1. What would happen if a wire with very little resistance was connected directly across the terminals of a 6-volt battery? Explain in your answer in terms of basic electrical circuit theory.

The low resistance of the wire would allow for a large amount of current to flow through it from one terminal of the battery to the other. The wire would get very hot due to the large current and could either fail or melt the plastic insulation.

2. Consider the circuit below:

Describe the output voltage $V_{out}$ when $R_a = 1\, \text{KOhm}$ and $R_b$ is:

$$V_{out} = \frac{R_b}{R_a + R_b} \cdot V_{in}$$

a. Very small
   $V_{out}$ will be approximately zero as the ratio of $R_b/ (R_a + R_b)$ will be very small.

b. Very large
   $V_{out}$ will be same as $V_{in}$ as ratio of $R_b/ (R_a + R_b)$ will be $\sim 1$
3. Determine the four voltmeter values A, B, C and D that will register connected to the circuit as shown. Assume that battery voltage is 5V. Provide enough explanation for your answer.

\[
\begin{align*}
A &= 5V \\
B &= 0V \\
C &= 5V \\
D &= 0V
\end{align*}
\]

4. For Figure 4, the resistors that are in parallel with each other are:
   c. R2 and R4
   d. R1 and R3
   e. Both R2 and R4 along with R1 and R3
   f. **R1 and (R2 + R3 + R4)**
   g. None of the above

5. For Figure 4, If \( R_{eq} = 100 \) Ohms and \( V_s = 10V \), the current leaving the voltage source must be:
   h. 1000A
   i. 1000W
   j. **0.1A**
   k. 0.1W
   l. None of the above

6. For Figure 4, \( V_s = 5V \), R1 = 100 Ohms, R2 = 100 Ohms, R3 = 150 Ohms, R4 = 50 Ohms. Find the power dissipated by resistor R3.

   **Series Equivalent of R2, R3 and R4 is 300 Ohms. Since R1 is in parallel with combination of R2, R3, and R4, then voltage of across the combination is 5V. Therefore the current flowing through the combination of R2, R3, R4 is 5V/300 Ohms = 0.0167 A.**

   **Power dissipated across R3 = Voltage across R3 x Current through R3.**

   Using Ohms law, \( V = IR \)

   **Therefore Power dissipated across R3 = \((I \times R) \times I\)**

   \[
   = (0.0167)^2 \times 150 \\
   = 0.0418335 \text{ W}
   \]
7. Define the term power rating.
   **Is the maximum power that can be dissipated can be safely dissipated by the device.**

8. To stop the servo motor on the Boe-Bot from turning, you should program the Boe-Bot to send a pulse width of \(1.5\) ms.

9. Assume that the BoeBot is moving through a room and there are certain instances where it must wait for 4 seconds before it can do anything. What commands will you need to perform so that BoeBot does not perform any action for 4 seconds?

   ```java
   for (int i = 0; i < 2; i++) {
       CPU.delay(20000);
   }
   ``

10. Infer the type of variable \(x\):
    
    \[ x = !x \land (x == \text{false}); \]
    
    **boolean**

11. What is the value of variable \(x\) after the following code snippet is executed:

    ```java
    int x = 4;
    if (x > 0)
        x = x + 10;
    x = x - 5;
    if (x <= 0)
        x = 50;
    else
        x = x * 10;
    
    x = 90.
    ```
    Note that statement 2 i.e. \(x = x - 5\) is not part of the if \(x > 0\). If we do not write curly brace, then only next statement after if statement is part of the if condition. If you thought that both statement 1 and statement 2 were part of if the block, then try \(x = 0\) and see what you get.

12. Using parentheses, show how Java will interpret the expressions below:
    
    m. \[ 2 / 3 \% 4 + 8 - ((2 / 3) \% 4) + 8 \]
    n. \[ \text{true} \&\& \text{true} \lor \text{false} - ((\text{true} \&\& \text{true}) \lor \text{false}) \]
13. Consider the valid expression below. Circle what best describes the value of the expression.

a. \( i \cdot i \geq i \) where \( i \) is a variable of type int

\[ \text{true} \quad \text{false} \quad \text{depends} \]

\textit{depends. If \( i \) is very large integer, then result of \( i \cdot i \) will be outside the integer range and it will appear as a negative number which is lesser than \( i \).}

b. \( p \lor \neg p \) where \( p \) is a boolean variable

\[ \text{true} \quad \text{false} \quad \text{depends} \]

\textit{true. One the operands is always true and the result of OR will be true.}

14. What is the outcome when the following code is executed?

```java
int val = 5;
for(int i = 5; i > 0; i--){
    for(int j = 1; j <= i; j++){
        System.out.print(i);
    }
    System.out.println(" ");
}
55555
4444
333
22
1
```

15. Write a static method called “max” that compares three integers and returns the largest of the three integers. Assume the method is written in class M.

Examples:
max(1, 2, 3) returns 3
max(5, 5, 5) returns 5
max(-1, 0, -2) returns 0
public class M{

    public static int max(int a, int b, int c){

        int max = a;

        if(b > max){
            max = b;
        }
        if(c > max){
            max = c;
        }

        return max;

    }//end of method max

}//end of class