

(i) By symmetry, the circuit is identical to that obtained by reflecting about the diagonal AC. Thus $V_B = V_D$; potentials at B and D identical (2)

(ii) There are several different methods of solution.

Solution 1

Reversing the currents produces an identical circuit. However currents in OD and OB have changed direction. Since both circuits are identical, these currents must be zero; thus O at same potential as B and D. Thus currents, by symmetry, in AOC, AOB and ABC must be equal each being $\frac{1}{3}I$.

Total resistance of 3 parallel resistors, resistance $r+r=2r$,

$$R = \left(\frac{1}{2r} + \frac{1}{2r} + \frac{1}{2r}\right)^{-1}$$

$$R = \frac{2r}{3}$$

(4)

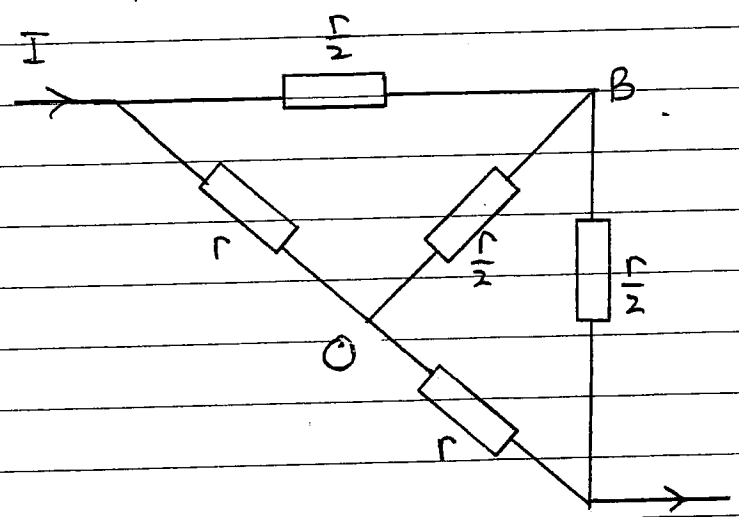
Solution 2

If only B and D are assumed to be at the same potential. Then

AD in parallel with AB; total resistance $\frac{r}{2}$

DO in parallel with OB; total resistance $\frac{r}{2}$

DC in parallel with BC; total resistance $\frac{r}{2}$



This is a balanced Wheatstone bridge with no current through O. Total resistance $(r+r)$ in parallel with $(\frac{r}{2} + \frac{r}{2})$

$$R = \left(\frac{1}{2r} + \frac{1}{r}\right)^{-1} = \frac{2r}{3}$$

(4)