CheggSolutions - Thegdp

Operational Amplifier Circuit Analysis

Given Data:

```
\( i_1 = 9 \text{ mA} \)
\( i_2 = 6 \text{ mA} \)
\( R_1 = 8 \text{ ohms} \)
\( R_2 = 2 \text{ ohms} \)
\( R_3 = 9 \text{ ohms} \)
\( R_4 = 5 \text{ ohms} \)
\( R_5 = 3 \text{ ohms} \)
```

Determine the voltages at the non-inverting input *(V_+)* and inverting input *(V_-)* of the op-amp:

Step 1: Voltage at \(V_+ \):

```
\( V_1 = i_1 \cdot R_1 \)
\( V_1 = 9 \text{ mA} \times 8 \text{ ohms} = 72 \text{ mV} \)
```

Step 2: Voltage at \(V_- \):

```
\( V_2 = i_2 \cdot R_3 \)
\( V_2 = 6 \text{ mA} \times 9 \text{ ohms} = 54 \text{ mV} \)
```

Supporting Statement:

An ideal op-amp has negligible input current and the voltage difference between its input terminals in a closed-loop configuration is zero. Thus, \(V_+ = V_- \).

```
\( V_+ = 72 \text{ mV} \)
\( V_- = 54 \text{ mV} \)
```

Note: Due to the ideal op-amp assumption, \(V_+ \) and \(V_- \) are same, i.e., \(V_+ = V_- \).

Calculate the output voltage \(V_{out} \) using virtual short concept:

```
\( V_{out} = V_- \left(1 + \frac {R_5}{R_4}\right) \)
\( V_{out} = 72 \text{ mV} \left(1 + \frac{3 \text{ ohms}}{5 \text{ ohms}}\right) \)
```

Supporting Statement:

An ideal op-amp will amplify the difference between its inputs based on the circuit configuration, here as a non-inverting configuration having feedback.

Solve the equation to find \(V_{out} \):

```
\( V_{out} = 72 \text{ mV} \left(1 + 0.6 \right) \)
\( V_{out} = 72 \text{ mV} \times 1.6 \)
\( V_{out} = 115.2 \text{ mV} \)
```

Determine i_{out}:

```
\( i_{out} = \frac{V_{out}}{R_5} \)
\( i_{out} = \frac{115.2 \text{ mV}}{3 \text{ ohms}} \)
\( i_{out} = 38.4 \text{ mA} \)
```

Final Solution:

The value of the output current i_{out} is 38.4 mA.

Supporting Statement:

The final output current is calculated using Ohm’s Law by dividing the derived V_{out} by the respective resistance in the circuit.