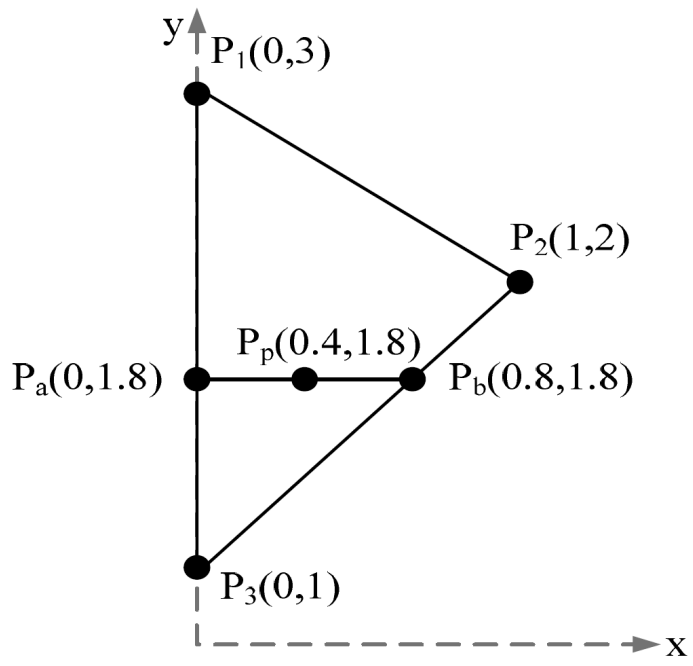
Started on	Friday, 12 March 2021, 4:10 PM
State	Finished
Completed on	Friday, 12 March 2021, 4:55 PM
Time taken	44 mins 53 secs
Grade	**16.00** out of 16.00 (**100**%)

Question **1**

Correct

Mark 6.00 out of 6.00

Consider the triangle shown in Figure. The intensity at P_1, P_2 and P_3 are I_1=64, I_2=54 and I_3=20, respectively. Compute the intensity $I(P_a)$, $I(P_b)$ and $I(P_p)$ at Point P_a, P_b and P_p, respectively using Gouraud Shading. [All calculation should be done with 3 decimal places (round off)]



a) [2 marks] $I(P_a)$ = 37.6

✔

b) [2 marks] $I(P_b)$ = 47.2

✔

c) [2 marks] $I(P_p)$ = 42.4

✔

Your answer is correct.

Detailed Answer:

$I_a = round(I_1 - (I_1 - I_3) * ((y_1 - y_a)/(y_1 - y_3)), 3)$

$= round(64 - (64 - 20) * ((3 - 1.8)/(3 - 1)), 3)$

$= 37.6;$

$I_b = round(I_2 - (I_2 - I_3) * ((y_2 - y_b)/(y_2 - y_3)), 3)$

$= round(54 - (54 - 20) * ((2 - 1.8)/(2 - 1)), 3)$

$= 47.2;$

$I_p = round(I_b - (I_b - I_a) * ((x_b - x_p)/(x_b - x_a)), 3)$

$= round(47.2 - (47.2 - 37.6) * ((0.8 - 0.4)/(0.8 - 0)), 3)$

$= 42.4;$

Question **2**

Correct

Mark 10.00 out of 10.00

Consider a polygonal surface ABC with the vertices A (48, 0, 48), B (48, 30, 0) and C (0, 48, 24). Phong illumination model is used to light the centroid of the polygonal surface. A point white light source is placed at coordinate (62, 76, 94) with intensity 0.8. Also, there is white ambient light with intensity 0.4. The viewer is standing at coordinate (92, 66, 44). Assume ambient reflection coefficient is 0.6, diffuse reflection coefficient is 0.6, specular reflection coefficient is 0.5, specular reflection exponent is 10 and attenuation factor is 1. Compute the following vectors and the intensity values at centroid. [All calculation should be done with 3 decimal places (round off)]

a) [1 mark] N is the normalized surface normal.

N = (0.504 *i, 0.732 *j, 0.458 *k)

✔

Detailed Answer:

Centroid of ABC

c_abc_x = round((48 + 48 + 0)/3, 3) = 32;

c_abc_y = round((0 + 30 + 48)/3, 3) = 26;

c_abc_z = round((48 + 0 + 24)/3, 3) = 24;

Surface normal AB x AC

#AB vector: (0, 30, -48)

#AC vector : (-48, 48, -24)

N = AB x AC

$N_i = round((30 * -24 - -48 * 48), 3) = 1584;$

$N_j = -round((0 * -24 - -48 * -48), 3) = 2304;$

$N_k = round((0 * 48 - 30 * -48), 3) = 1440;$

$N_{mag} = round(sqrt(1584 * 1584 + 2304 * 2304 + 1440 * 1440), 3) = 3145.007;$

Normalized N vector: $N = (n_i, n_j, n_k);$

$n_i = round(1584/3145.007, 3) = 0.504;$

$n_j = round(2304/3145.007, 3) = 0.733$;

$n_k = round(1440/3145.007, 3) = 0.458;$

b) [1 mark] L is the normalized direction vector to light source.

L = (0.329 *i, 0.549 *j, 0.768 *k)

✔

Detailed Answer:

Light Vector L

$L = (62 - 32, 76 - 26, 94 - 24) = (30, 50, 70)$;

$L_{mag} = round(sqrt(30 * 30 + 50 * 50 + 70 * 70), 3) = 91.104;$

Normalized $L = (l_i, l_j, l_k)$

$l_i = round(30/91.104, 3) = 0.329;$

$l_j = round(50/91.104, 3) = 0.549;$

$l_k = round(70/91.104, 3) = 0.768;$

c) [1 mark] V is the normalized direction vector to viewer.

V = (0.802 *i, 0.535 *j, 0.267 *k)

✔

Detailed Answer:

Viewer Vector V

$V = (92-32, 66-26, 44-24) = (60, 40, 20)$;

$V_{mag} = round(sqrt(60 * 60 + 40 * 40 + 20 * 20), 3) = 74.833$;

Normalized $V = (v_i, v_j, v_k)$

$v_i = round(60/74.833, 3) = 0.802$;

$v_j = round(40/74.833, 3) = 0.535$;

$v_k = round(20/74.833, 3) = 0.267$;

d) [1 mark] R is the normalized direction vector for reflection.

R = (0.597 *i, 0.799 *j, 0.074 *k)

✔

Detailed Answer:

$\#N \cdot L$

$N \cdot L = round(0.504 * 0.329 + 0.733 * 0.549 + 0.458 * 0.768, 3) = 0.92$;

Normalized $R = 2N(N \cdot L) - L$ # N and L are normalized

Normalized Reflection vector $R = (r_i, r_j, r_k)$

$r_i = round(2 * 0.504 * 0.92 - 0.329, 3) = 0.598$;

$r_j = round(2 * 0.733 * 0.92 - 0.549, 3) = 0.8$;

$r_k = round(2 * 0.458 * 0.92 - 0.768, 3) = 0.075$;

e) [1 mark] I_{amb} is the intensity of due to ambient light.

I_{amb} = 0.24

✔

Detailed Answer:

I_{amb} is the intensity of due to ambient light.

$I_{amb} = k_a * I_a = round(0.6 * 0.4, 3) = 0.24$;

f) [2 marks] I_{diff} is the intensity of due to diffuse light.

I_{diff} = 0.441

✔

Detailed Answer:

I_{diff} is the intensity of due to diffuse light.

$I_{diff} = f_{att} * I_p * k_d * (N \cdot L) = round(1 * 0.8 * 0.6 * 0.92, 3) = 0.442$;

g) [2 marks] I_{spec} is the intensity of due to specular light.

I_{spec} = 0.184

✔

Detailed Answer:

$R \cdot V = round(0.598 * 0.802 + 0.8 * 0.535 + 0.075 * 0.267, 3) = 0.928$;

I_{spec} is the intensity of due to specular light.

$I_spec = f_{att} * I_p * k_s * 0.928^{10} = round(1 * 0.8 * 0.5 * 0.928^{10}, 3) = 0.189$;

h) [1 mark] I is the total resultant intensity.

I = 0.865

✔

Detailed Answer:

0.871 is the total resultant intensity.

$$I = I_{amb} + I_{diff} + I_{spec} = 0.24 + 0.442 + 0.189 = 0.871;$$

Your answer is correct.

◄ Part-3

Jump to...

Part-5 ►