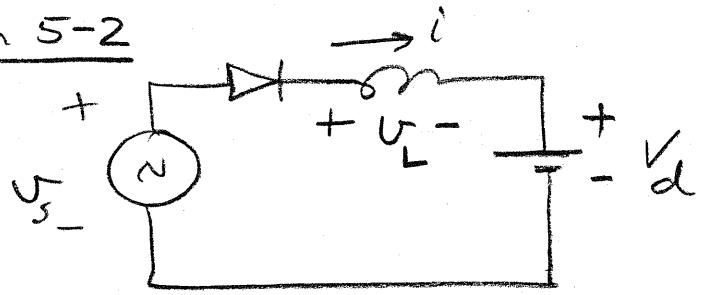
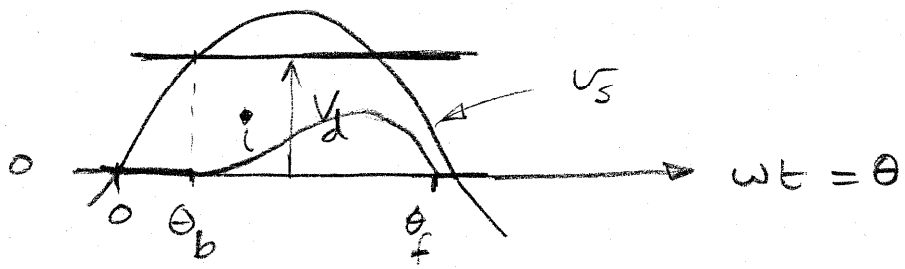
Problem 5-2



$$v_L = v_s - V_d \qquad i > 0$$



$$\sqrt{2} V_s \sin\theta_b = V_d$$

$$\therefore \quad \theta_b = \sin^{-1}\left(\frac{150}{\sqrt{2}\times 120}\right) = 1.084 \text{ rad } (62.11^\circ)$$

$$i(\theta) = \frac{1}{\omega L}\int_{\theta_b}^{\theta} v_L \cdot d\theta = \frac{1}{\omega L}\int_{\theta_b}^{\theta}\left(\sqrt{2} V_s \sin\theta - V_d\right) d\theta$$

$$i(\theta) = \frac{1}{\omega L}\left[\sqrt{2} V_s\left(-\cos\theta + \cos\theta_b\right) - V_d(\theta - \theta_b)\right]$$

$$= -45.01\cos\theta - 39.79\theta + 64.19 \qquad \theta_b < \theta < \theta_f$$

θ_f: final value

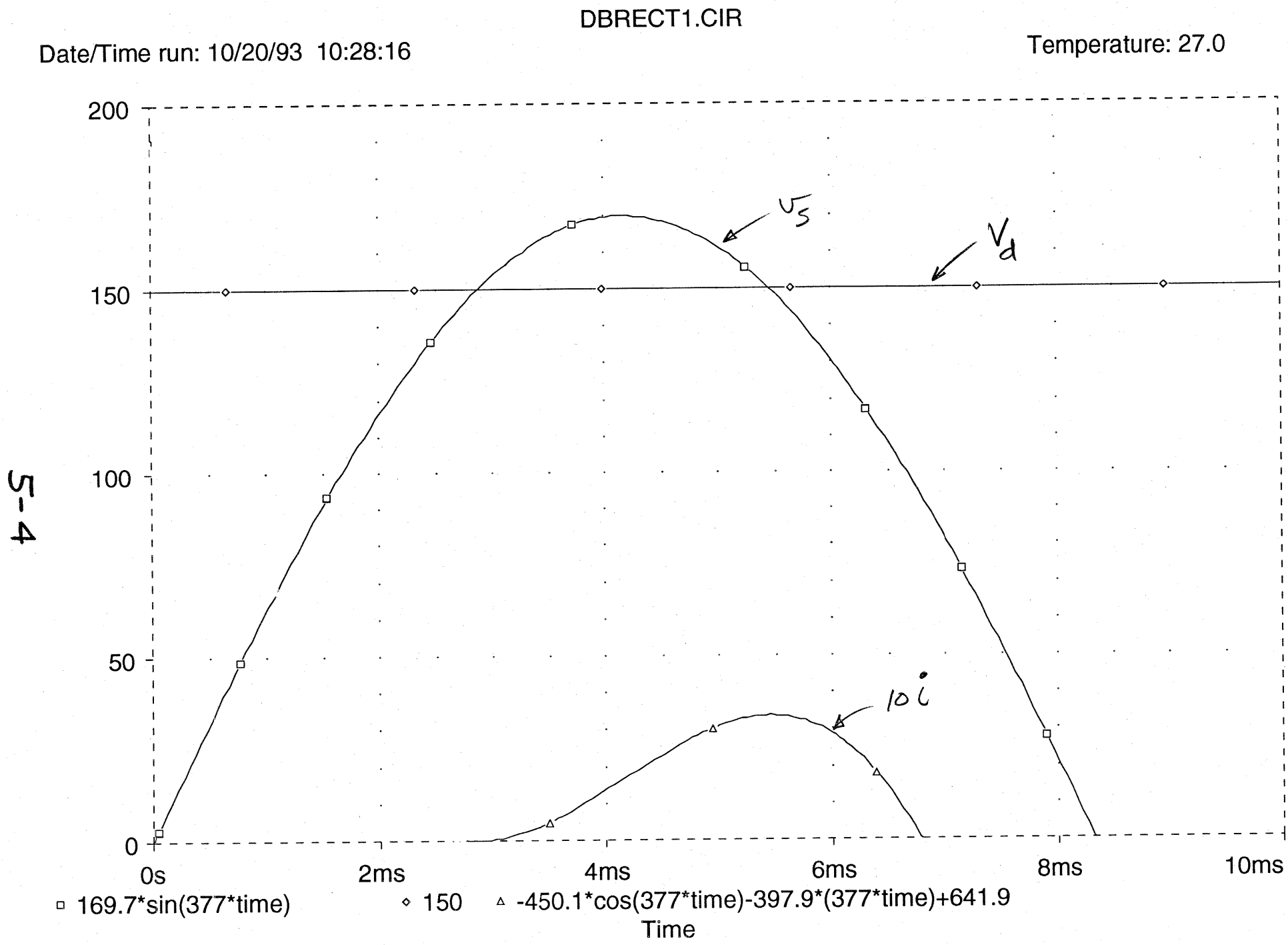
Calculate θ_f

$$i(\theta_f) = 0 = -45.01\cos\theta - 39.79\theta + 64.19$$

$$\cos\theta_f + 0.884\,\theta_f = 1.426 \qquad \text{(by trial-and-error, or some other procedure)}$$

$$\therefore \quad \theta_f = 2.56 \text{ rad}$$

$i(\theta)$ can be calculated and plotted between $\theta_b = 1.084$ rad and $\theta_f = 2.56$ rad from the above equation $i(\theta)$.


DBRECT1.CIR
Date/Time run: 10/20/93 10:28:16
Temperature: 27.0
200
150
100
50
0
0s
2ms
4ms
6ms
8ms
10ms
v_s
v_d
10 i
169.7*sin(377*time)
150
-450.1*cos(377*time)-397.9*(377*time)+641.9
Time

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