

### Exercise Set 1.9

1. The accompanying figure shows a network in which the flow rate and direction of flow in certain branches are known. Find the flow rates and directions of flow in the remaining branches.

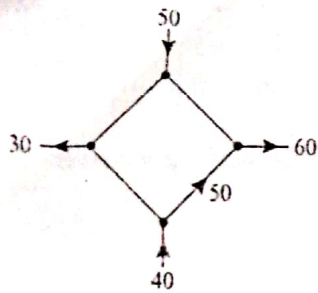


Figure Ex-1

2. The accompanying figure shows known flow rates of hydrocarbons into and out of a network of pipes at an oil refinery.

- (a) Set up a linear system whose solution provides the unknown flow rates.  
(b) Solve the system for the unknown flow rates.  
(c) Find the flow rates and directions of flow if  $x_4 = 50$  and  $x_6 = 0$ .

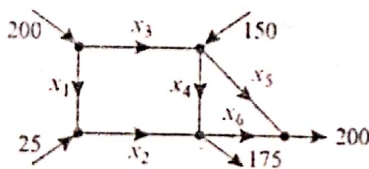


Figure Ex-2

3. The accompanying figure shows a network of one-way streets with traffic flowing in the directions indicated. The flow rates are measured as the average number of vehicles per hour.

- (a) Set up a linear system whose solution provides the unknown flow rates.  
(b) Solve the system for the unknown flow rates.  
(c) If the flow along the road from A to B must be reduced for construction, what is the minimum flow that is required to keep traffic flowing on all roads?

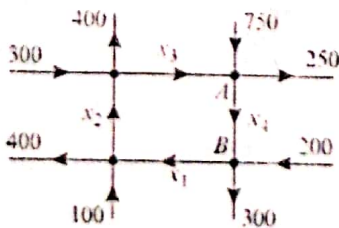


Figure Ex-3

4. The accompanying figure shows a network of one-way streets with traffic flowing in the directions indicated. The flow rates are measured as the average number of vehicles per hour.

- (a) Set up a linear system whose solution provides the unknown flow rates.

- (b) Solve the system for the unknown flow rates.

- (c) Is it possible to close the road from A to B for construction and keep traffic flowing on the other streets? Explain.

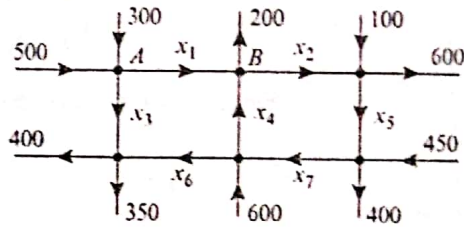
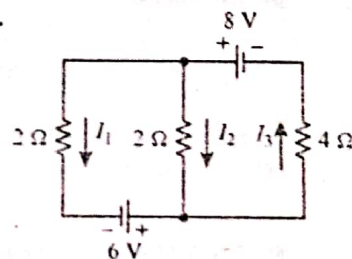


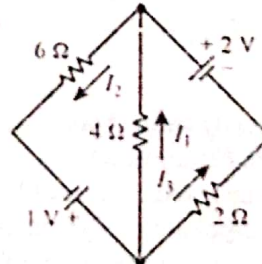
Figure Ex-4

In Exercises 5-8, analyze the given electrical circuits by finding the unknown currents.

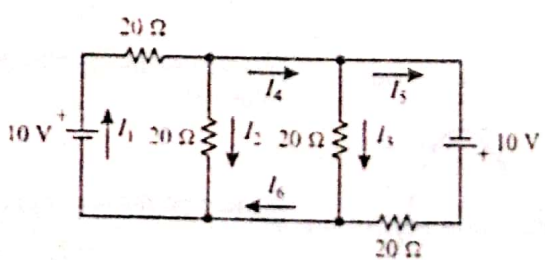
5.



6.



7.



8.

