
Development of a Computerized Variable Item Generator (VIGOR)

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HumRRO

Human Resources Research Organization

Project Background

- ✓ FAA/HumRRO developed the Basic Electronics Screening Tool (BEST)
- ✓ Computer-based multiple-choice test
- ✓ Interest in developing alternate forms of BEST

Project Background (Continued)

- ✓ Explore feasibility of computer generation of items
- ✓ Use of this technology may be risky in a personnel selection arena

Main Objectives

- ✓ To identify and evaluate attributes of the BEST items that can be changed without impacting the level of difficulty of the item.
- ✓ To develop and integrate variable item generation software with the BEST software.

Key Project Activities

- ✓ Identify Knowledges and Structural Characteristics of Items
- ✓ Select items most appropriate for variable item generation
- ✓ Prepare Item Generation Specifications
- ✓ Develop Variable Item Generator Software

Identify Knowledges

- ✓ Identified 48 knowledges required to solve the BEST items

e.g., Ohm's Law

Digital IC Circuits

Parallel Resistances

- ✓ Developed a knowledge x item matrix

Identify Structural Characteristics

- ✓ Identified 20 structural characteristics
 - e.g., - Number of formulae required
 - Complexity of each formula
 - Number of steps required to solve the problem
 - Number of input/output analysis diagrams

Select “Vigor” Items

- ✓ Identified 60 items most appropriate for variable item generation

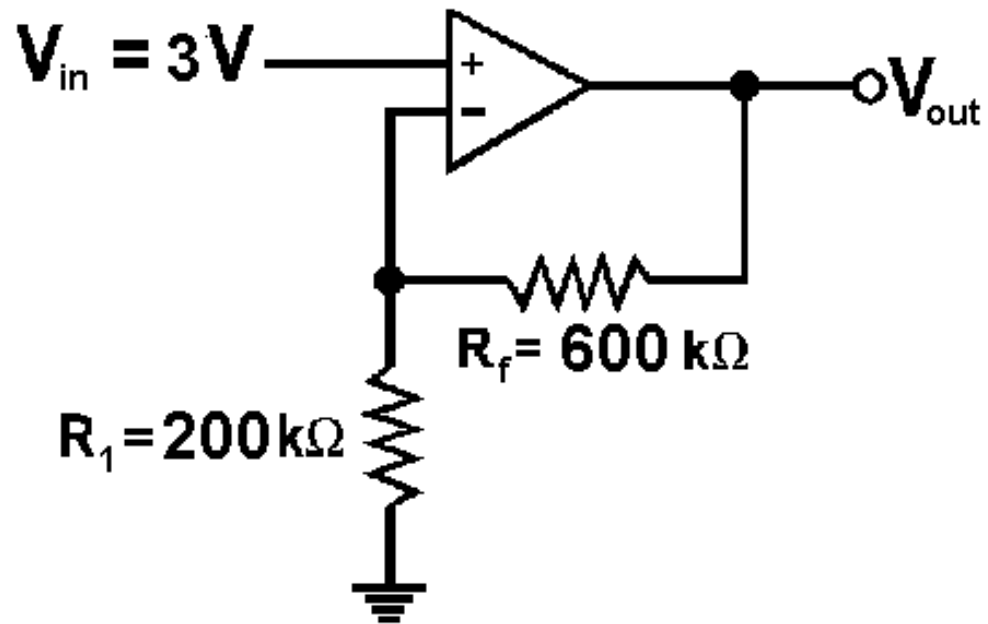
Items are:

- numerical in nature
- involve circuit diagrams
- require calculations to compute the answer

Prepare Item Generation Specifications

- ✓ Solve VIGOR problems and record solution steps
- ✓ Determine incorrect solution paths that could account for alternate distractors
- ✓ Decide which values to vary
- ✓ Determine the range of values
- ✓ Identify other constraints

Example Item



Determine the output voltage.

- a. 6 V
- b. 8 V
- c. 9 V
- d. 12 V

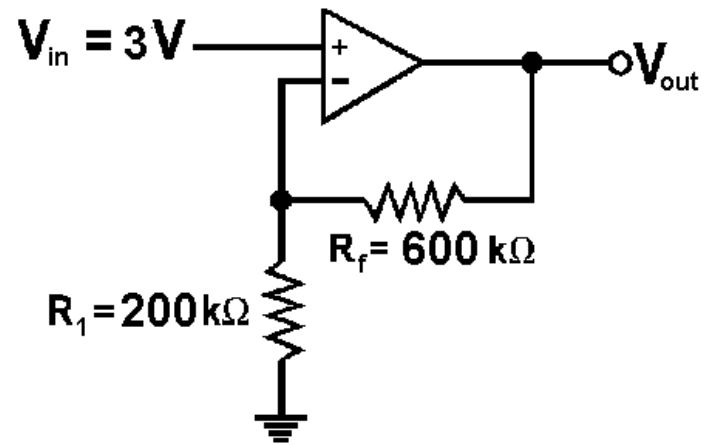
Item Specification

Givens:

1 input voltages, V_{in}

1 resistor value R_1

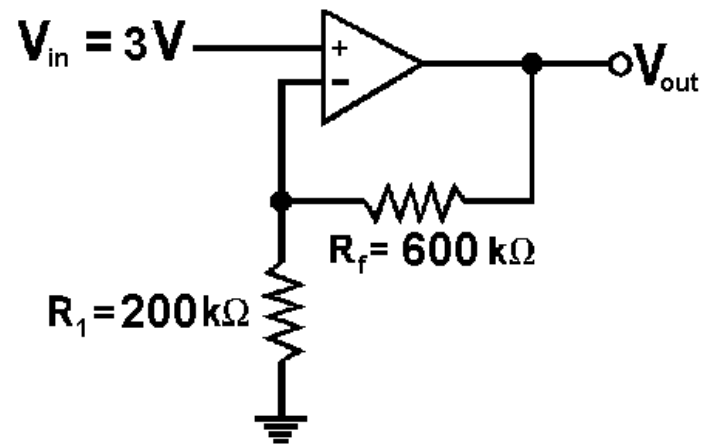
1 R_f value



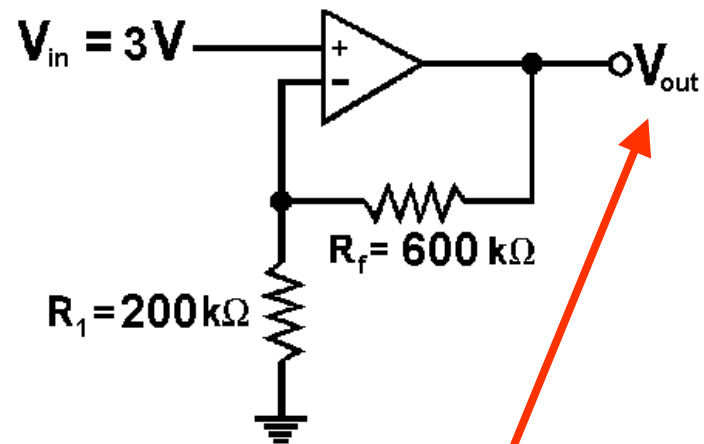
Item Specification (continued)

What may vary:

V_{in} , R_1 , R_f



Item Specification (continued)



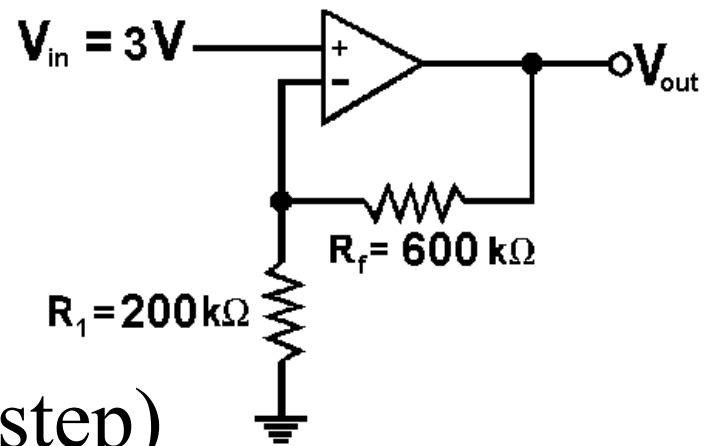
Correct solution:

1. Solve for A_v : $A_v = 1 + (R_f/R_1)$
2. Solve for V_{out} : $V_{out} = (A_v)(V_{in})$

Item Specification (continued)

Wrong answers:

1. Compute $A_v = R_f/R_1$ (step)
2. $(R_1 + R_f)/100$
3. $V_{out}/2$

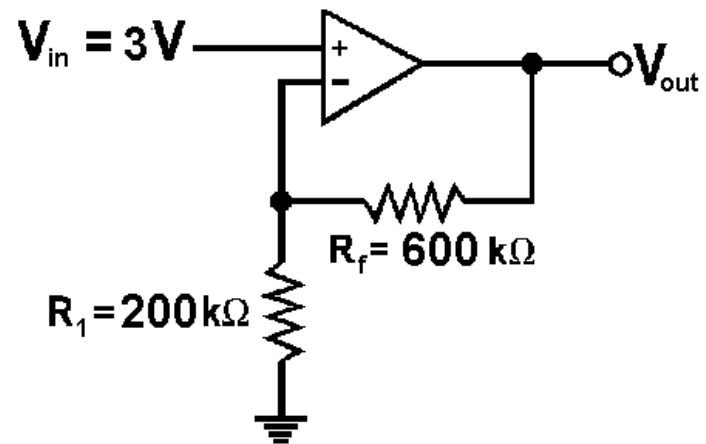


Item Specification (continued)

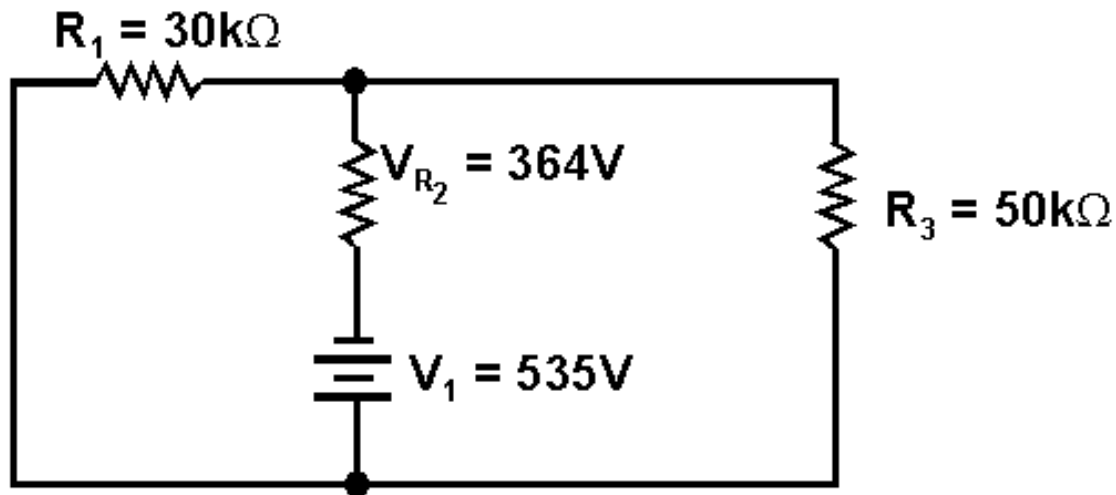
Discussion:

Constraints:

1. $V_{in} \leq 12V$
2. $1 < R_f/R_1 < 4$



Item Generation: Example 1



What is the current thru R_3 in this circuit?

- a. 2.96 mA
- b. 3.42 mA
- c. 6.35 mA
- d. 9.34 mA

Item Generation: Example 2

The sum of the following binary-coded decimal numbers is:

0101 1001

0010 0100

a. 0111 1101

b. 1001 0011

c. 0010 1101

d. 1000 0011

Contributions/Next Steps

- ✓ Helpful in developing alternate tests for other projects
- ✓ First step to investigating the feasibility of generating alternate items via computer for a selection test

Contributions/Next Steps

- ✓ Began to identify the components that may impact item difficulty
- ✓ Conduct research to assess the difficulty and comparability of the different items/tests generated by VIGOR