19. The first-order principle maximum produced by a grating is located at an angle of θ= 18.0°. What is the angle for the third-order maximum with the same light?

For a diffraction grating the condition for bright spots is given by

$$d\sin(\theta) = m\lambda$$

$$d\sin(\theta_1) = \lambda$$

and

$$d\sin(\theta_3) = 3\lambda$$

Divide the two equations

$$\frac{d\sin(\theta_3)}{d\sin(\theta_1)} = \frac{3\lambda}{\lambda}$$

$$\frac{\sin(\theta_3)}{\sin(\theta_1)} = 3$$

$$\sin(\theta_3) = 3\ \sin(\theta_1) = 3\sin(18.0°) = 0.927$$

$$\theta_3 = \sin^{-1}(0.927) = 67.97° = 68.0°$$

$$\boxed{\theta_3 = 68.0°}$$

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