

4 Introduction to Graphics (rkm38)

(a) Phong’s reflection model is given by the equation

$$I = I_a k_a + \sum_i I_i k_d (\mathbf{L}_i \cdot \mathbf{N}) + \sum_i I_i k_s (\mathbf{R}_i \cdot \mathbf{V})^n$$

- (i) Draw a schematic diagram showing a flat surface, two point-light sources, a camera, a ray-intersection point on the surface and all relevant vectors. Label each vector using the symbols from the equation above. Use indices 1 and 2 for the point lights. [2 marks]
 - (ii) Explain what type of reflection is modelled by the *diffuse* term and what parameter(s) control it. [2 marks]
 - (iii) Explain what type of reflection is modelled by the *specular* term and what parameter(s) control it. [2 marks]
 - (iv) Explain what type of reflection is modelled by the *ambient* term and what parameter(s) control it. [2 marks]
 - (v) What does the dot product $\mathbf{L}_i \cdot \mathbf{N}$ represent and what physical property does it model? [3 marks]
 - (vi) How does the distribution of microfacets differ on the surface of diffuse, imperfect specular and perfect specular materials? [3 marks]
- (b) A ray originates at point A , hits a perfectly specular plane with normal N_1 at point B , gets reflected and hits point C on the plane defined by normal N_2 and point D . Refer to the figure below. Use vector algebra to find the coordinates of point C given all the other points and vectors listed in the figure. [6 marks]

