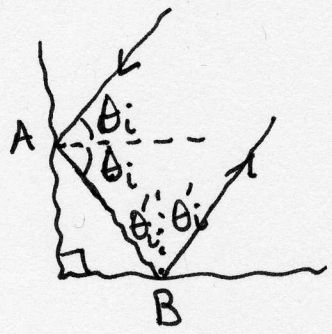
Ch. 2

1.a.



Law of Reflection

∠ of incident ray = ∠ of reflected ray

$$\theta_i = \theta_i$$
$$\theta_i' = \theta_i'$$

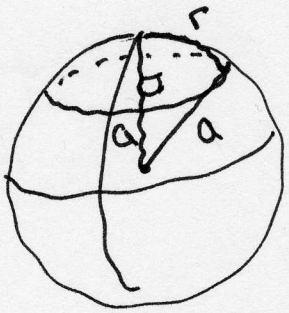
Outgoing ray // to incoming ray if

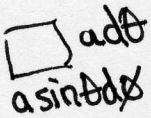
$$\theta_i + \theta_i + \theta_i' + \theta_i' = 180^\circ$$

From geometry of diagram we see that $\theta_i + \theta_i' = 90^\circ$

$$\therefore \quad 2(\theta_i + \theta_i') = 180^\circ \quad \text{Q.E.D.}$$

5.





$$dA = (a\,d\theta)(a\sin\theta\,d\phi)$$

$$A = \int dA = \int_0^\theta d\theta' \int_0^{2\pi} a^2 \sin\theta'\, d\phi$$

$$= 2\pi a^2 (-\cos\theta')\Big|_0^\theta$$

$$= 2\pi a^2 (1 - \cos\theta)$$

$\theta = \frac{r}{a}$ For $r \ll a$ or $\frac{r}{a} \ll 1$

$$\cos\left(\frac{r}{a}\right) = 1 - \frac{1}{2}\left(\frac{r}{a}\right)^2 + \frac{1}{24}\left(\frac{r}{a}\right)^4 - \ldots$$

$$A \approx \pi r^2$$