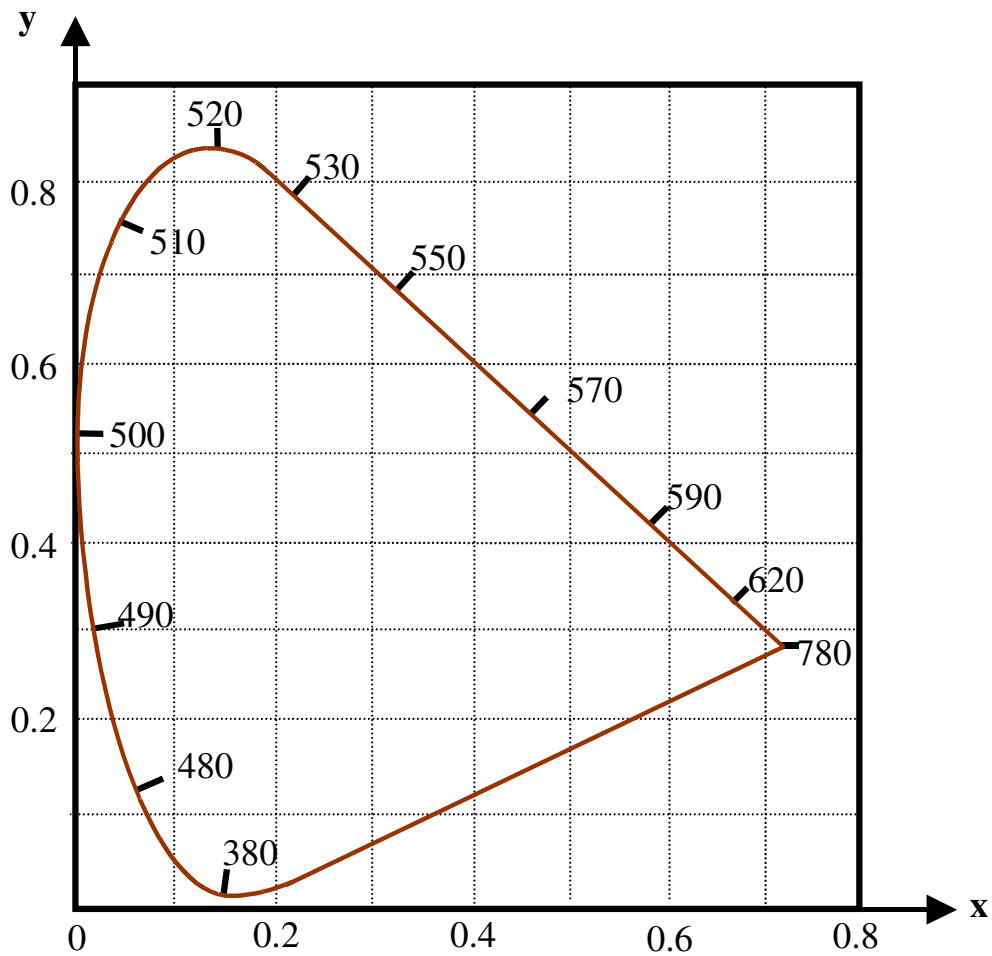
Assume that the triangle is visible from the viewpoint.

- a. Find the outer normal vector of the surface.
  - b. The scene is lit by a single light source, which is located at position (-2, -40, -50). Assuming that only diffuse lighting is being used, find the brightest point on the triangle.
  - c. If the triangle is to be drawn using interpolation shading, which will be the brightest point? Assume that the incident light at each point of the triangle is a constant (no inverse square attenuation of the light).
  - d. Would the result be different if the inverse square law was taken into account?
  - e. The triangle is part of a bigger surface. A fourth point  $P_4$  at (-25, 25, 40) forms another two triangles. One is with  $P_1$  and  $P_2$ , and the other with  $P_1$  and  $P_3$ . There are no other faces that meet at  $P_1$ . What is the unit normal vector at  $P_1$  that would be used for Gouraud shading (or Phong shading)?
2. A graphics card is set to a colour representation where 24 bits are used for each pixel. These are configured normally with 8 bits representing the red value, 8 bits representing the green value and 8 representing the blue value. A polygon in the scene is coloured using:  $r = 150$ ,  $g = 99$  and  $b = 51$ .
    - a. Calculate the corresponding x and y coordinates in the CIE diagram and plot the point on the diagram provided, labeling it P.
    - b. By constructing a line on the CIE diagram, estimate the wavelength of the fully saturated colour, which when mixed with white will produce the colour of part a.
    - c. Using your CIE diagram estimate the saturation of the colour of part a.
    - d. Using your CIE diagram estimate the wavelength of the complement colour to that found in part b.
    - e. A monitor has the following CIE coordinates for its phosphors:

	$x$	$y$
Red	0.6	0.35
Green	0.27	0.6

Blue 0.15 0.07

Plot the area that includes all possible colours that can be displayed on the CIE diagram.



f. Explain briefly why the shape of the CIE diagram must be convex.