Analog Circuits Test 3

Number of Questions: 25 **Time: 60 min.**

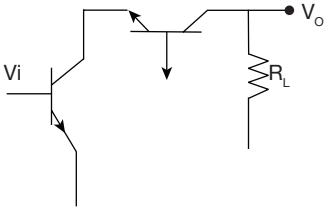
Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. A good voltage buffer has
(A) low input impedance and low output impedance
(B) high input impedance and high output impedance
(C) high input impedance and low output impedance
(D) low input impedance and high output impedance

2. The RMS thermal noise voltages of two resistors individually are V_1 and V_2. If these resistors are connected in series, the total noise voltage is given by
(A) $V_1 + V_2$ (B) $\sqrt{V_1 V_2}$
(C) $\left(\sqrt{V_1}+\sqrt{V_2}\right)^2$ (D) $\sqrt{V_1^2+V_2^2}$

3. For full wave rectification, A center tap circuit utilizes
(A) one-fourth of secondary voltage
(B) half of secondary voltage
(C) full secondary voltage
(D) None of the above

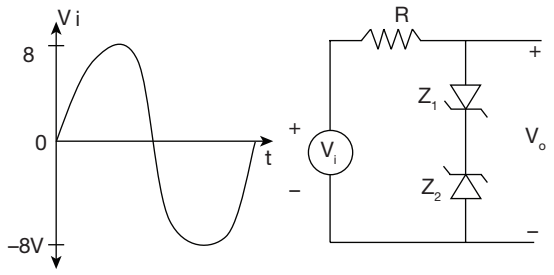
4. In the cascode amplifier, if the CE stage has a transconductance g_{m1} and CB has transconductance g_{m2}, then overall transconductance is

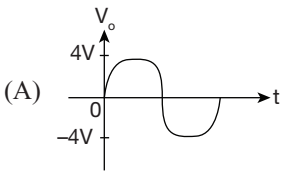


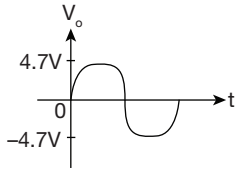
(A) g_{m_2} (B) $0.5\, g_{m_2}$
(C) $0.5\, g_{m_1}$ (D) g_{m_1}

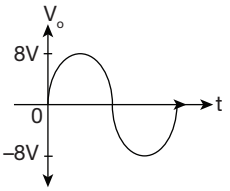
5. Gold doping is used in switching devices in order to
(A) protect terminals against corrosion
(B) improve bonding
(C) increase the mobility of the carrier
(D) reduce storage device

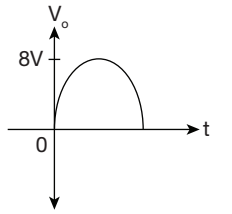
6. In below shown circuit zener voltage $V_{Z_1} = 4\text{V}$ and $V_{Z_2} = 4\text{V}$, $V\gamma = 0.7\text{V}$, then output voltage V_o is



(A) 

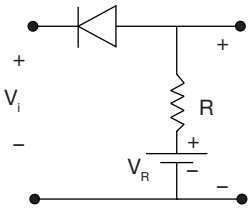
(B) 

(C) 

(D) 

7. The ripple factor in an LC filter
(A) has the lowest value
(B) increases with load current
(C) increases with the load resistance
(D) remains constant with the load current

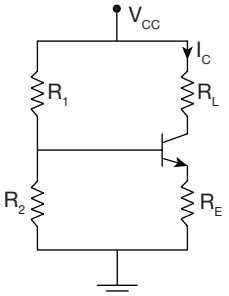
8. In below figure V_i is input, V_o is output and V_R is reference voltage.



(A) The circuit clips off the input $V_i > V_R$
(B) The circuit clips off the input $V_i < V_R$
(C) output $V_o = V_R$ always
(D) The negative swings of V_i are only clipped off

9. Consider the following rectifier circuits for low load:
(1) Full wave rectifier will series inductance filter
(2) Full wave rectifier with capacitance filter
(3) Full-wave rectifier without filter
(4) Half wave rectifier without filter
The sequence of these rectifier circuits in increasing order of their ripple factor is
(A) 2, 1, 3, 4 (B) 1, 2, 3, 4
(C) 4, 3, 1, 2 (D) 4, 3, 2, 1

10. The circuit shown below is a

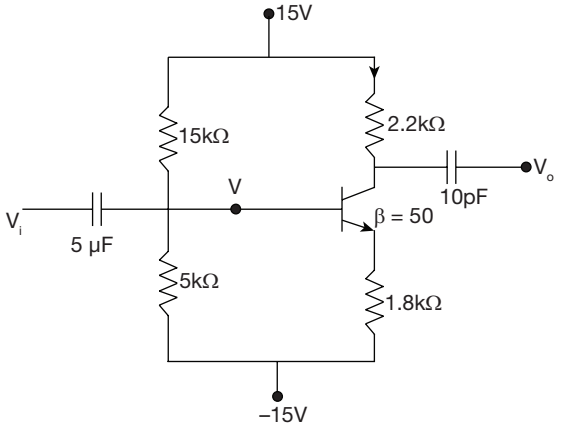


(A) constant voltage source
(B) constant current source
(C) common base amplifier
(D) None of the above

11. A d.c power supply has no load voltage of 30V and full load voltage of 20V at a full load current of 2A. Its output resistance is
(A) 15 Ω (B) 10 Ω
(C) 5 Ω (D) 25 Ω

12. The gain of a transistor amplifier falls at high frequencies due to
(A) coupling capacitor at the input
(B) coupling capacitor at the output
(C) internal capacitance of the device
(D) All the above

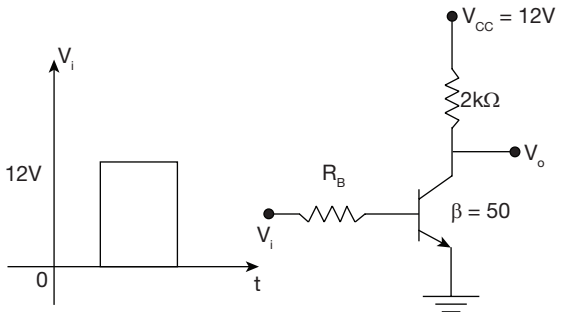
13. Find Base voltage (V_B)?



(A) 3.75 V (B) –11.37 V
(C) 3.57 V (D) –10.5 V

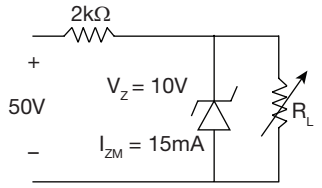
14. Which of the following sentences are correct?
(1) β increases with increase in temperature
(2) V_{BE} decreases 2.5 mV/°C increase in temperature
(3) Reverse saturation current (I_{CO}) doubles in value for every 10°C increase in temperature
(A) (1) and (2) only (B) (2) and (3) only
(C) (1) and (3) only (D) (1), (2) and (3)

15. Determine R_B value for the transistor inverter. [$V_{CE(sat)} = 0.2V$]



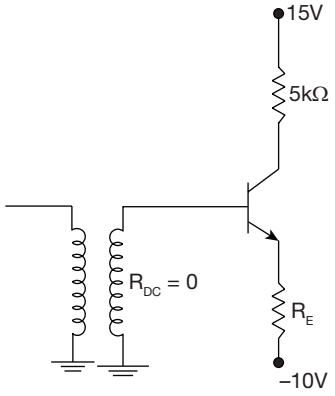
(A) 2 kΩ (B) 95.7 kΩ
(C) 60.2 kΩ (D) 40.4 kΩ

16. Find the range of R_L in below circuit.



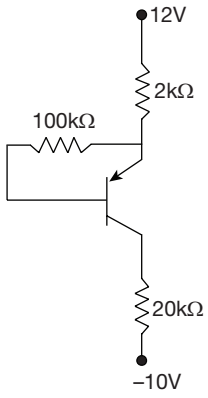
(A) 533 Ω < R_L < 1 kΩ (B) 2 kΩ < R_L < 4 kΩ
(C) 800 Ω < R_L < 2 kΩ (D) 500 Ω < R_L < 2 kΩ

17. For the circuit shown below figure, β = 80, V_{CE} = 6V. Find R_E.



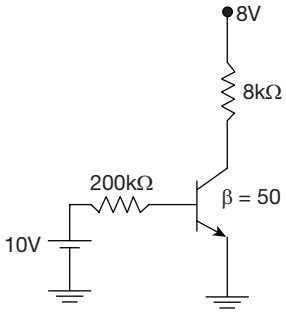
(A) 8.3 kΩ (B) 5.2 kΩ
(C) 4.7 kΩ (D) None of the above

18. In the below circuit V_E = 8V, then if transistor is in active region.



(A) 284 (B) 285
(C) 0.99 (D) 0.49

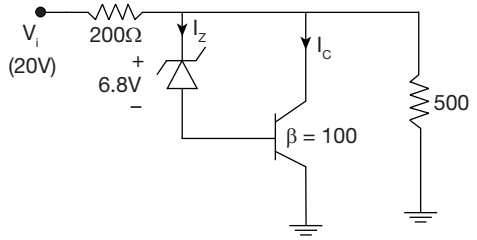
19.



The transistor in the above circuit is operating in

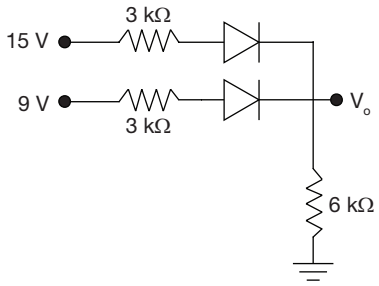
(A) saturation (B) active
(C) cut-off (D) reverse active

20. Determine collector for the below shown shunt regulator.



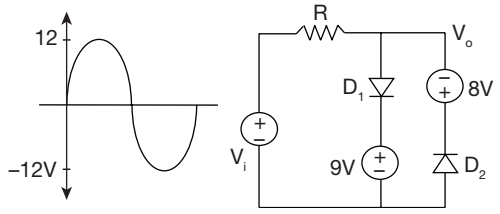
(A) 3.75 mA (B) 62 mA
(C) 58.25 mA (D) 25 mA

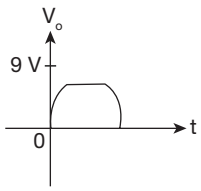
21. In below circuit assume that all diodes are ideal. Find output voltage V_o.

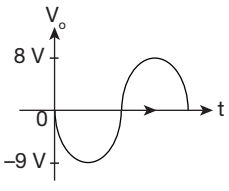


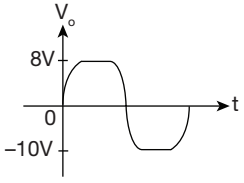
(A) 0 V (B) 9.6 V
(C) 10 V (D) 8 V

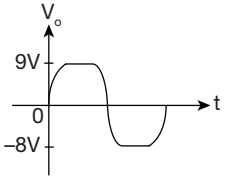
22. The diodes in circuit are ideal



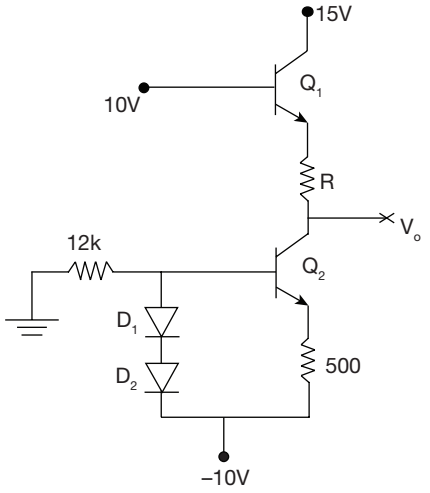
(A)


(B)


(C)


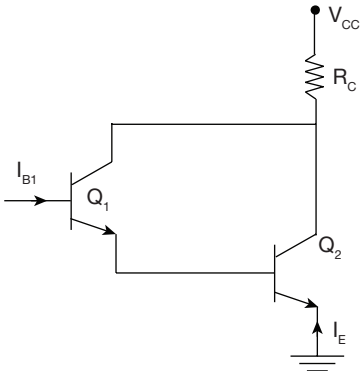
(D)


23. Calculate the value of R for V_o to become 3V. [$V_{BE} = V_D = 0.7$ and β is large]



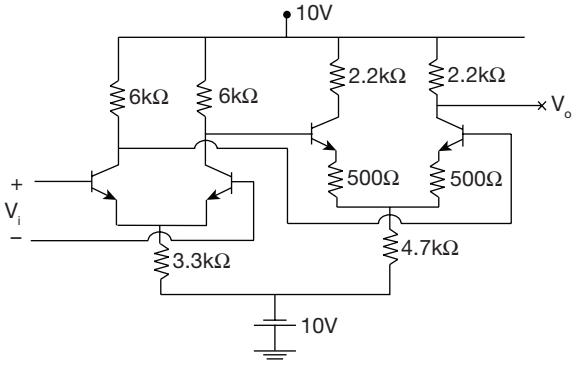
(A) 2.25 kΩ (B) 4.5 kΩ
(C) 6 kΩ (D) None of the above

24. For the circuit below shown, $\alpha_1 = 0.96$, $\alpha_2 = 0.98$, $V_{CC} = 15V$, $R_C = 250\ \Omega$ and $I_E = -120mA$, calculate I_B.



(A) –86 μA (B) 2.4 mA
(C) –2.4 mA (D) 96 μA

25. Find output voltage V_O in below circuit.



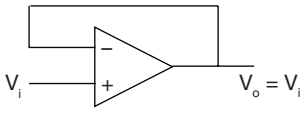
(A) 6.2 V (B) 6.9 V
(C) 8.5 V (D) 7.338 V

Answer Keys

1. C	**2.** D	**3.** B	**4.** D	**5.** D	**6.** B	**7.** A	**8.** A	**9.** A	**10.** B
11. B	**12.** C	**13.** B	**14.** D	**15.** B	**16.** D	**17.** C	**18.** C	**19.** A	**20.** C
21. C	**22.** D	**23.** B	**24.** D	**25.** D					

Hints and Explanations

1. Buffer circuit has very high input impedance and low output impedance



Choice (C)

2. Choice (D)

3. Choice (B)

4. Choice (D)

5. Choice (D)

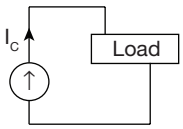
6. For $|V_i| \le 4.7$V, $V_o = V_i$ Choice (B)

7. Choice (A)

8. if $V_i > V_R$ then diode is off output is V_R
if $V_i < V_R$ then diode is on output is V_{input} Choice (A)

9. Ripple factor of half wave rectifier is 1.21
Ripple factor of full wave rectifier is 0.482 Choice (A)

10. Given circuit can be redrawn as



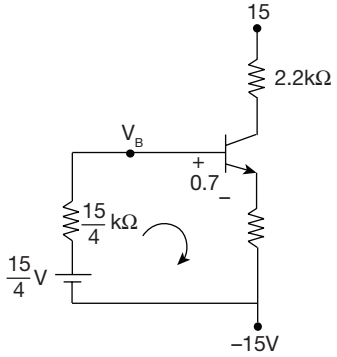
So it is constant current source Choice (B)

11. $R_L = \dfrac{V_{FL}}{I} = 10\ \Omega$ Choice (B)

12. Choice (C)

13. $V_{th} = \dfrac{5\times 15}{20} = \dfrac{15}{4}V$

$R_{th} = 15//5 = \dfrac{15}{4}\text{k}\Omega$

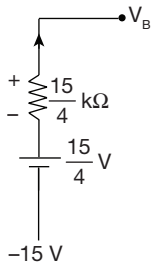


KVL in loop

$$\frac{15}{4} - 0.7 = \left[\frac{15}{4} + (1.8)(51)\right] i_B \times 10^3$$

$\Rightarrow \quad i_B = 31.9\ \mu\text{A}$

Write KVL equation



$$15 - \frac{15}{4} - \left(\frac{15}{4}\times 10^3 \times 31.9\times 10^{-6}\right) + V_B = 0$$

$V_B = -11.37$V Choice (B)

14. Choice (D)

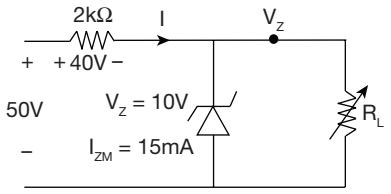
15. For transistor inverter transistor opssserates in saturation and cut-off rgion

$$\Rightarrow I_{C_{sat}} = \frac{V_{CC} - V_{CE(sat)}}{R_C} = \frac{12-0.2}{2}\text{mA} = 5.9\text{ mA}$$

$$\Rightarrow R_B = \frac{(V_i - V_{BE})\beta}{I_C}$$

$$= \frac{12-0.7}{5.9}\times 50\times 10^3 = 95.7\ \text{k}\Omega$$ Choice (B)

16. To determine the value of R_L that will turn on zener diode



$$V_Z = \frac{50\times R_L}{R_L + 2K} = 10$$

$R_{L\min} = 500\ \Omega$

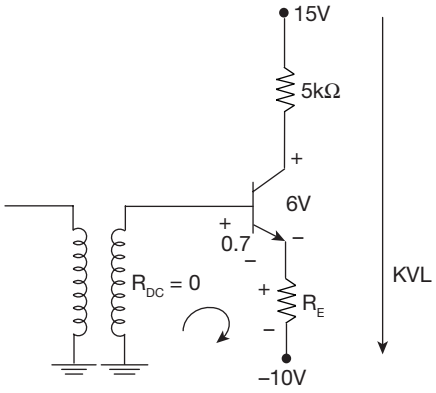
$$I = \frac{40}{2\text{k}\Omega} = 20\text{mA}$$

$I_{L\min} = I - I_{ZM} = 5$ mA

$$R_{L\max} = \frac{V_z}{I_{L\min}} = \frac{10\times10^3}{5} = 2\,\text{k}\Omega$$

$\Rightarrow$ R_L range is $500\ \Omega < R_L < 2\ \text{k}\Omega$ Choice (D)

17.



$$\propto = \frac{80}{81} = 0.98$$

$$15 - 6 = 5I_C + R_E\,\frac{I_C}{\alpha} - 10 \qquad [I_C = \alpha\, I_E]$$

$$\Rightarrow \quad 19 = I_C\left[5 + \frac{R_E}{0.98}\right] \rightarrow @$$

KVL at input side $0.7 + \frac{I_C}{\alpha}R_E = 10$

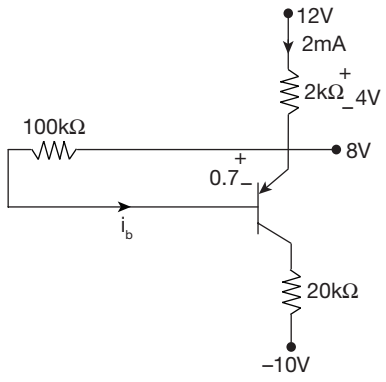
$\Rightarrow$ $I_C R_E = (10 - 0.7)\,0.98 = 9.114$

Substitute in @ equation $19 = 5I_C + 9.3$

$\Rightarrow$ $I_C = 1.94$ mA

$\Rightarrow$ $R_E = \frac{9.114}{1.94}\times10^3 = 4.7\ k\Omega$ Choice (C)

18.



$$I_E = \frac{12-8}{2\text{k}\Omega} = 2\ \text{mA}$$

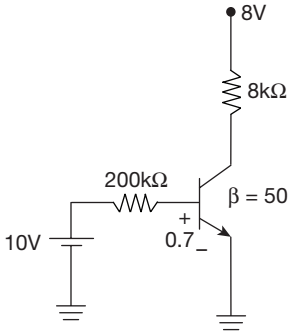
$$I_b = \frac{0.7}{100}\times10^{-3} = 7\ \mu A$$

$$I_E = (1+\beta)I_b$$

$$\frac{2\times10^{-3}}{7\times10^{-6}} = 1+\beta \Rightarrow 284$$

$$\alpha = \frac{\beta}{1+\beta} = 0.99$$ Choice (C)

19.



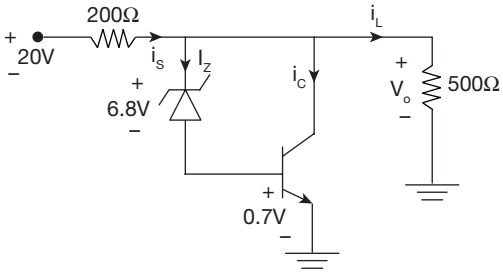
$$I_B = \frac{10-0.7}{200\,\text{k}\Omega} = 46.5\ \mu\text{A}$$

$$I_C = \frac{8 - V_{CE(sat)}}{8\,\text{k}\Omega} = \frac{7.8}{8}\,\text{mA} = 0.975\ \text{mA}$$

$\beta I_B = 2.32\ \text{mA} > I_{C(\text{sat})}$. So transistor in saturation region.

Choice (A)

20.



$\Rightarrow$ $V_o = 6.8 + 0.7 = 7.5V$

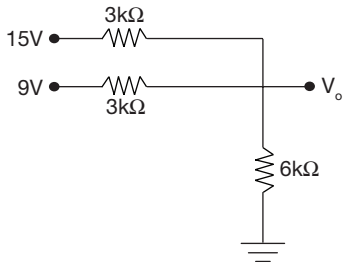
$$i_L = \frac{7.5}{500} = 3.75\text{mA}$$

$$i_S = \frac{20-7.5}{200} = \frac{12.5}{200} = 62\text{mA}$$

as I_z is very small $i_C \simeq i_S - i_L$

$\simeq$ 58.25 mA Choice (C)

21. Assume that two diodes are ON.



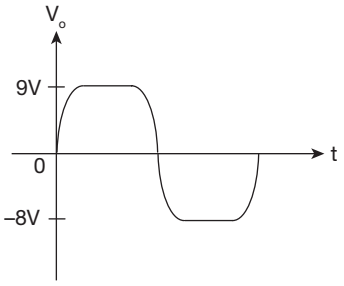
$\Rightarrow$ KCL at V_o Node

$$\frac{V_o - 15}{3} + \frac{V_o - 9}{3} + \frac{V_o}{6} = 0$$

$\Rightarrow V_o = \frac{48}{5} > 9$ So D_2 is OFF

Then $V_o = \frac{15 \times 6}{9} = 10\text{V}$ Choice (C)

22. If $V_{i/p} > 9\text{V}$ then D_1 is On and D_2 is Off so output is 9V, if $V_{i/p} < -8\text{V}$ then D_1 is off D_2 is on and output is –8V output waveform is

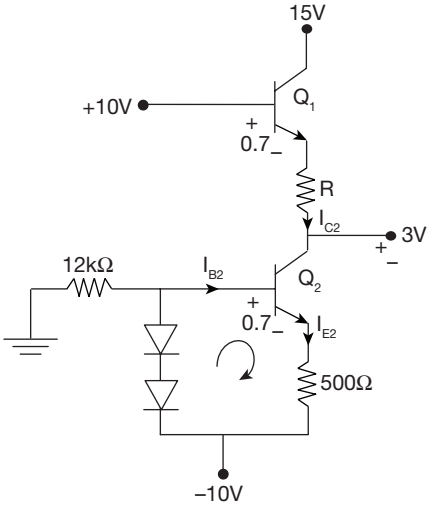


Choice (D)

23. Write KVL loop equation

$\Rightarrow 0.7 + 0.7 - 0.7 - I_{E_2}\,500 = 0$

$\Rightarrow I_{E_2} = 1.4mA$



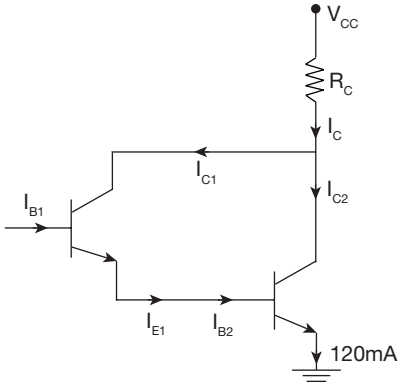
$\Rightarrow I_{C_1} \approx I_{E_2} = I_{C_2}$ [β is large]

$\Rightarrow$ write KVL equation

$10 = 0.7 + I_{c_2} R + 3$

$\Rightarrow R = \frac{10 - 3.7}{1.4}\text{k}\Omega = 4.5\ \text{k}\Omega$ Choice (B)

24.



$\beta_1 = \frac{\alpha_1}{1-\alpha_1} = 24$

$\beta_2 = \frac{\alpha_2}{1-\alpha_2} = 49$

$I_{B_2} = \frac{I_E}{(1+\beta_2)} = \frac{120\text{mA}}{50}$

$= 2.4\ \text{mA} = I_{E_1}$

$\Rightarrow I_{B_1} = \frac{I_{E_1}}{1+\beta_1} = \frac{2.4\text{mA}}{25} = 96\mu\text{A}$ Choice (D)

25. Write KVL

$10 - 0.7 = (6 \times I_C + 0.5\, I_E + 4.7 \times 2\, I_E) \times 10^3 - 10$

$19.3 = 15.9 \times I_C \times 10^3$ $[I_C \approx I_E]$

$\Rightarrow$ $I_C = 1.21$ mA

$\Rightarrow$ output voltage $V_o = 10 - (2.2 \times 10^3 \times 1.2 \times 10^{-3})$

$= 7.338$ V Choice (D)