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

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

**1.** Class AB operation is often used in power amplifiers in order to
(A) get maximum efficiency
(B) reduce collector dissipation
(C) remove even harmonics
(D) overcome a crossover distortion

**2.** Calculate the harmonic distortion components for an output signal having fundamental amplitude of 3V, second harmonic amplitude of 0.3V. Third harmonic amplitude of 0.03V
(A) 3% (B) 10%
(C) 11% (D) 9%

**3.** Single stage transformer coupled class A amplifier uses a transistor with maximum dissipation capability of 3 watts. The maximum a.c power in the load is
(A) 1.5 watt (B) 0.75 watt
(C) 3 watt (D) 6 watt

**4.** Higher order active filters are used for
(A) variable bandwidth (B) variable impedance
(C) variable roll-off rate (D) all of the above

**5.** Match List-I with List-II where List-I contains devices and List-II contains characteristic of the device

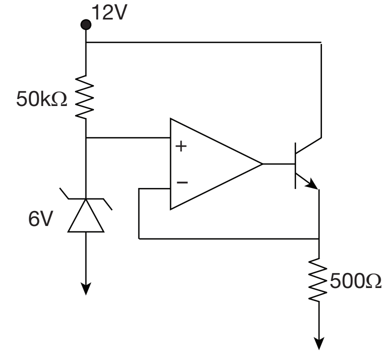
| List-I | List-II |
|---|---|
| (*p*) BJT | (1) negative conductance device |
| (*q*) UJT | (2) current controlled device |
| (*r*) FET | (3) voltage controlled device |
| (*s*) IMPATT diode | (4) conductivity modulation device |

(A) $p-2, q-4, r-3, s-1$
(B) $p-3, q-1, r-2, s-4$
(C) $p-2, q-1, r-3, s-4$
(D) $p-3, q-4, r-2, s-1$

**6.** The most commonly used amplifier in sample and hold circuits is
(A) an inverting amplifier with a gain of 100
(B) a unity gain inverting amplifier
(C) an non-inverting amplifier with a gain of 10
(D) a unit gain non-inverting amplifier

**7.** A class C transistor amplifier is operating at 200 kHz. The transistor is conducting for 1 μsec in each cycle. Transistor has $V_{CE(sat)} = 0.2$ V, $I_{C(sat)} = 80$mA. Find average power dissipation. [assume that output swing over the entire load line]
(A) 16 mW (B) 8 mW
(C) 3.2 mW (D) 11.3 mW

**8.** In below circuit Op-Amp is ideal. If β = 50, the total current supplied by the 12V.




(A) 12.12 mA (B) 11.88 mA
(C) 12 mA (D) 11.6 mA

**9.** Match List-I with List-II where List-I contains oscillator and List-II has characteristics.

| List-I | List-II |
|---|---|
| (p) clapp oscillator | (1) RC oscillator for audio frequency applications |
| (q) colpittes oscillator | (2) RF oscillator: Two inductances and one capacitance on the reactance network. |
| (r) Hartley oscillator | (3) LC oscillator for RF frequency: Three capacitances and one inductance in the resistance network. |
| (s) wein bridge oscillator | (4) RF oscillator: Two capacitance and one inductance as the reactance network. |

(A) $p-1, q-2, r-3, s-4$
(B) $p-4, q-3, r-2, s-1$
(C) $p-1, q-4, r-2, s-3$
(D) $p-3, q-2, r-1, s-4$

**10.** The time base voltage of an oscilloscope can be generated by using
(1) time delay circuit
(2) a controlled circuit
(3) boot strap integrator circuit
(4) miller sweep circuit
(A) 2, 3, 4 only (B) 1, 3, 4 only
(C) 1, 2, 3 only (D) All the above

**11.** A power amplifier delivers 10W output at 50% of collector efficiency. If the maximum allowable junction temperature is 125°C, then maximum thermal resistance $\theta_{jc}$ that can be tolerated
[∴ ambient temperature = 25°C]
(A) 20° C/W (B) 5° C/W
(C) 10° C/W (D) 40° C/W

**12.** In a complementary symmetry transistor emitter follower type class B push-pull amplifier works at power conversion efficiency of 40%; given that $R_L = 10\ \Omega$ and peak output voltage $V_m$ across $R_L$ is volts, the dc power drawn by each transistor is

(A) 8W (B) 12W
(C) 20W (D) 16W

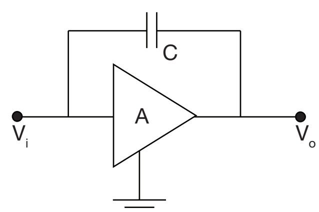
**13.** In class B push-pull operation the power delivered to the load $R_L = 10\ \Omega$ is $P_{ac} = 20$W. Then peak load current is

(A) $\sqrt{2}$A (B) 2A
(C) 1A (D) 0.5A

**14.** A colpitt's oscillator has a coil with an inductance of 25 μH and is tuned by a capacitor of 150 pF across the amplifier input and 50 pF across the output. The minimum gain for maintaining oscillation is

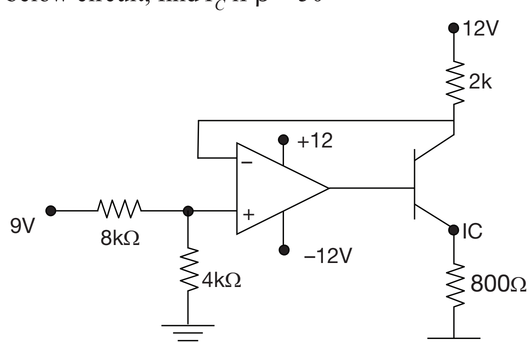
(A) 1/3 (B) 3
(C) 1/2 (D) 6

**15.** An amplifier of gain $A$ is bridge by a capacitance $C$ as shown in below circuit, then the effective input capacitance is




(A) $C/A$ (B) $AC$
(C) $C(1 + A)$ (D) $C(1 – A)$

**16.** In below circuit, find $I_C$ if β = 50




(A) 4.5 mA (B) 1.5 mA
(C) 4.41 mA (D) 3 mA

**17.** Consider the following statements with reference to a CE transistor amplifier

(1) high voltage and current gains
(2) The use of step-up transformer
(3) The use of negative feedback
(4) The conversion of d.c power to a.c power

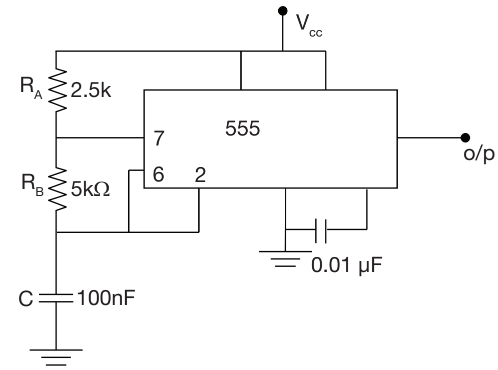
The power gain is due to

(A) 1, 2 and 3 (B) 2, 3 and 4
(C) 1 and 4 only (D) All the above

**18.** Given circuit is to be used as a divided by 2 network. The frequency of the input trigger signal is 4 kHz. If the value of capacitor is 1 nF then value of $R$ is

(A) 39 kΩ (B) 120 kΩ
(C) 140 kΩ (D) 272 kΩ

**19.** In astable multivibrator, determine free running frequency $f_o$

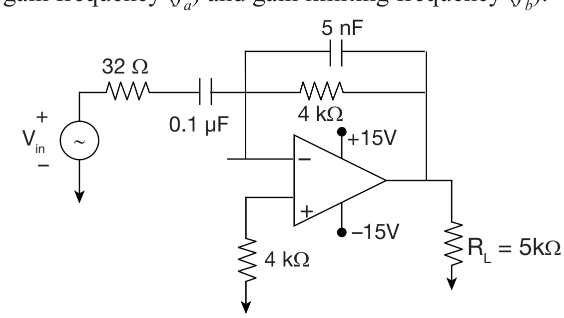



(A) 635 Hz (B) 1.27 kHz
(C) 1.16 kHz (D) 2.32 kHz

**20.** In the Astable multivibrator $R_A = 2.5$ kΩ, $R_B = 5$ kΩ and $C = 0.1$ kμF then duty cycle is

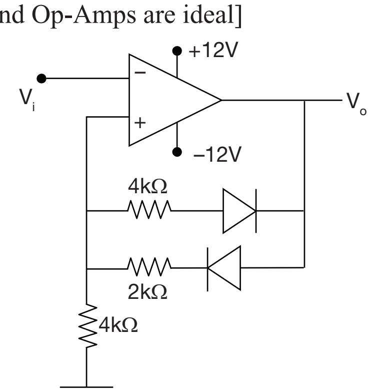
(A) 50% (B) 60%
(C) 40% (D) 80%

**21.** Differentiation amplifier is given below. Find the unity gain frequency ($f_a$) and gain limiting frequency ($f_b$).




(A) $f_a = 49.7$ KHz, $f_b = 398$ KHz
(B) $f_a = 398$ Hz, $f_b = 49.7$ KHz
(C) $f_a = 398$ KHz, $f_b = 49.7$ Hz
(D) $f_a = 49.7$ Hz, $f_b = 398$ Hz

**22.** Hysteresis loop width of below Schmitt trigger is [diodes and Op-Amps are ideal]

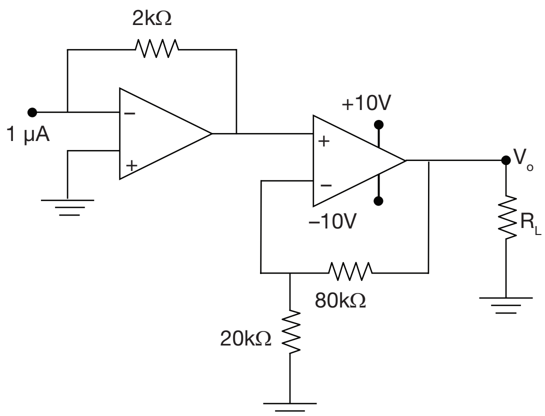



(A) 24V (B) 8V
(C) –6V (D) 14V

**23.** An ideal sawtooth voltage waveform of frequency 1kHz and amplitude 5V is generated by charging capacitor of 4 mF in every cycle. The charging requires

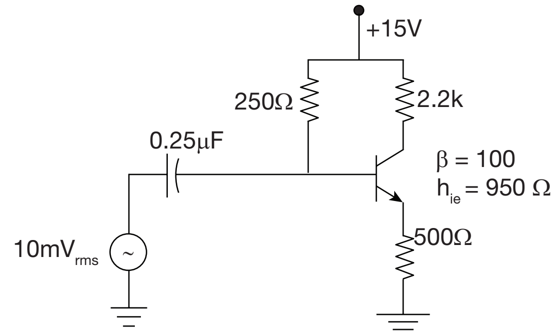
(A) constant voltage source of 5V for 1 ms
(B) constant voltage source of 5V for 2 ms
(C) constant current source of 20A for 1 ms
(D) constant current source of 20A for 2 ms

**24.** The output voltage $V_o$ of the below given figure




(A) 0.1 mV  (B) 1 mV
(C) 10 mV  (D) 10 V

**25.** Find the voltage gain of below circuit.




(A) 0.0689  (B) $1.94 \times 10^{-3}$
(C) −0.028  (D) 0.087

## Answer Keys

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

## Hints and Explanations

**1.** Choice (D)

**2.** $\%D_2 = \frac{|A_2|}{|A_1|} \times 100\% = \frac{0.3}{3} \times 100\% = 10\%$

$\%D_3 = \frac{|A_3|}{|A_1|} \times 100\% = \frac{0.03}{3} \times 100\% = 1\%$

Total harmonic distortion $\% = \sqrt{D_2^2 + D_3^2} \times 100\%$

$= \sqrt{(0.1)^2 + (0.01)^2} \times 100\% = 10.04\%$  Choice (B)

**3.** In transformer action we assume ideal power transfer from primary winding to secondary i.e. power loss. Choice (C)

**4.** High order active filters are used for variable roll-off rate. Choice (C)

**5.** UJT is negative conductance device. Choice (C)

**6.** Choice (D)

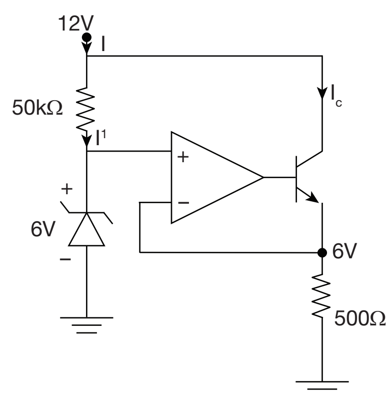
**7.** Given that $f = 200$ kHz

$T = \frac{1}{f} = 5\mu\text{sec}$

$P_{\text{avg}} = \frac{T_{on}}{T} \times I_{C(sat)} \times V_{CE(sat)}$

$= \frac{1}{5} \times 0.2 \times 80 \times 10^{-3} = 3.2$ mW  Choice (C)

**8.**




$I = I^1 + I_C;\ I_E = \frac{6}{500} = 12$ mA

$I_C = \alpha I_E = \frac{\beta}{1+\beta} I_E = \frac{50}{51} \times 12 \times 10^{-3} = 11.76\text{mA}$

$I^1 = \frac{12-6}{50}\text{mA} = \frac{6}{50}\text{mA} = 0.12\text{mA}$

$I = I_C + I^1 = 11.88$ mA  Choice (B)

**9.** Choice (C)

**10.** Choice (B)

**11.** $P = 10W$, $\eta = 50\%$, $T_a = 25C^o$, $T_i = 125^oC$

$\theta_{jc} P_D = T_j - T_a$

$\theta_{jc} = \frac{100}{10} = 10^o$ C/W Choice (C)

**12.** $P = \frac{V_m^2}{R_L} = \frac{400}{10} = 40$ ; $\eta = 40\%$

$\Rightarrow$ power drawn by each transistor is 16W. Choice (D)

**13.** $P_{ac} = I_{ac}^2 R_L \Rightarrow 20 = I^2_{AC}(10)$

$\Rightarrow I_{ac} = \sqrt{2}$

$\Rightarrow I_m = \sqrt{2}\ I_{ac} = 2$ Choice (B)

**14.** For maintaining oscillation $A_{loop} \geq 1$

$\Rightarrow A_{loop} = 1 = A_{V_o} \frac{C_2}{C_1}$

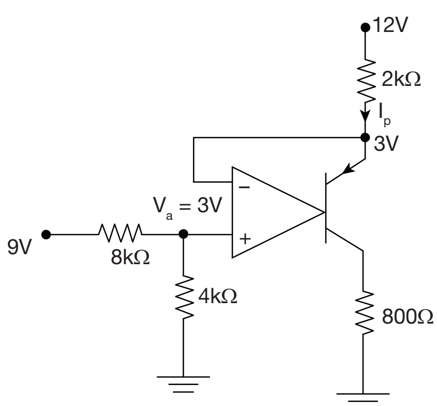
$\Rightarrow A_{V_o} = \frac{150}{50} = 3$ Choice (B)

**15.** Assuming voltage amplifier with zero input current

$Q_i = C(V_i - AV_i)$

$\Rightarrow \frac{Q_i}{V_i} = C_{eq} = C(1 - A)$ Choice (D)

**16.**




$V_a = \frac{9 \times 4}{12} = 3V$

$I_E = \left(\frac{12-3}{2}\right)$mA $= 4.5$ mA

$I_C = \alpha\, I_E = \frac{\beta}{1+\beta} I_E = \frac{50}{51} \times 4.5 = 4.41$mA Choice (C)

**17.** Power gain is due to high voltage and current gains and the conversion of d.c power to a.c power Choice (C)

**18.** $t_p = 1.2T = \frac{1.2}{4} \times 10^{-3} = 1.1\ RC$

$= \frac{1.2 \times 10^{-3}}{4 \times 1.1 \times 10^{-9}} = R = 272\text{k}\Omega$ Choice (D)

**19.** Free running oscillator frequency

$f_o = \frac{1}{T} = \frac{1.45}{(R_A + 2R_B)C}$

$= \frac{1.45}{(2.5 + 2 \times 5) \times 10^3 \times 100 \times 10^{-9}}$

$= \frac{1.45 \times 10^4}{12.5} = 1.16\,\text{kHz}$ Choice (C)

**20.** Duty cycle $= \frac{T_{on}}{T_{off}} \times 100\% = \frac{R_A + R_B}{R_A + 2R_B} \times 100$

$= \frac{2.5+5}{2.5+5\times 2} \times 100 = \frac{7.5}{12.5} \times 100 = 60\%$ Choice (B)

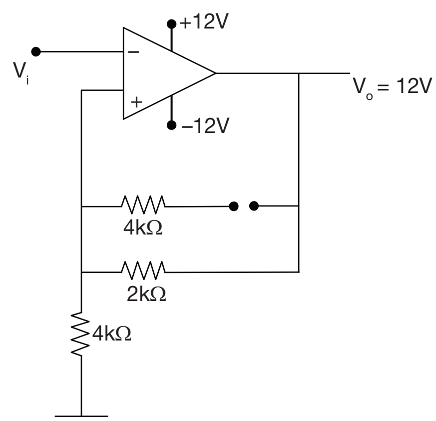
**21.** $f_a = \frac{1}{2\pi\, R_F\, C_1}$

$= \frac{1}{2\pi \times 4 \times 10^3 \times 0.1 \times 10^{-6}} = 398$ Hz

$f_b = \frac{1}{2\pi\, R_1\, C_1} = \frac{1}{2\pi \times 32 \times 0.1 \times 10^{-6}} = 49.7$ kHz

Choice (B)

**22.**




If $V_o = +12V$ then

$V_1 = \frac{12 \times 4}{6} = 8V$

If $V_o = -12V$ then

$V_2 = \frac{-12 \times 4}{8} = -6V$

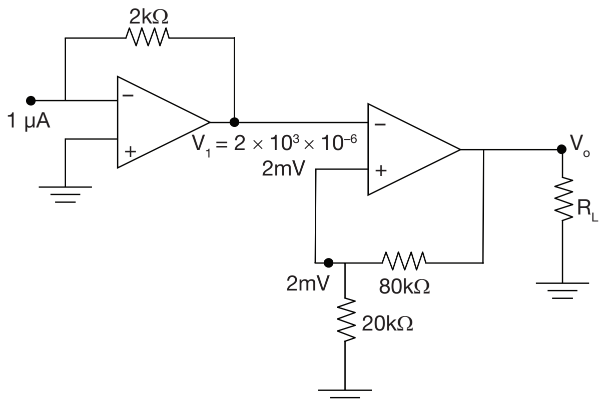
$V_H = V_1 - V_2 = 14V$ Choice (D)

**23.** $T = \frac{1}{f} = 1$ms

$I_c = c.\frac{dV_c}{dt}$

$= \frac{4 \times 10^{-3} \times 5}{10^{-3}} = 20A$ Choice (C)

**24.**




$$\frac{V_o \times 20}{100} = 2 \times 10^{-3}$$

$V_o = 10\text{mV}$ Choice (C)

**25.** $A = \dfrac{I_O}{I_i} = \dfrac{-h_{fe}}{h_{ie} + R_E}$

$$= \frac{-100}{950+500} = \frac{-100}{1450} = -0.689$$

$$\beta = \frac{V_f}{I_O} = -R_E = -500$$

$A_f = \dfrac{A}{1+A\beta} = \dfrac{-0.689}{1+\beta A} = 1.94 \times 10^{-3}$ Choice (B)