**Algorithm 1** RAY-TRACE(Scene, Canvas)

```latex
\begin{algorithm}
\For{\text{point} \in \text{Canvas}}{
  \text{cast a ray to find the nearest object}
  \If{\text{ray intersects an object}}{
    \For{\text{each light}}{
      \text{cast a ray to the light and evaluate the lighting equation}
      \quad \text{Canvas}[pt] = \text{Canvas}[pt] + \text{ambient color} + \text{diffuse color.}
    \}
  }\Else{
    \quad \text{Canvas}[pt] = \text{background color}
  \}
}\end{algorithm}
```

1. The high-level view of our ray tracer is exactly the same as for intersect, except for a few additions. Below is the high-level pseudocode for intersect.

2. Given vector $\vec{v}$ from the surface to a light and the surface normal $\vec{n}$, find the equation for the vector $\vec{r}$ which is the reflection of an incoming light ray about $\vec{n}$. Write your equation in terms of vector operations. How do you compute the color contributed by the reflected ray? Give a brief description.

3. [1 point] Is ray tracing a local or global illumination algorithm? Why?

4. [1 point] For what two cases will an object (or portions of an object) not be affected by a light source? There are actually more than two cases, but we expect you to be able to list at least two; you can list more for extra credit.

5. [2 points] Recall that we can think of texture mapping in two steps. First, mapping from the object to the unit square, and second, mapping from the unit square to the texture map. Let $u$ and $v$ be the $x$ and $y$ values in the unit square that a particular point on an object gets mapped to in the first step. Note that $u$ and $v$ are calculated differently depending on the object. From here, how do you find the coordinates $(s, t)$ to look up in a texture map in terms of $u, v, j, k, w$ and $h$, where $j$ and $k$ are the number of repetitions in the $x$ and $y$ directions, respectively, $w$ is the texture width, and $h$ is the texture height? (You may assume that both the $u,v$ and $s,t$ coordinate systems are oriented with (0,0) in the same corner.)

6. [1 point] Given the ambient, diffuse, and specular components of a surface point’s color, how would you add in the color of its texture map at that point? (Hint: You’ll need both the color of the texture map and the blend value in the lighting equation.)

7. [1 point] What is the purpose of the specular exponent in the Phong lighting model?

8. [Extra credit] Compare and contrast radiosity and raytracing: what are the advantages and disadvantages to each? How might you combine the two - or what might you use instead?