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

EEEB273 - Quiz 5
SEMESTER 1, ACADEMIC YEAR 2018/2019
Date: 28 August 2018 Time: 15 minutes .

Question:

Consider **ideal** inverting op-amp circuits in **Figure 1**. Given $\boldsymbol{R_1}$ = **5 kΩ**, $\boldsymbol{R_2}$ = **40 kΩ**, $\boldsymbol{R_3}$ = **10 kΩ**, and $\boldsymbol{R_4}$ = **200 kΩ.**

(a) **Derive** the expression for the output voltage $\boldsymbol{v_O}$ in terms of input voltages $\boldsymbol{v_{I1}}$ and $\boldsymbol{v_{I2}}$. [6 marks]

(b) **Determine** $\boldsymbol{v_O}$ for $\boldsymbol{v_{I1}}$ **= +5 mV** and $\boldsymbol{v_{I2}}$ = **–25 – 50 sin ωt mV**. [3 marks]

(c) **What** is the maximum value of the output voltage, i.e. $\boldsymbol{v_O}$ **(max)**? [1 mark]

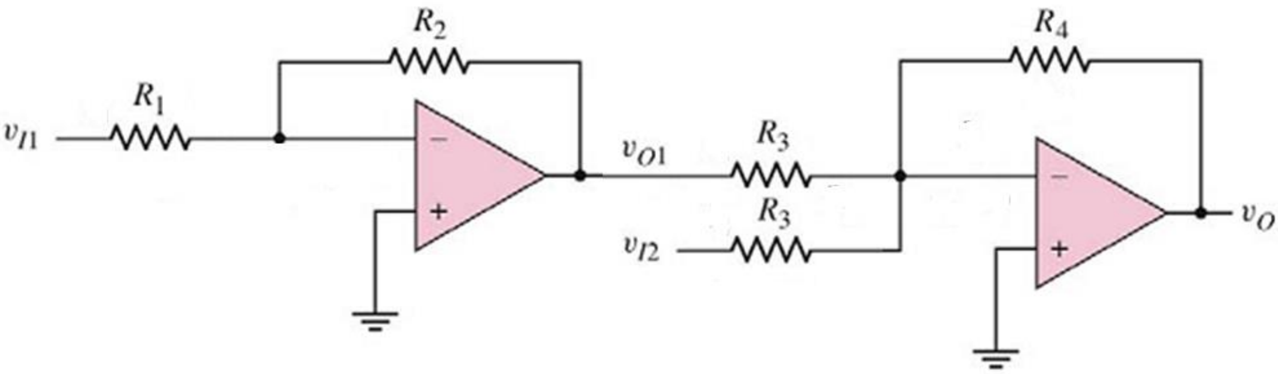

Figure 1

Answer:

(a)

$v_{O1} = -(R_2/R_1)\, v_{I1} = -(40k/5k)\, v_{I1} = -8\, v_{I1}$ **[3]**

$v_O = -(R_4/R_3)(v_{O1} + v_{I2}) = -(200k/10k)(-8\, v_{I1} + v_{I2})$

$v_O = -20(-8\, v_{I1} + v_{I2}) = 160\, v_{I1} - 20\, v_{I2}$ **[3]**

(b)

$v_O = 160\, v_{I1} - 20\, v_{I2} = 160(+5\text{ mV}) - 20(-25 - 50 \sin \omega t \text{ mV})$ **[2]**

$v_O = 800\text{ mV} + 500\text{ mV} + 1000 \sin \omega t \text{ mV}$

$v_O = 1300\text{ mV} + 1000 \sin \omega t \text{ mV} = 1.3 + 1 \sin \omega t \text{ V}$ **[1]**

(c)

v_O **(max)** is the value when **sin ωt = 1.**

v_O **(max) = 1.3 + 1 (1) = 2.3 V.** **[1]**

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Question:

Consider **ideal** inverting op-amp circuits in **Figure 1**. Given R_1 **= 15 kΩ**, R_2 **= 45 kΩ**, R_3 **= 8 kΩ**, and R_4 **= 240 kΩ.**

(a) **Derive** the expression for the output voltage v_O in terms of input voltages v_{I1} and v_{I2}. [6 marks]

(b) **Determine** v_O for v_{I1} **= +5 mV** and v_{I2} **= –25 – 50 sin ωt mV**. [3 marks]

(c) **What** is the maximum value of the output voltage, i.e. v_O **(max)**? [1 mark]

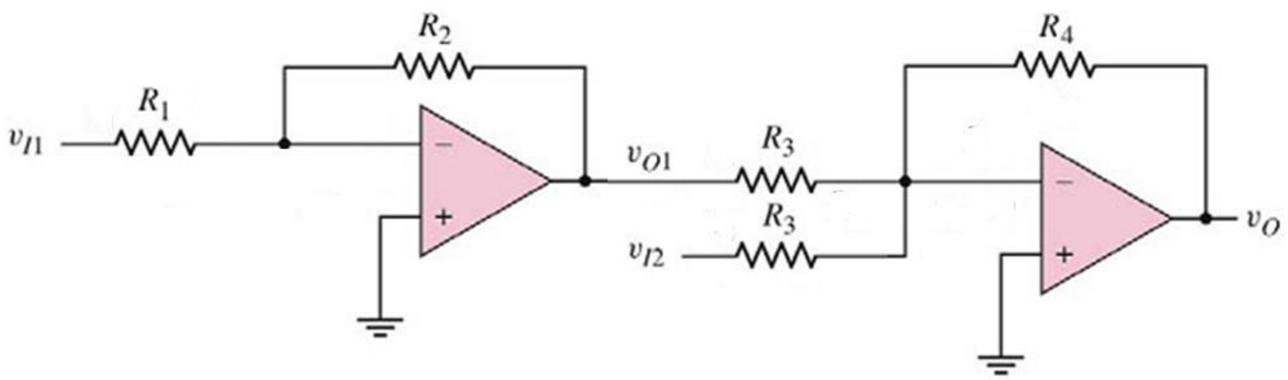

Figure 1

Answer:

(a)

$v_{O1} = -(R_2/R_1)\, v_{I1} = -(45k/15k)\, v_{I1} = -3\, v_{I1}$ **[3]**

$v_O = -(R_4/R_3)(v_{O1} + v_{I2}) = -(240k/8k)(-3\, v_{I1} + v_{I2})$

$v_O = -30(-3\, v_{I1} + v_{I2}) = 90\ v_{I1} - 30\, v_{I2}$ **[3]**

(b)

$v_O = 90\, v_{I1} - 30\, v_{I2} = 90(+5\text{ mV}) - 30(-25 - 50 \sin \omega t \text{ mV})$ **[2]**

$v_O = 450\text{ mV} + 750\text{ mV} + 1500 \sin \omega t \text{ mV}$

$v_O = 1200\text{ mV} + 1500 \sin \omega t \text{ mV} = 1.2 + 1.5 \sin \omega t \text{ V}$ **[1]**

(c)

v_O **(max)** is the value when **sin ωt = 1.**

v_O **(max) = 1.2 + 1.5 (1) = 2.7 V.** **[1]**

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Question:

Consider **ideal** inverting op-amp circuits in **Figure 1**. Given R_1 = **5 kΩ**, R_2 = **40 kΩ**, R_3 = **10 kΩ**, and R_4 = **200 kΩ.**

(a) **Derive** the expression for the output voltage v_O in terms of input voltages v_{I1} and v_{I2}. [6 marks]

(b) **Determine** v_O for v_{I1} = **+7.5 mV** and v_{I2} = **–35 – 60 sin ωt mV**. [3 marks]

(c) **What** is the maximum value of the output voltage, i.e. v_O **(max)**? [1 mark]

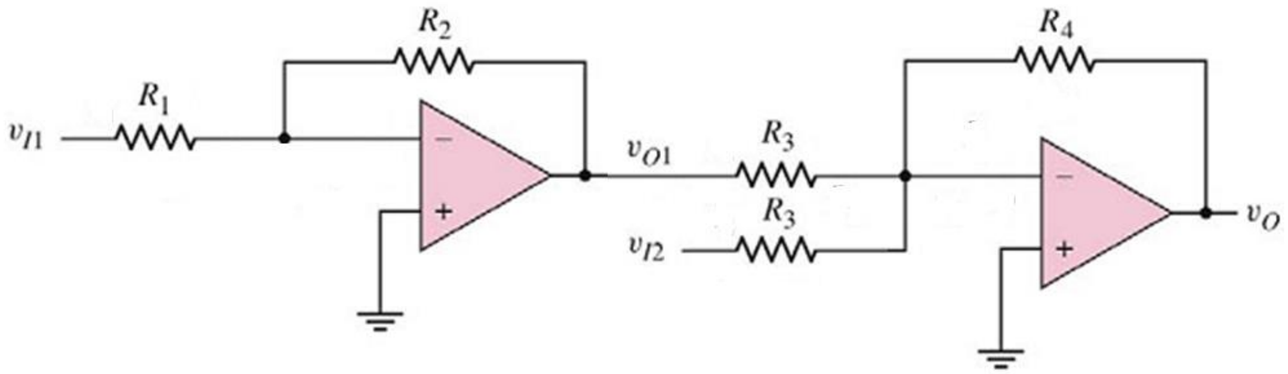

Figure 1

Answer:

(a)

$v_{O1} = -(R_2 / R_1)\, v_{I1} = -(40k/5k)\, v_{I1} = -8\, v_{I1}$ **[3]**

$v_O = -(R_4 / R_3)(v_{O1} + v_{I2}) = -(200k/10k)(-8\, v_{I1} + v_{I2})$

$v_O = -20(-8\, v_{I1} + v_{I2}) = 160\, v_{I1} - 20\, v_{I2}$ **[3]**

(b)

$v_O = 160\, v_{I1} - 20\, v_{I2} = 160\,(+7.5\text{ mV}) - 20\,(-35 - 60 \sin \omega t\text{ mV})$ **[2]**

$v_O = 1200\text{ mV} + 700\text{ mV} + 1200 \sin \omega t\text{ mV}$

$v_O = 1900\text{ mV} + 1200 \sin \omega t\text{ mV} = 1.9 + 1.2 \sin \omega t\text{ V}$ **[1]**

(c)

v_O **(max)** is the value when **sin ωt = 1.**

v_O **(max) = 1.9 + 1.2 (1) = 3.1 V.** **[1]**

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Question:

Consider **ideal** inverting op-amp circuits in **Figure 1**. Given $\boldsymbol{R_1}$ = **15 kΩ**, $\boldsymbol{R_2}$ = **45 kΩ**, $\boldsymbol{R_3}$ = **8 kΩ**, and $\boldsymbol{R_4}$ = **240 kΩ.**

(a) **Derive** the expression for the output voltage $\boldsymbol{v_O}$ in terms of input voltages $\boldsymbol{v_{I1}}$ and $\boldsymbol{v_{I2}}$. [6 marks]

(b) **Determine** $\boldsymbol{v_O}$ for $\boldsymbol{v_{I1}}$ **= +7.5 mV** and $\boldsymbol{v_{I2}}$ = **–35 – 60 sin ωt mV**. [3 marks]

(c) **What** is the maximum value of the output voltage, i.e. $\boldsymbol{v_O}$ **(max)**? [1 mark]

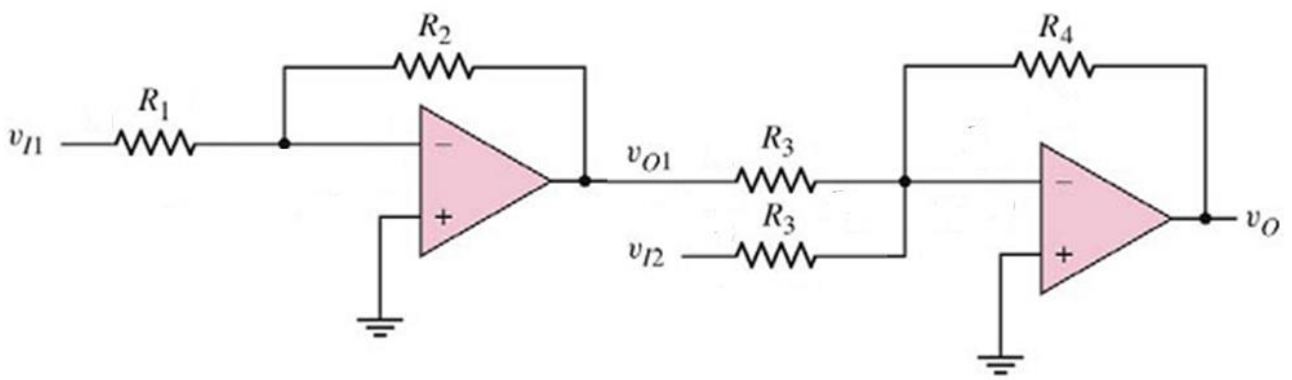

Figure 1

Answer:

(a)

$v_{O1} = -(R_2/R_1)\, v_{I1} = -(45k/15k)\, v_{I1} = -3\, v_{I1}$ **[3]**

$v_O = -(R_4/R_3)(v_{O1} + v_{I2}) = -(240k/8k)(-3\, v_{I1} + v_{I2})$

$v_O = -30(-3\, v_{I1} + v_{I2}) = 90\, v_{I1} - 30\, v_{I2}$ **[3]**

(b)

$v_O = 90\, v_{I1} - 30\, v_{I2} = 90(+7.5 \text{ mV}) - 30(-35 - 60 \sin \omega t \text{ mV})$ **[2]**

$v_O = 675 \text{ mV} + 1050 \text{ mV} + 1800 \sin \omega t \text{ mV}$

$v_O = 1725 \text{ mV} + 1800 \sin \omega t \text{ mV} = 1.725 + 1.8 \sin \omega t \text{ V}$ **[1]**

(c)

v_O **(max)** is the value when **sin ωt = 1.**

v_O **(max) = 1.725 + 1.8 (1) = 3.525 V.** **[1]**