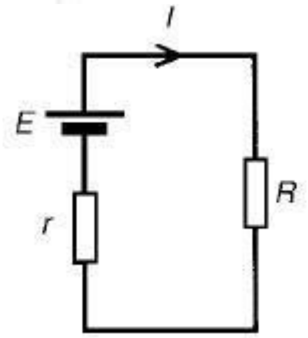
THEVENINS THEOREM:

In circuit theory, **Thévenin's theorem** for linear electrical networks states that any combination of voltage sources, current sources, and resistors with two terminals is electrically equivalent to a single voltage source V and a single series resistor R. For single frequency AC systems the theorem can also be applied to general impedances, not just resistors.

The procedure adopted when using Thévenin's determine the current in any branch of an active network (i.e. one containing a source of e.m.f.):

(i) remove the resistance R from that branch,
(ii) determine the open-circuit voltage, E, across the break,

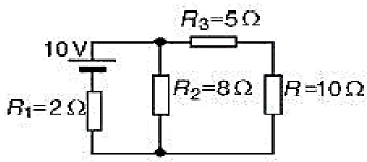
remove each source of e.m.f. and replace them by their internal resistances and then determine the resistance, r, 'looking-in'break.
(iv) determine the value of the current from the equivalent circuit shown in Figure 13.33, i.e. **I = ER+r**



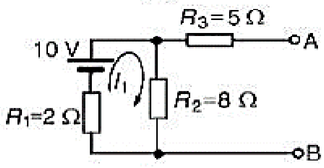
Problem 1: Use Thévenin's theorem to find the current flowing in the 10 Ω resistor for the circuit shown in Figure

Solution:
Following the above procedure:
The 10 Ω resistance is removed from the circuit as shown in Figure There is no current flowing in the 5 Ω resistor and current I1 is given by:

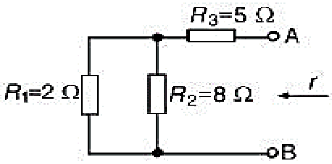
I1 = 10/R1 + R2
= 10/2 + 8
= 1A



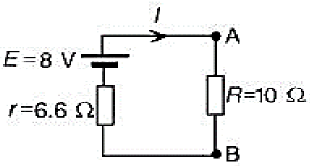
(a)



(b)



(c)



(d)

P.d. across R2

$=I_1R_2$

$=1\times 8$

$=8V$

Hence p.d. across AB, i.e. the open-circuit voltage across the break,

E =8V

Removing the source of e.m.f. gives the circuit of Figure Resistance,

$r = R_3 + R_1R_2/R_1 + R_2$

$=5+ (2\times 8/2+8)$

$= 5 + 1.6$

$= 6.6\ \Omega$

The equivalent thévenin's circuit is shown in F Current

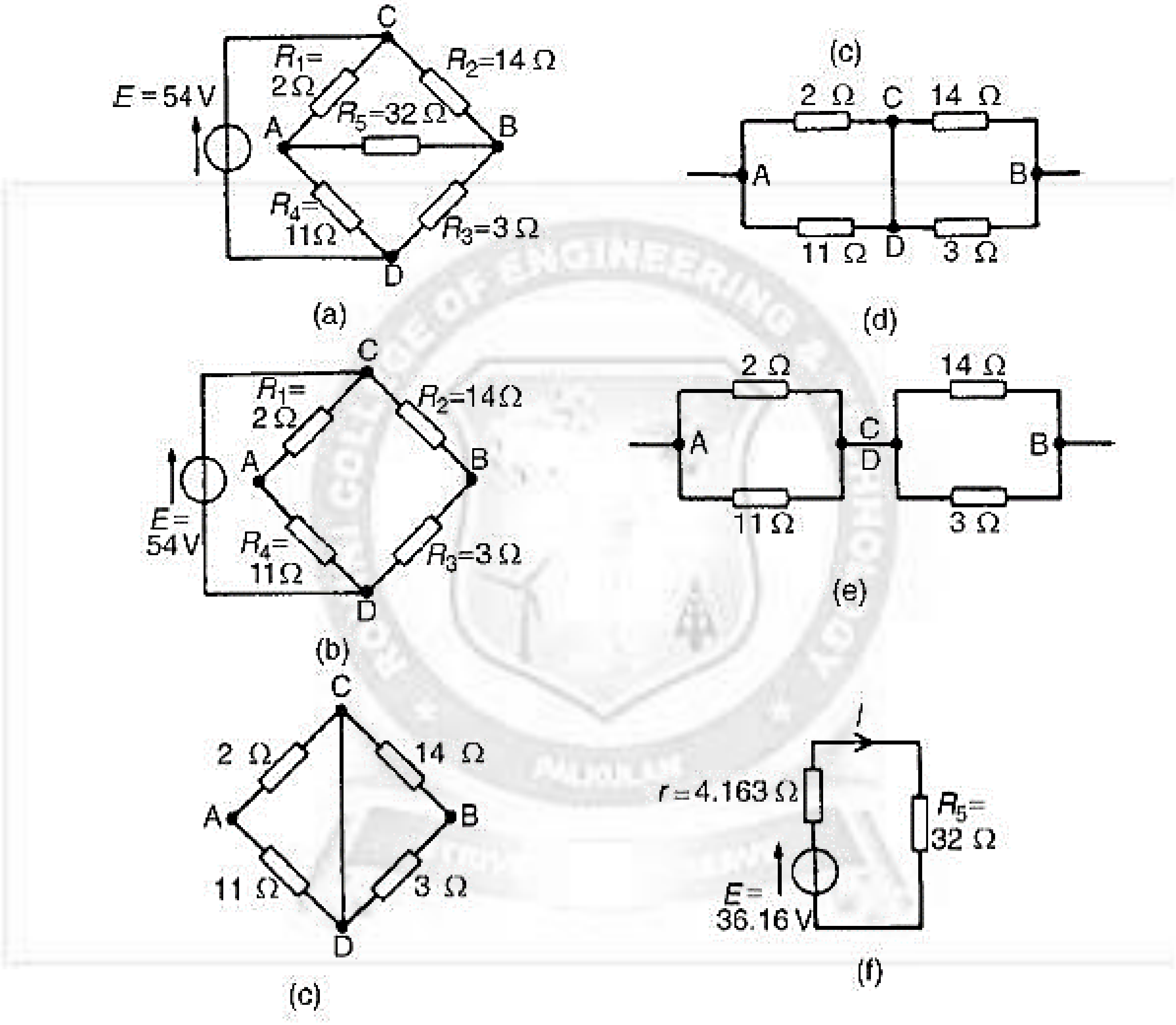
$I = E/R+r$

$= 8/10+6.6$

$= 8/16.6$

$=0.482A$

Problem 2: A Wheatstone Bridge network is shown in Figure (a). Calculate the current flowing in the 32 Ω resistor, and its direction, using Thévenin's negligible resistance.



The 32 Ω resistor is removed from the circuit as shown in Figure (b)
The p.d. between A and C,

VAC =R1/R1 +R4 (E)
=2/2+11(54)
= 8.31V

The p.d. between B and C,

$V_{BC} = R_2/R_2 + R_3\,(E)$

$= 14/14+3(54)$

$= 44.47V$

Hence the p.d. between A and B

$= 44.47 - 8.31$

$= 36.16V$

Point C is at a potential of +54V.
Between C and A is a voltage drop of 8.31V.
Hence the voltage at point A is 54−8.31=45.69V.

Between C and B is a voltage drop of 44.47V.

Hence the voltage at point B is 54−44.47=9.53V.

Since the voltage at A is greater than at B, current must flow in the direction A to B.
Replacing the source of e.m.f. with a short-circuit (i.e. zero internal resistance) gives the circuit shown in Figure (c). The circuit is redrawn and simplified as shown in Figure (d) and (e), from which the resistance between terminals A and B,

$r = 2 \times 11/2 + 11 + 14 \times 3/14 + 3$

$= 22/13 + 42/17$

$= 1.692 + 2.471$

$= 4.163\ \Omega$

(iii) The equivalent Thévenin's circuit is show current $I = E/r + R_5$

$= 36.16/4.163+32$

$= 1A$