

---

# ***Development of a Computerized Variable Item Generator (VIGOR)***

Suzanne Tsacoumis

June 6, 2000

Presented at the 24th Annual IPMAAC Conference on  
Personnel Assessment

---

*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

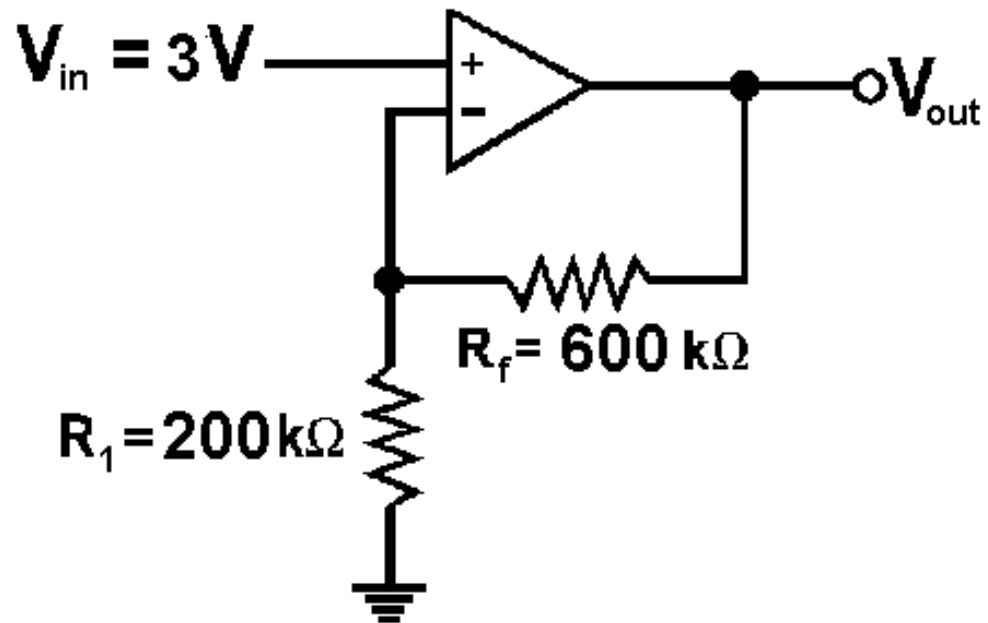


---

## ***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

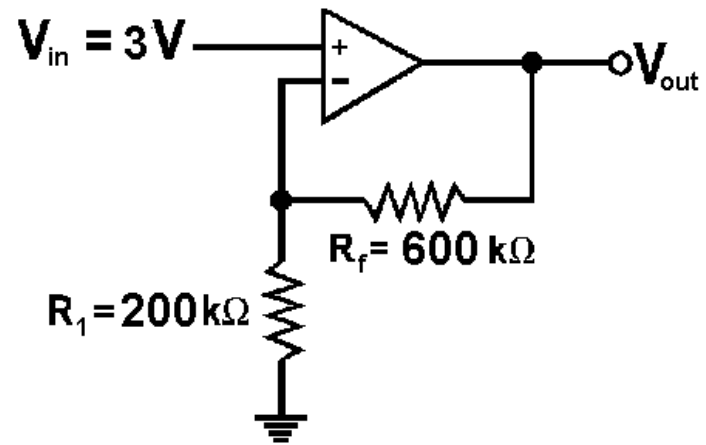
## Item Specification

Givens:

1 input voltages,  $V_{in}$

1 resistor value  $R_1$

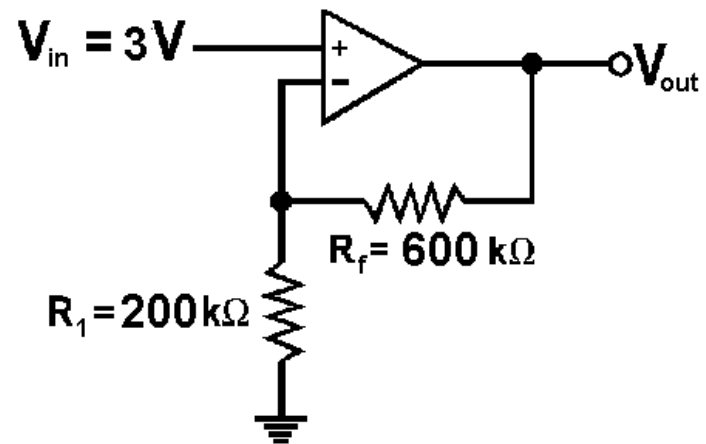
1  $R_f$  value



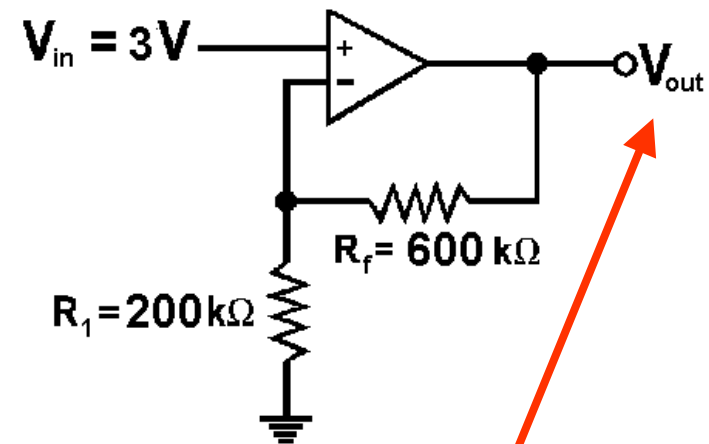
## *Item Specification (continued)*

What may vary:

$V_{in}$ ,  $R_1$ ,  $R_f$



## Item Specification (continued)



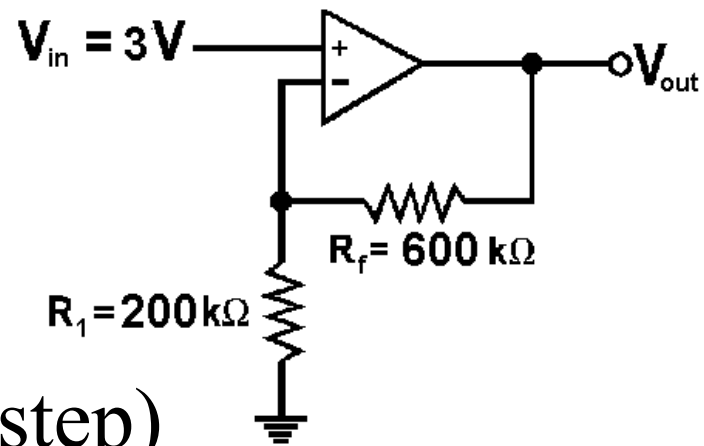
Correct solution:

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.  $V_{out}/2$

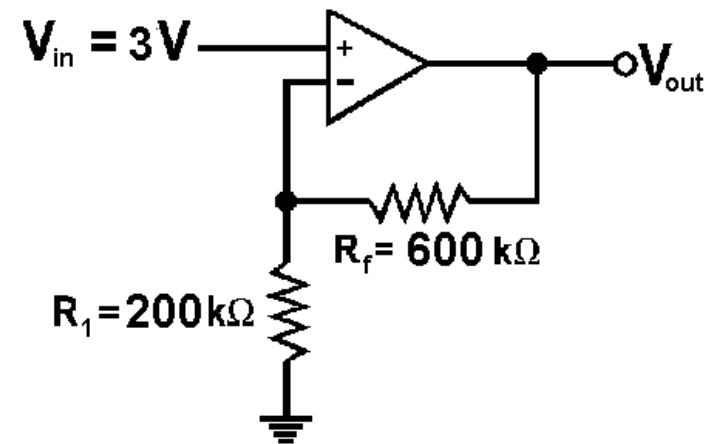


## *Item Specification (continued)*

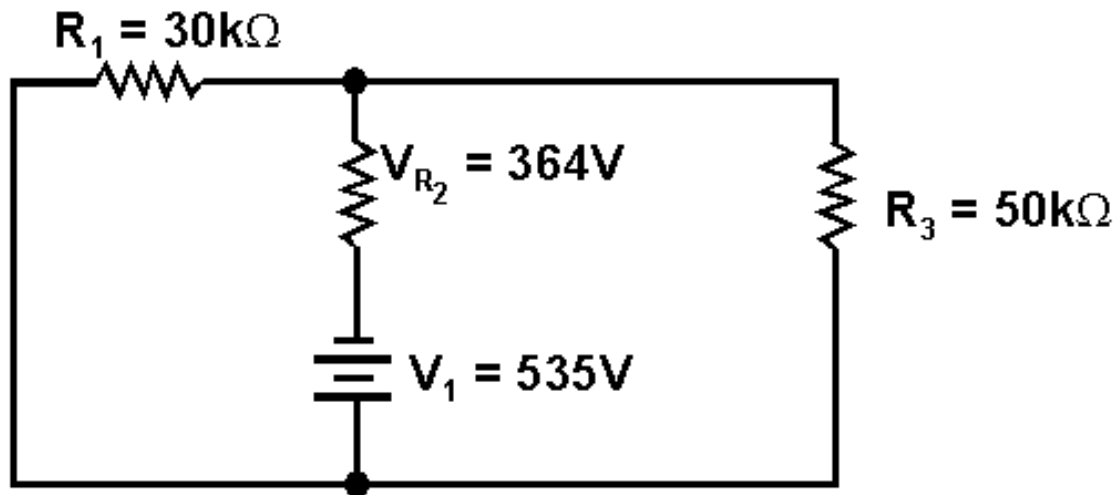
Discussion:

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