For the following problems, assume that the opamp is ideal.
Here are some tips and assumptions:
1. $V_+ = V_-$, 2. $I_+ = 0$, 3. $I_- = 0$

Writing KCL equations will yield most results. Do not write the KCL at the ground terminals. Also do not write KCL at the opamp output (since $I_{\text{out}}$ is not known).

**Problem 1**
Determine the voltage gain $V_{\text{out}}/V_{\text{in}}$ for the following circuits.

(a) 
![Circuit (a)](image-a)

(b) 
![Circuit (b)](image-b)

(c) 
![Circuit (c)](image-c)

(d) 
![Circuit (d)](image-d)
Problem 2

Determine the output voltage $V_{out}$ as a function of input voltages $V_{in1}$ & $V_{in2}$ for the following circuits:

(a) 

(b) 

Problem 3

For the circuit shown below, determine the following voltage gains: (a) $\frac{V_{out1}}{V_{in}}$, (b) $\frac{V_{out2}}{V_{out1}}$, (c) $\frac{V_{out2}}{V_{in}}$

Problem 4

Synthesize (design) op amp circuits with component values to implement the following functions. Note that the circuit has a single output ($V_{out}$) but may have one input ($V_{in}$) as in (a)-(c) or two inputs ($V_{in1}$ & $V_{in2}$) for (d)-(f).

(a) $V_{out} = -3V_{in}$
(b) $V_{out} = 4V_{in}$
(c) $V_{out} = \frac{1}{2}V_{in}$
(d) $V_{out} = -5V_{in1} - 2V_{in2}$
(e) $V_{out} = V_{in1} - V_{in2}$
(f) $V_{out} = 3V_{in1} - 4V_{in2}$

Notes:

1. Some of these designs require multiple opamps.
2. There may be multiple ways of arriving at similar results.