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Student ID Number:	**Model Answer**
Section:	01A / 01B / 05A / 05B
Lecturer:	Dr. Jamaludin Bin Omar

EEEB273 - Quiz 6 [Question Set 1]
SEMESTER 1, ACADEMIC YEAR 2011/2012
Date: 1 August 2011

Question:

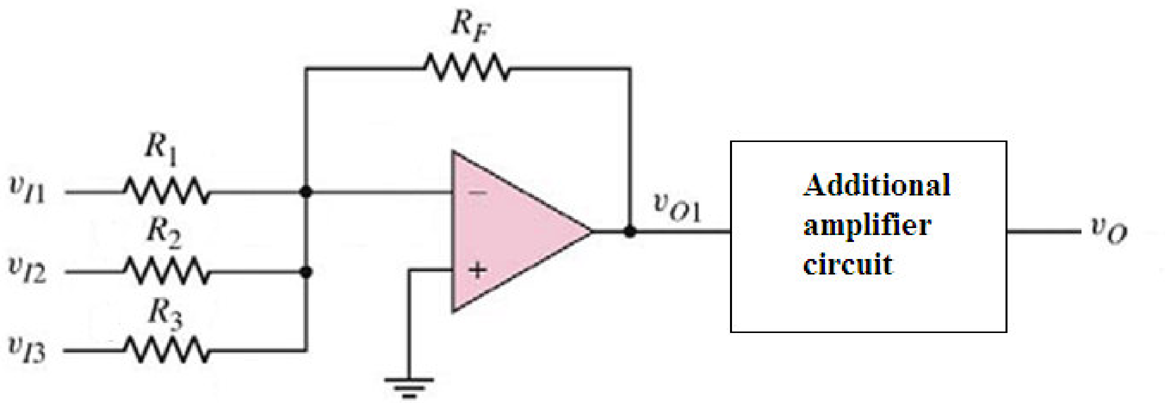

Figure 1

Refer to Figure 1.

(a) By using the **smallest resistance** in the circuit is **10 kΩ**, **design an ideal inverting summing amplifier** to produce an output voltage of

$$v_{O1} = -2.5(2.4v_{I1} + 0.24v_{I2} + 1.2v_{I3}) \qquad \text{--Equation 1--}$$

[8 marks]

Hint: Use the general equation for the ideal inverting summing amplifier.

(b) **Design an additional amplifier circuit** (using ideal inverting operational amplifier) to be connected to the output of the ideal inverting summing amplifier so that the equation for the output voltage of the **new summing amplifier** can be modified to

$$v_O = +2.5(2.4v_{I1} + 0.24v_{I2} + 1.2v_{I3}) \qquad \text{--Equation 2--}$$

[2 marks]

Hint: Note that **negative sign** in **Equation 1** is inverted in order to produce **Equation 2**.

Show clearly all calculations in order to get full marks.

Answer:

(a)

$v_{O1} = -2.5(2.4v_{I1} + 0.24v_{I2} + 1.2v_{I3})$

$v_{O1} = (-6v_{I1}) + (-0.6v_{I2}) + (-3v_{I3})$ [1/2]

$= (-(R_F/R_1)v_{I1}) + (-(R_F/R_2)v_{I2}) + (-(R_F/R_1)v_{I3})$ [1/2]

$-6v_{I1} = -(R_F/R_1)$ → $R_F = 6R_1$ [1]

$-0.6v_{I2} = -(R_F/R_2)$ → $R_F = 0.6R_2$ [1]

$-3v_{I3} = -(R_F/R_3)$ → $R_F = 3R_3$ [1]

Therefore, the smallest resistor is R_1. So, set R_1 = 10 kΩ [1]

$R_F = 6R_1$ = 60 kΩ [1]

$R_2 = R_F/0.6$ = 60k/0.6 = 100 kΩ [1]

$R_3 = R_F/3$ = 60k/3 = 20 kΩ [1]

(b)

To invert the negative sign in Equation 1 to a positive sign, then the voltage gain of the additional amplifier circuit is -1. [1/2]

For the additional amplifier circuit using the inverting operational amplifier, let its feedback resistor as R_5 and its input resistor as R_4.

Then $-1 = -(R_5/R_4)$ → $R_5 = R_4$ [1/2]

Let R_4 = 10 kΩ, **then** R_5 = 10 kΩ. [1]

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EEEB273 - Quiz 6 [Question Set 2]
SEMESTER 1, ACADEMIC YEAR 2011/2012
Date: 1 August 2011

Question:

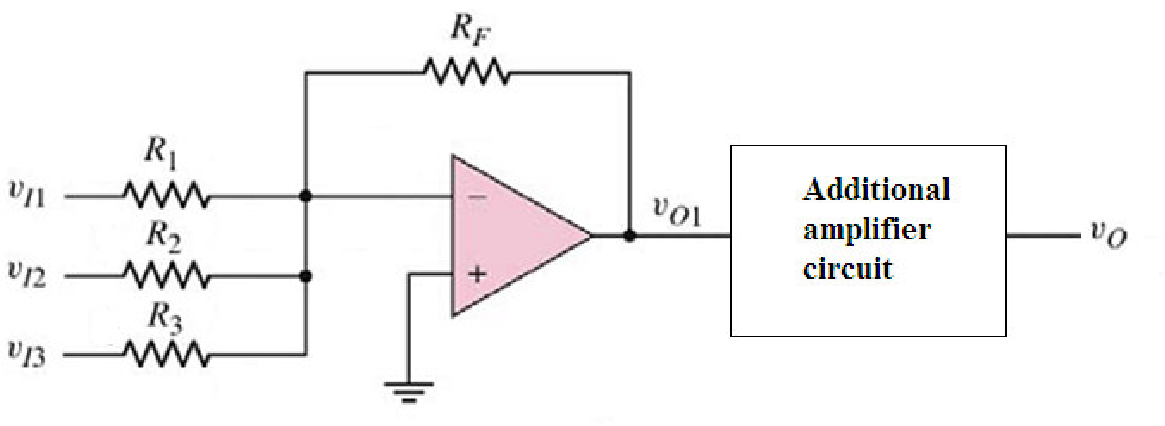

Figure 1

Refer to Figure 1.

(a) By using the **smallest resistance** in the circuit is **15 kΩ**, **design an ideal inverting summing amplifier** to produce an output voltage of

$$v_{O1} = -2.5(0.24v_{I1} + 1.2v_{I2} + 2.4v_{I3}) \quad \text{--Equation 1--}$$

[8 marks]

Hint: Use the general equation for the ideal inverting summing amplifier.

(b) **Design an additional amplifier circuit** (using ideal inverting operational amplifier) to be connected to the output of the ideal inverting summing amplifier so that the equation for the output voltage of the **new summing amplifier** can be modified to

$$v_O = +2.5(0.24v_{I1} + 1.2v_{I2} + 2.4v_{I3}) \quad \text{--Equation 2--}$$

[2 marks]

Hint: Note that **negative sign** in **Equation 1** is inverted in order to produce **Equation 2**.

Show clearly all calculations in order to get full marks.

Answer:

(a)

v_{O1} $= -2.5(0.24v_{I1} + 1.2v_{I2} + 2.4v_{I3})$

v_{O1} $= (-0.6v_{I1}) + (-3v_{I2}) + (-6v_{I3})$ [1/2]

$= (-(R_F/R_1)v_{I1}) + (-(R_F/R_2)v_{I2}) + (-(R_F/R_1)v_{I3})$ [1/2]

$-0.6v_{I1} = -(R_F/R_1)$ → $R_F = 0.6R_1$ [1]

$-3v_{I2} = -(R_F/R_2)$ → $R_F = 3R_2$ [1]

$-6v_{I3} = -(R_F/R_3)$ → $R_F = 6R_3$ [1]

Therefore, the smallest resistor is R_3. So, set R_3 = 15 kΩ [1]

R_F	$= 6R_3$		$= 90$ kΩ	[1]
R_1	$= R_F/0.6$	$= 90k/0.6$	$= 150$ kΩ	[1]
R_2	$= R_F/3$	$= 90k/3$	$= 30$ kΩ	[1]

(b)

To invert the negative sign in Equation 1 to a positive sign, then the voltage gain of the additional amplifier circuit is -1. [1/2]

For the additional amplifier circuit using the inverting operational amplifier, let its feedback resistor as R_5 and its input resistor as R_4.

Then $-1 = -(R_5/R_4)$ → $R_5 = R_4$ [1/2]

Let $R_4 = 15$ kΩ, **then** $R_5 = 15$ kΩ. [1]

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EEEB273 - Quiz 6 [Question Set 3]
SEMESTER 1, ACADEMIC YEAR 2011/2012
Date: 1 August 2011

Question:

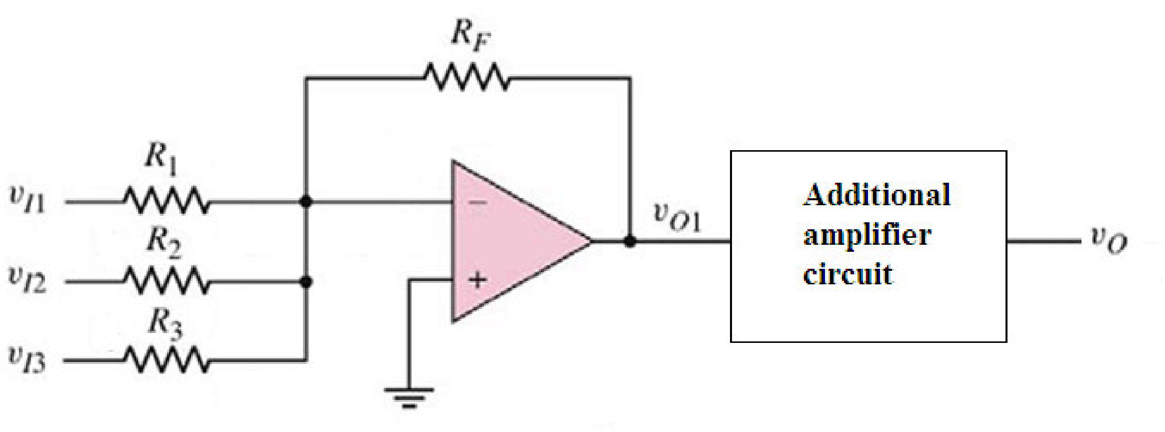

Figure 1

Refer to Figure 1.

(a) By using the **smallest resistance** in the circuit is **12 kΩ**, **design an ideal inverting summing amplifier** to produce an output voltage of

$$v_{O1} = -2.5(1.2v_{I1} + 0.24v_{I2} + 2.4v_{I3})$$ **--Equation 1--**

[8 marks]

Hint: Use the general equation for the ideal inverting summing amplifier.

(b) **Design an additional amplifier circuit** (using ideal inverting operational amplifier) to be connected to the output of the ideal inverting summing amplifier so that the equation for the output voltage of the **new summing amplifier** can be modified to

$$v_O = +2.5(1.2v_{I1} + 0.24v_{I2} + 2.4v_{I3})$$ **--Equation 2--**

[2 marks]

Hint: Note that **negative sign** in **Equation 1** is inverted in order to produce **Equation 2**.

Show clearly all calculations in order to get full marks.

Answer:

(a)

v_{O1} = $-2.5(1.2v_{I1} + 0.24v_{I2} + 2.4v_{I3})$

v_{O1} = $(-3v_{I1}) + (-0.6v_{I2}) + (-6v_{I3})$ [1/2]

= $(-(R_F/R_1)v_{I1}) + (-(R_F/R_2)v_{I2}) + (-(R_F/R_1)v_{I3})$ [1/2]

$-3v_{I1} = -(R_F/R_1)$ → $R_F = 3R_1$ [1]

$-0.6v_{I2} = -(R_F/R_2)$ → $R_F = 0.6R_2$ [1]

$-6v_{I3} = -(R_F/R_3)$ → $R_F = 6R_3$ [1]

Therefore, the smallest resistor is R_3. So, set R_3			= 12 kΩ	[1]
R_F	$= 6R_3$		= 72 kΩ	[1]
R_1	$= R_F/3$	= 72k/3	= 24 kΩ	[1]
R_2	$= R_F/0.6$	= 72k/0.6	= 120 kΩ	[1]

(b)

To invert the negative sign in Equation 1 to a positive sign, then the voltage gain of the additional amplifier circuit is -1. [1/2]

For the additional amplifier circuit using the inverting operational amplifier, let its feedback resistor as R_5 and its input resistor as R_4.

Then $-1 = -(R_5/R_4)$ → $R_5 = R_4$ [1/2]

Let R_4 = 12 kΩ, **then** R_5 = 12 kΩ. [1]

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EEEB273 - Quiz 6 [Question Set 4]
SEMESTER 1, ACADEMIC YEAR 2011/2012
Date: 1 August 2011

Question:

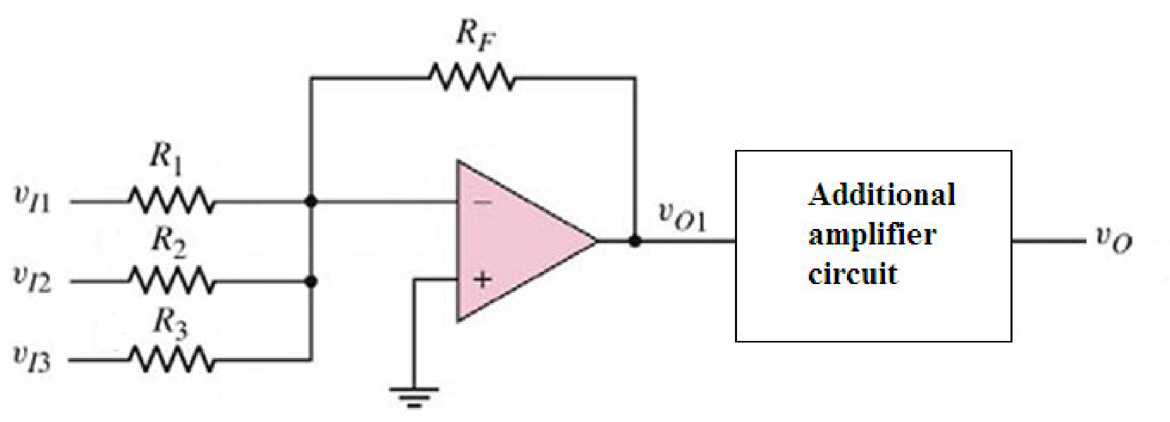

Figure 1

Refer to Figure 1.

(a) By using the **smallest resistance** in the circuit is **18 kΩ**, **design an ideal inverting summing amplifier** to produce an output voltage of

$$v_{O1} = -2.5(0.24v_{I1} + 1.2v_{I2} + 2.4v_{I3}) \qquad \text{--Equation 1--}$$

[8 marks]

Hint: Use the general equation for the ideal inverting summing amplifier.

(b) **Design an additional amplifier circuit** (using ideal inverting operational amplifier) to be connected to the output of the ideal inverting summing amplifier so that the equation for the output voltage of the **new summing amplifier** can be modified to

$$v_O = +2.5(0.24v_{I1} + 1.2v_{I2} + 2.4v_{I3}) \qquad \text{--Equation 2--}$$

[2 marks]

Hint: Note that **negative sign** in **Equation 1** is inverted in order to produce **Equation 2**.

Show clearly all calculations in order to get full marks.

Answer:

(a)

$v_{O1} = -2.5(0.24v_{I1} + 1.2v_{I2} + 2.4v_{I3})$

$v_{O1} = (-0.6v_{I1}) + (-3v_{I2}) + (-6v_{I3})$ [1/2]

$= (-(R_F/R_1)v_{I1}) + (-(R_F/R_2)v_{I2}) + (-(R_F/R_1)v_{I3})$ [1/2]

$-0.6v_{I1} = -(R_F/R_1)$ → $R_F = 0.6R_1$ [1]

$-3v_{I2} = -(R_F/R_2)$ → $R_F = 3R_2$ [1]

$-6v_{I3} = -(R_F/R_3)$ → $R_F = 6R_3$ [1]

Therefore, the smallest resistor is R_3. So, set R_3 = 18 kΩ [1]

$R_F = 6R_3$ = 108 kΩ [1]

$R_1 = R_F/0.6$ = 108k/0.6 = 180 kΩ [1]

$R_2 = R_F/3$ = 108k/3 = 36 kΩ [1]

(b)

To invert the negative sign in Equation 1 to a positive sign, then the voltage gain of the additional amplifier circuit is -1. [1/2]

For the additional amplifier circuit using the inverting operational amplifier, let its feedback resistor as R_5 and its input resistor as R_4.

Then $-1 = -(R_5/R_4)$ → $R_5 = R_4$ [1/2]

Let R_4 = 18 kΩ, **then** R_5 = 18 kΩ. [1]