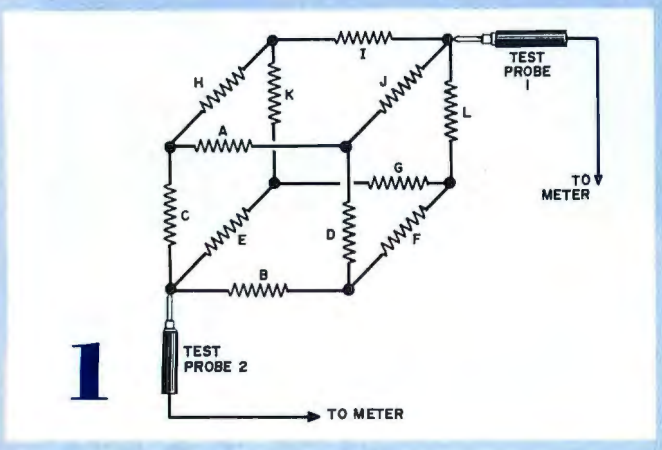
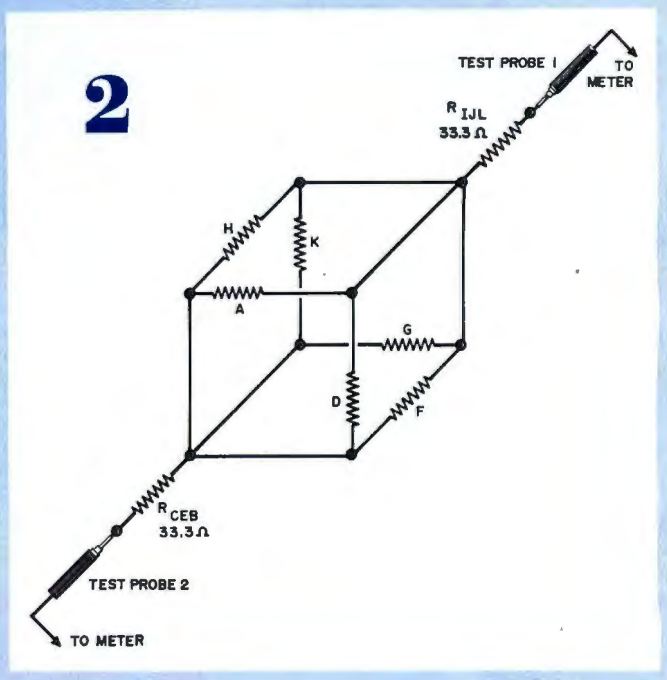
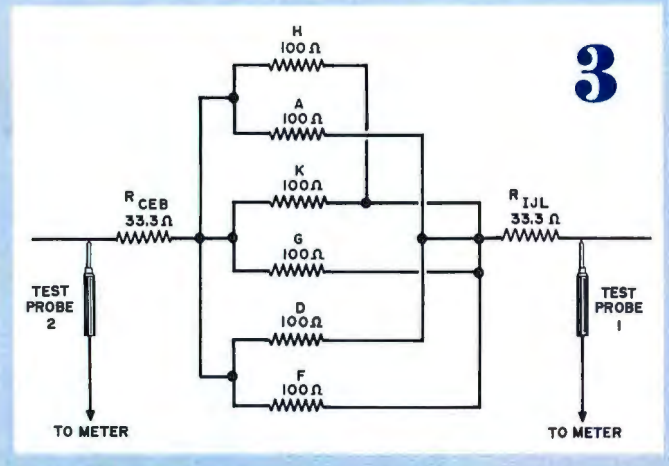
THREE-DIMENSIONAL RESISTOR QUIZ

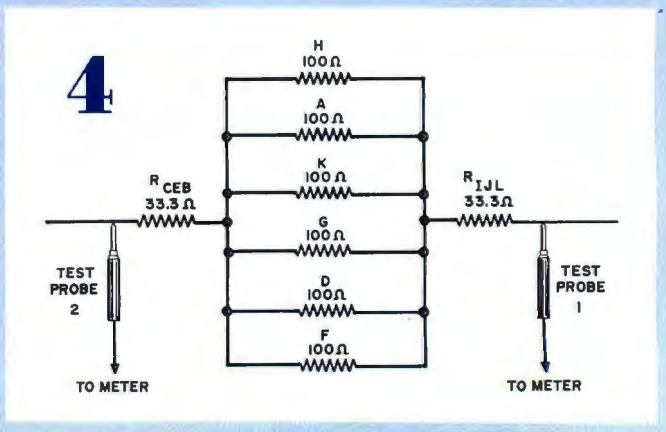
BY GARY W. SEAVER

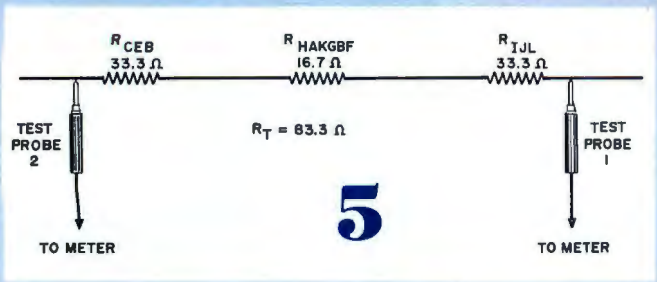
A three-dimensional resistor array such as that shown in Fig. 1 is not likely to occur often in real life—especially made up of 12 equal 100-ohm resistors as it is here. However, complicated circuits do occur and it is handy to know how you can solve for their effective resistance by reducing them through a succession of pi and T transformations, rearrangement of components, etc. (Or, of course, the circuit can always be built up on a breadboard and checked with an ohmmeter.) For the purposes of the quiz, however, determine the resistance analytically. The answer is printed below upside-down.











ANSWER

Here's one possible solution to the Three-Dimensional Resistor Quiz. Because resistors I, J, and L share a common node at test probe 1, let's assume they are in parallel. Employing the formula for resistors in parallel, we obtain an equivalent resistance of 33.3 ohms. Similarly, we assume that resistors B, C, and E are in parallel with an effective resistance of 33.3 ohms. The resulting circuit is shown in Fig. 2.

It can now be seen that resistors H, A, K, G, D, and F all share a common node with effective reistance R_{IJL}. The same resistors share a command node with R_{BCE}. If we redraw the circuit, we get that shown in Fig. 3. Further simplified, it becomes Fig. 4. Obviously, resistors H, A, K, G, E, and F are in parallel, with an effective resistance of 16.7 ohms. The final simplified version of the circuit is shown in Fig. 5. With three effective resistance in series, they can be summed to obtain a total of 83.3 ohms.