ELECTRONICS AND EXPERIMENTAL METHODS

NET/JRF (JUNE-2011)

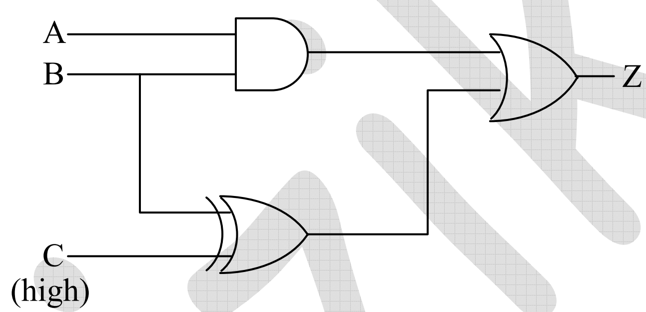
Q1. A signal of frequency 10 kHz is being digitized by an A/D converter. A possible sampling time which can be used is

(a) 100 μs (b) 40 μs (c) 60 μs (d) 200 μs

Ans: (a)

Solution: $T_S = \frac{1}{f_S} = \frac{1}{10\times10^3} = 100\,\mu s$.

Q2. Consider the digital circuit shown below in which the input C is always high (1).



The truth table for the circuit can be written as

A	B	Z
0	0	
0	1	
1	0	
1	1	

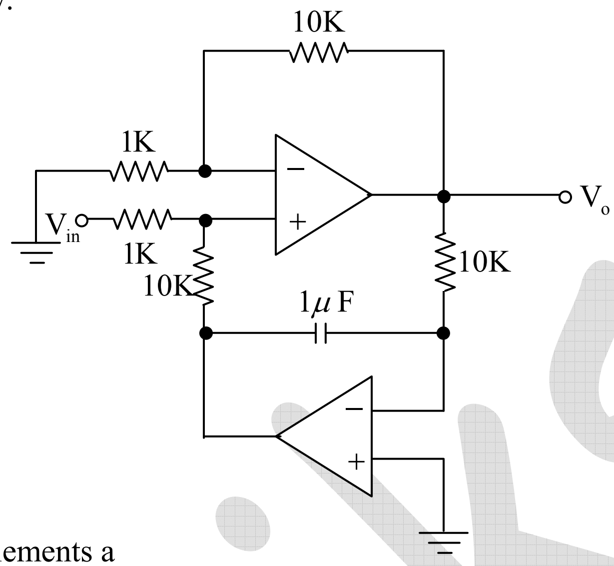
The entries in the Z column (vertically) are

(a) 1010 (b) 0100 (c) 1111 (d) 1011

Ans: (d)

Solution: $Z = A.B + (B \oplus 1)$

Q3. A time varying signal V_{in} is fed to an op-amp circuit with output signal V_0 as shown in the figure below.



The circuit implements a

(a) high pass filter with cutoff frequency 16 Hz

(b) high pass filter with cutoff frequency 100 Hz

(c) low pass filter with cutoff frequency 16 Hz

(d) low pass filter with cutoff frequency 100 Hz

Ans: (c)

Solution: Since circuit has R and C combination, its a Low Pass filter and cutoff frequency

$$=\frac{1}{2\pi RC}\approx 16Hz.$$

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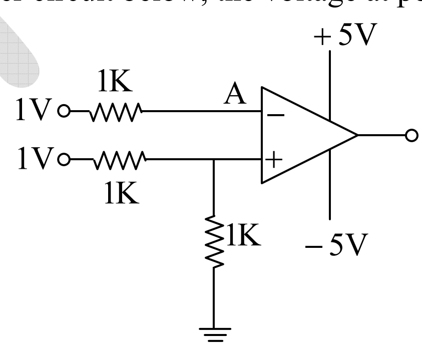
Q4. In the operational amplifier circuit below, the voltage at point A is

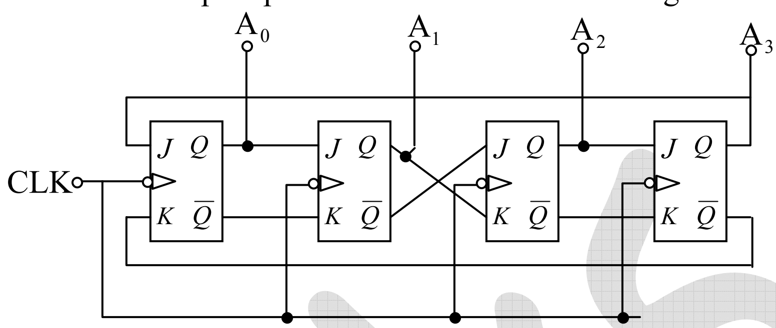


(a) 1.0 V (b) 0.5 V (c) 0 V (d) – 5.0 V

Ans: (b)

Solution: $V_A = \frac{1}{1+1} \times 1 = 0.5V$.

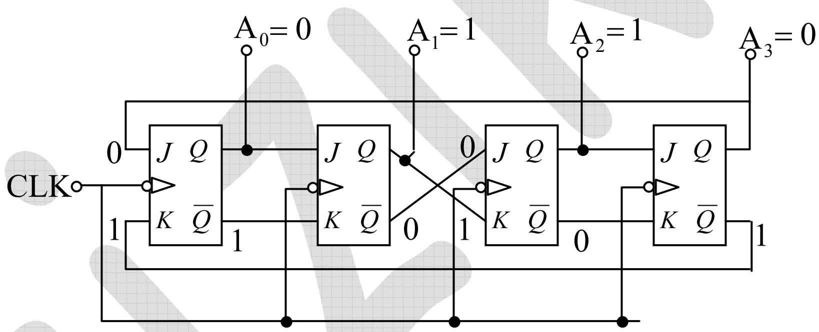
Q5. A counter consists of four flip-flops connected as shown in the figure:



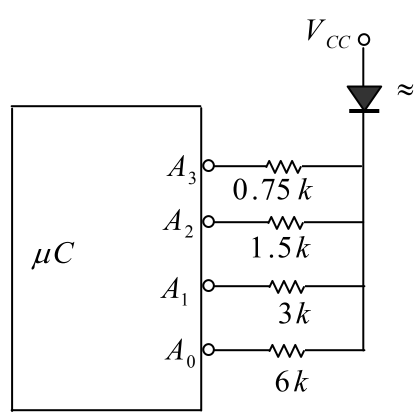
If the counter is initialized as $A_0\,A_1\,A_2\,A_3 = 0110$, the state after the next clock pulse is

(a) 1000 (b) 0001 (c) 0011 (d) 1100

Ans: (b)



Q6. The pins 0, 1, 2 and 3 of part A of a microcontroller are connected with resistors to drive an LED at various intensities as shown in the figure. For $V_{CC} = 4.2$ V and a voltage drop of 1.2 V across the LED, the range (maximum current) and resolution (step size) of the drive current are, respectively,



(a) 4.0 mA and 1.0 mA

(b) 15.0 mA and 1.0 mA

(c) 7.5 mA and 0.5 mA

(d) 4.0 mA and 0.5 mA

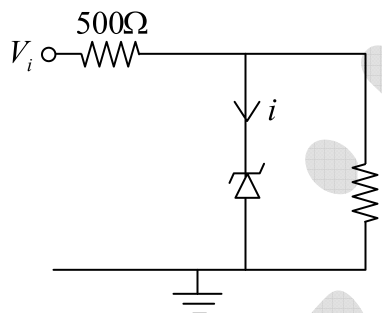
Ans: (c)

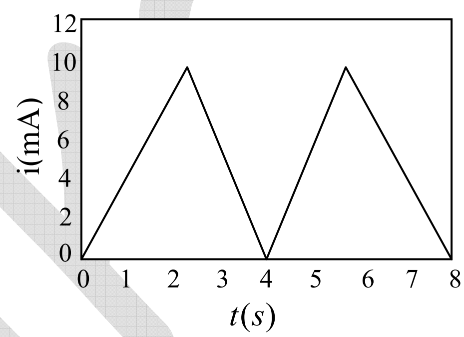
For Maximum current $\begin{matrix} A_3, A_1, A_2, A_0 \\ 0, \ 0, \ 0, \ 0 \end{matrix}$.

Thus $I_{\max} = \dfrac{4.2-1.2}{0.75k} + \dfrac{4.2-1.2}{1.5k} + \dfrac{4.2-1.2}{3k} + \dfrac{4.2-1.2}{6k} = 7.5mA$

For Step size $\begin{matrix} A_3, A_1, A_2, A_0 \\ 0, \ 0, \ 0, \ 1 \end{matrix}$. Thus $I_0 = \dfrac{4.2-1.2}{6k} = 0.5mA$

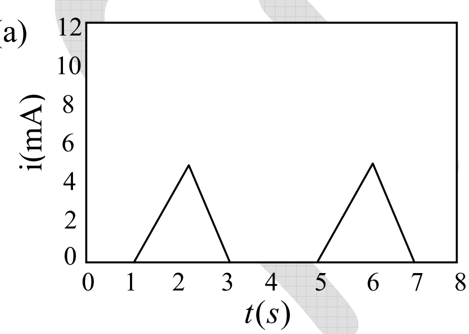
Q7. The figure below shows a voltage regulator utilizing a Zener diode of breakdown voltage 5 V and a positive triangular wave input of amplitude 10 V.



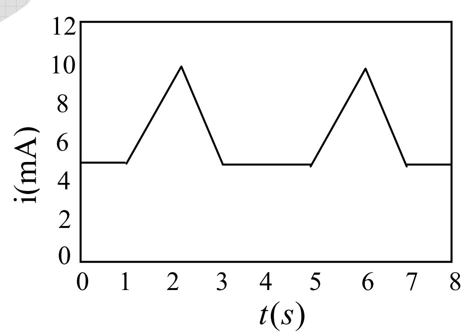


For $V_i > 5$V, the Zener regulates the output voltage by channeling the excess current through itself. Which of the following waveforms shows the current i passing through the Zener diode?

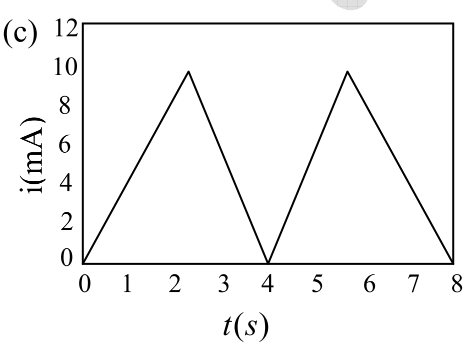
(a)



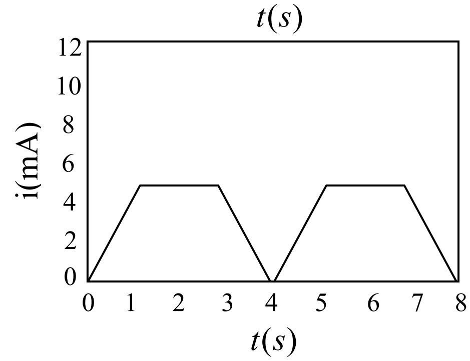
(b)



(c)



(d)



Ans: (a)

Solution: When zener is OFF zener current is zero when zener is ON zener current will flow.

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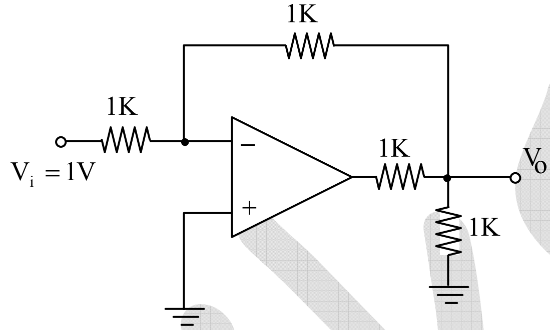
Q8. In the op-amp circuit shown in the figure below, the input voltage is 1V. The value of the output V_0 is



(a) -0.33 V (b) -0.50 V (c) -1.00 V (d) -0.25 V

Ans: (b)

Solution: $V_0 = -\frac{R_F V_{in}}{R_1} = -\frac{1}{2}V = -0.05$ where $R_F = \frac{1\times 1}{1+1} = \frac{1}{2}K$ and $R_1 = 1K$.

Q9. An LED operates at 1.5 V and 5 mA in forward bias. Assuming an 80% external efficiency of the LED, how many photons are emitted per second?

(a) 5.0 x 10^{16} (b) 1.5 x 10^{16} (c) 0.8 x 10^{16} (d) 2.5 x 10^{16}

Ans: (d)

Solution: $P_{in} = \eta_{\text{int}} \frac{i}{e} hf$, number of photon$= \frac{P_{in}}{hf} = \eta_{\text{int}} \frac{i}{e} = .8 \times \frac{5\times 10^{-3}}{1.6\times 10^{-19}} = 2.5\times 10^{16}$

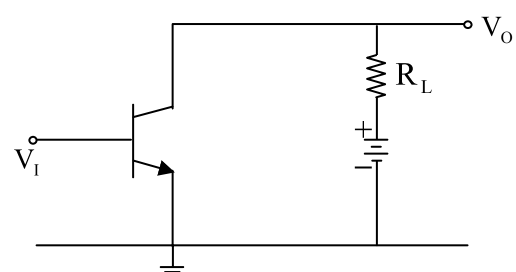
Q10. The transistor in the given circuit has h_{fe} = 35Ω and h_{ie} = 1000Ω. If the load resistance R_L = 1000Ω, the voltage and current gain are, respectively.

(a) -35 and + 35

(b) 35 and - 35

(c) 35 and – 0.97

(d) 0.98 and - 35



Ans: (a)

Q11. The output, O, of the given circuit in cases I and II, where

Case I: A, B = 1; C, D = 0; E, F = 1 and G = 0

Case II: A, B = 0; C, D = 0: E, F = 0 and G = 1

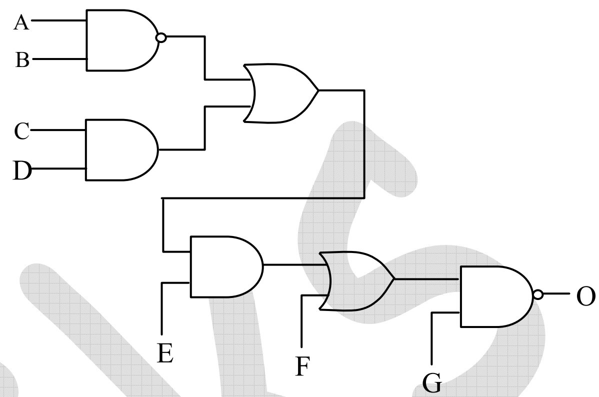
are respectively

(a) 1, 0

(b) 0, 1

(c) 0, 0

(d) 1, 1



Ans: (d)

Solution: $O = \overline{\left(\left(\overline{AB} + CD\right)E + F\right)G}$

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Q12. A live music broadcast consists of a radio-wave of frequency 7 MHz, amplitude-modulated by a microphone output consisting of signals with a maximum frequency of 10 kHz. The spectrum of modulated output will be zero outside the frequency band

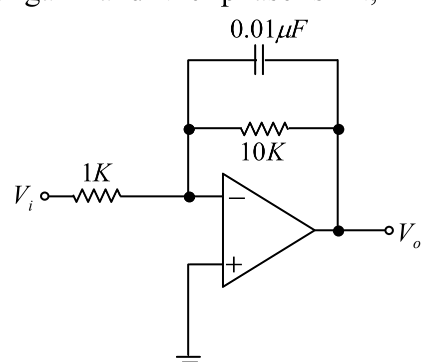
(a) 7.00 MHz to 7.01 MHz (b) 6.99 MHz to 7.01 MHz

(c) 6.99 MHz to 7.00 MHz (d) 6.995 MHz to 7.005 MHz

Ans: (b)

Solution: Spectrum consists of $f_c - f_m$ and $f_c + f_m$.

Q13. In the op-amp circuit shown in the figure, V_i is a sinusoidal input signal of frequency 10 Hz and V_0 is the output signal. The magnitude of the gain and the phase shift, respectively, close to the values



(a) $5\sqrt{2}$ and $\pi/2$

(b) $5\sqrt{2}$ and $-\pi/2$

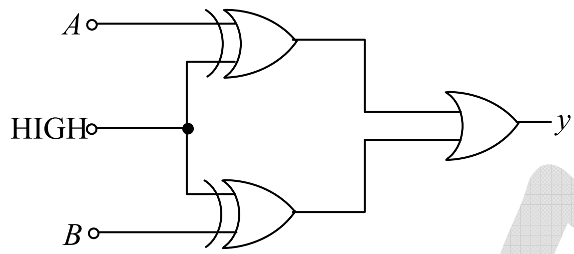
(c) 10 and zero

(d) 10 and π

Ans: (d)

Solution: $\frac{v_0}{v_{in}} = -\frac{X_C R_F}{R_1(R_1 + R_F)} \Rightarrow \left|\frac{v_0}{v_{in}}\right| \approx 10$

Q14. The logic circuit shown in the figure below Implements the Boolean expression



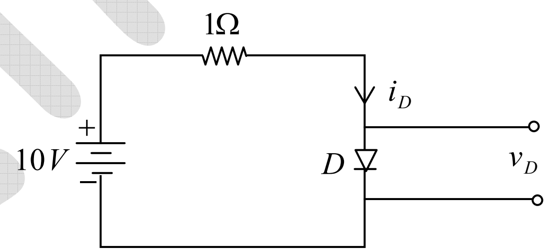
(a) $y = \overline{A \cdot B}$ (b) $y = \overline{A} \cdot \overline{B}$ (c) $y = A \cdot B$ (d) $y = A + B$

Ans: (a)

Solution: Output of each Ex-OR gate is $\overline{A}$ and $\overline{B}$. Thus $y = \overline{A} + \overline{\vec{B}} = \overline{A \cdot B}$

Q15. A diode D as shown in the circuit has an i-v relation that can be approximated by

$$i_D = \begin{cases} v_D^2 + 2v_D, & \text{for } v_D > 0 \\ 0, & \text{for } v_D \le 0 \end{cases}$$



The value of v_D in the circuit is

(a) $\left(-1+\sqrt{11}\right)V$ (b) 8 V

(c) 5 V (d) 2 V

Ans: (d)

Solution: $-10 + \left(v_D^2 + 2v_D\right) \times 1 + v_D = 0 \Rightarrow v_D = 2V$

Q16. Band-pass and band-reject filters can be implemented by combining a low pass and a high pass filter in series and in parallel, respectively. If the cut-off frequencies of the low pass and high pass filters are ω_0^{LP} and ω_0^{HP}, respectively, the condition required to implement the band-pass and band-reject filters are, respectively,

(a) $\omega_0^{HP} < \omega_0^{LP}$ and $\omega_0^{HP} < \omega_0^{LP}$ (b) $\omega_0^{HP} < \omega_0^{LP}$ and $\omega_0^{HP} > \omega_0^{LP}$

(c) $\omega_0^{HP} > \omega_0^{LP}$ and $\omega_0^{HP} < \omega_0^{LP}$ (d) $\omega_0^{HP} > \omega_0^{LP}$ and $\omega_0^{HP} > \omega_0^{LP}$

Ans: (c)

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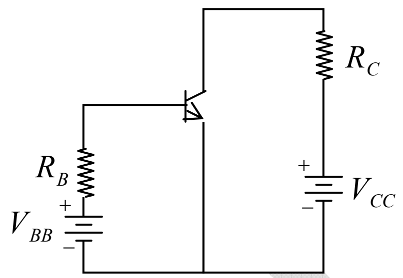
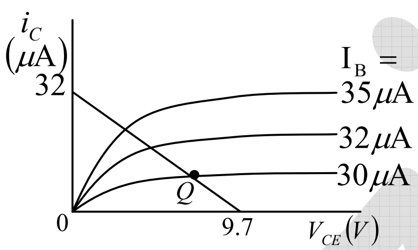
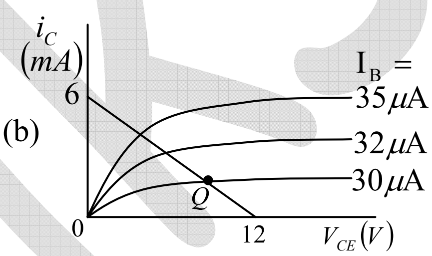
Q17. A silicon transistor with built-in voltage 0.7 V is used in the circuit shown, with $V_{BB} = 9.7V$, $R_B = 300k\Omega$, $V_{CC} = 12V$ and $R_C = 2k\Omega$. Which of the following figures correctly represents the load line and quiescent Q point?



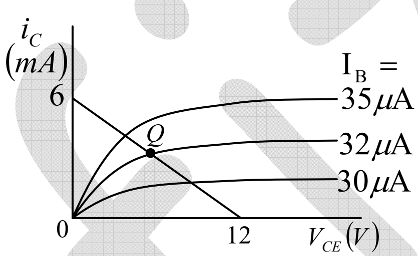
(a)



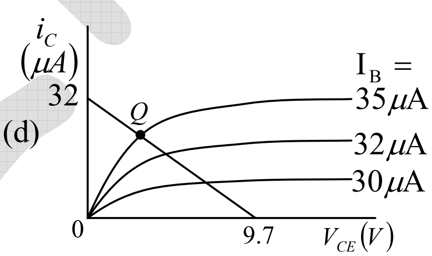
(b)



(c)



(d)



Ans: (b)

Solution: $I_B = \dfrac{V_{CC} - V_{BE}}{R_B} = \dfrac{9.7 - 0.7}{300 \times 10^3} = 30\mu A$ and $I_{C,sat} = \dfrac{V_{CC}}{R_C} = \dfrac{12}{2 \times 10^3} = 6mA$

Q18. If the analog input to an 8-bit successive approximation ADC is increased from 1.0 V to 2.0 V, then the conversion time will

(a) remain unchanged

(b) double

(c) decrease to half its original value

(d) increase four times

Ans: (a)

Q19. The input to a lock-in amplifier has the form $V_i(t) = V_i \sin(\omega t + \theta_i)$ where V_i, ω, θ_i are the amplitude, frequency and phase of the input signal respectively. This signal is multiplied by a reference signal of the same frequency ω, amplitude V_r and phase θ_r. If the multiplied signal is fed to a low pass filter of cut-off frequency ω, the final output signal is

(a) $\frac{1}{2}V_iV_r \cos(\theta_i - \theta_r)$ (b) $V_iV_r\left[\cos(\theta_i - \theta_r) - \cos\left(\frac{1}{2}\omega t + \theta_i + \theta_r\right)\right]$

(c) $V_iV_r \sin(\theta_i - \theta_r)$ (d) $V_iV_r\left[\cos(\theta_i - \theta_r) + \cos\left(\frac{1}{2}\omega t + \theta_i + \theta_r\right)\right]$

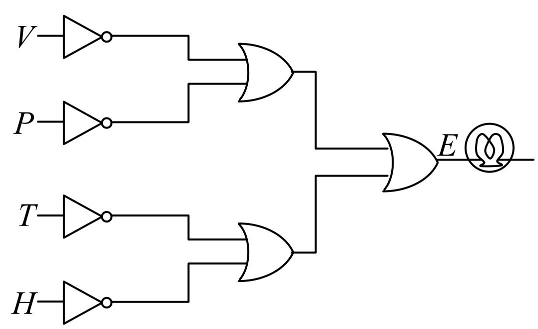
Ans: (a)

Solution: $V = V_r \sin(\omega t + \theta_r) \times V_i \sin(\omega t + \theta_i) = \frac{V_iV_r}{2}\left[\cos(\theta_i - \theta_r) - \cos(2\omega t + \theta_i + \theta_r)\right]$

Output of low pass filter$= \frac{V_iV_r}{2}\cos(\theta_i - \theta_r)$

Q20. Four digital outputs V, P, T and H monitor the speed v, tyre pressure p, temperature t and relative humidity h of a car. These outputs switch from 0 to 1 when the values of the parameters exceed 85 km/hr, 2 bar, $40^0 C$ and 50%, respectively. A logic circuit that is used to switch ON a lamp at the output E is shown below.

Which of the following condition will switch the lamp ON?



(a) $v < 85km/hr, p < 2bar, t > 40^0 C, h > 50\%$

(b) $v < 85km/hr, p < 2bar, t > 40^0 C, h < 50\%$

(c) $v > 85km/hr, p < 2bar, t > 40^0 C, h < 50\%$

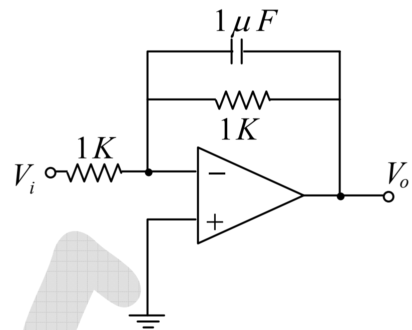
(d) $v > 85km/hr, p < 2bar, t > 40^0 C, h > 50\%$

Ans: (a)

JRF/NET-(DEC-2013)

Q21. Consider the op-amp circuit shown in the figure.

If the input is a sinusoidal wave $V_i = 5\sin(1000t)$, then the amplitude of the output V_0 is



(a) $\frac{5}{2}$ (b) 5

(c) $\frac{5\sqrt{2}}{2}$ (d) $5\sqrt{2}$

Ans: (c)

$$\frac{v_o}{v_{in}} = -\frac{X_F}{R_1},\ X_F = \frac{R_F X_C}{R_F + X_C} = \frac{10^3}{(1+j)} \text{ where } R_F = 1\times10^3\,\Omega,\ X_C = \frac{1}{j\times10^3\times10^{-6}}$$

$$\left|\frac{v_o}{v_{in}}\right| = \frac{10^3}{\sqrt{2}}\times\frac{1}{10^3} = \frac{1}{\sqrt{2}} \Rightarrow v_o = \frac{5}{\sqrt{2}}\sin\omega t = \frac{5\sqrt{2}}{2}\sin\omega t$$

Q22. If one of the inputs of a J-K flip flop is high and the other is low, then the outputs Q and $\overline{Q}$

(a) oscillate between low and high in race around condition

(b) toggle and the circuit acts like a T flip flop

(c) are opposite to the inputs

(d) follow the inputs and the circuit acts like an $R-S$ flip flop

Ans: (d)

Q23. A sample of Si has electron and hole mobilities of 0.13 and $0.05\,\text{m}^2/\text{V-s}$ respectively at 300 K. It is doped with P and Al with doping densities of $1.5\times10^{21}/\text{m}^3$ and $2.5\times10^{21}/\text{m}^3$ respectively. The conductivity of the doped Si sample at 300 K is

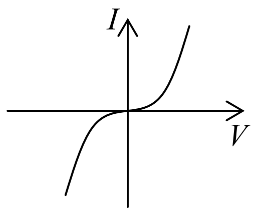
(a) $8\ \Omega^{-1}m^{-1}$ (b) $32\ \Omega^{-1}m^{-1}$ (c) $20.8\ \Omega^{-1}m^{-1}$ (d) $83.2\ \Omega^{-1}m^{-1}$

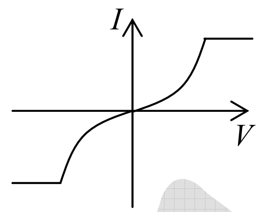
Ans: (a)

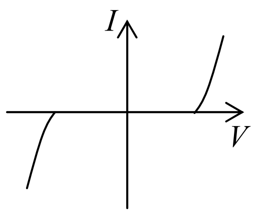
Solution: Resulting doped crystal is p-type and $p_p = (2.5-1.5)\times10^{21}/m^3 = 1\times10^{21}/m^3$

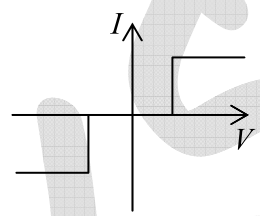
$$\sigma = e(n_p\mu_n + p_p\mu_p) \approx ep_p\mu_p = 1.6\times10^{-19}\times1\times10^{21}\times0.05 = 8\ \Omega^{-1}m^{-1}$$

Q24. Two identical Zener diodes are placed back to back in series and are connected to a variable DC power supply. The best representation of the *I-V* characteristics of the circuit is

(a)


(b)


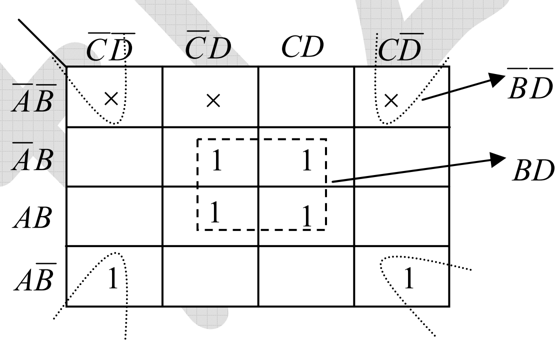
(c)


(d)


Ans: (d)

Q25. A 4-variable switching function is given by $f = \sum(5, 7, 8, 10, 13, 15) + d(0, 1, 2)$, where d is the do-not-care-condition. The minimized form of f in sum of products (SOP) form is

(a) $\overline{A}\,\overline{C} + \overline{B}\,\overline{D}$ (b) $A\overline{B} + C\overline{D}$ (c) $AD + BC$ (d) $\overline{B}\,\overline{D} + BD$

Ans: (d)


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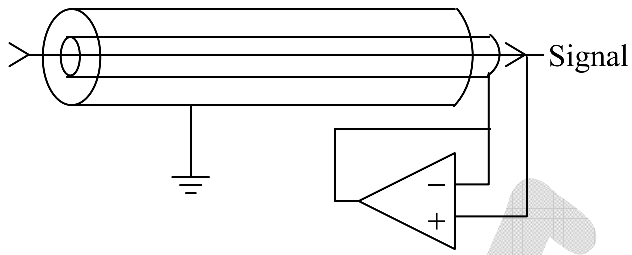
Q26. The inner shield of a triaxial conductor is driven by an (ideal) op-amp follower circuit as shown. The effective capacitance between the signal-carrying conductor and ground is



(a) unaffected (b) doubled (c) halved (d) made zero

Ans: (a)

Q27. An op-amp based voltage follower

(a) is useful for converting a low impedance source into a high impedance source.

(b) is useful for converting a high impedance source into a low impedance source.

(c) has infinitely high closed loop output impedance

(d) has infinitely high closed loop gain

Ans: (b)

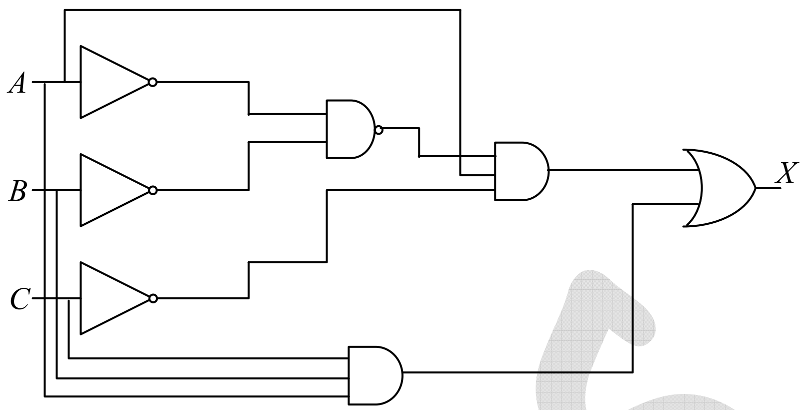
Q28. An RC network produces a phase-shift of 30°. How many such RC networks should be cascaded together and connected to a Common Emitter amplifier so that the final circuit behaves as an oscillator?

(a) 6 (b) 12 (c) 9 (d) 3

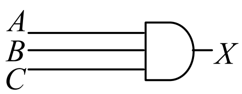
Ans: (a)

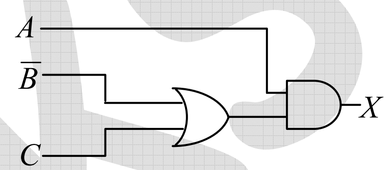
Solution: Total phase shift must be 0 or 360^{0}. Common Emitter amplifier has phase change of 180^{0} so we need 6 RC network for next 180^{0} phase shift.

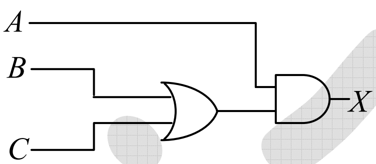
Q29. For the logic circuit shown in the below

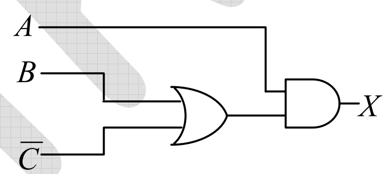


A simplified equivalent circuit is

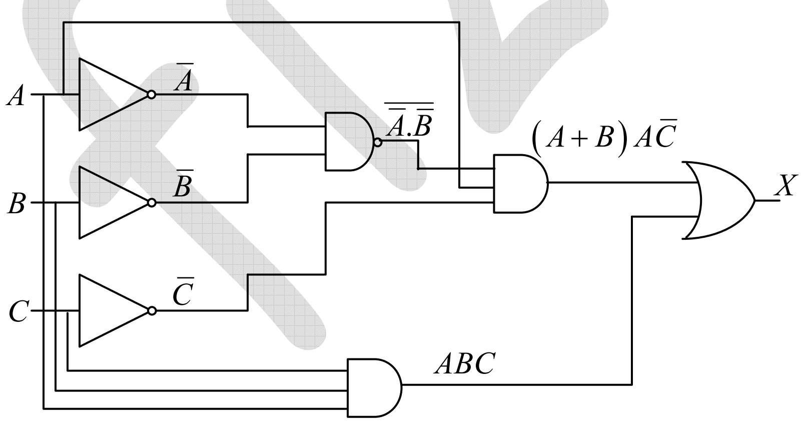
(a)


(b)


(c)


(d)


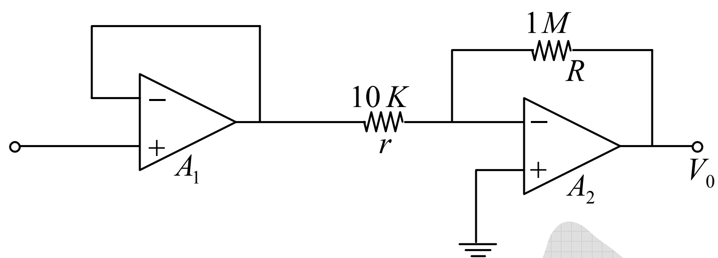
Ans: (d)



$$X=(A+B)A\bar{C}+ABC=A\bar{C}+AB\bar{C}+ABC=A\bar{C}+AB=A(B+\bar{C})$$

NET/JRF (DEC-2014)

Q30. Consider the amplifier circuit comprising of the two op-amps A_1 and A_2 as shown in the figure.



If the input ac signal source has an impedance of $50k\Omega$, which of the following statements is true?

(a) A_1 is required in the circuit because the source impedance is much greater than r

(b) A_1 is required in the circuit because the source impedance is much less than R

(c) A_1 can be eliminated from the circuit without affecting the overall gain

(d) A_1 is required in the circuit if the output has to follow the phase of the input signal

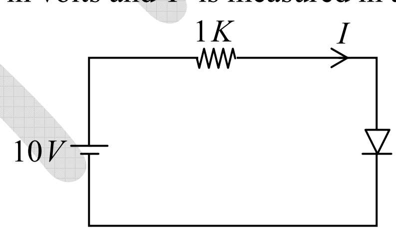
Ans: (a)

Solution: A_1 is required in the circuit because the source impedance is much greater than r

Q31. The $I-V$ characteristics of the diode in the circuit below is given by

$$I = \begin{cases} (V-0.7)/500 & \text{for} \quad V \ge 0.7 \\ 0 & \text{for} \quad V < 0.7 \end{cases}$$

where V is measured in volts and I is measured in amperes.



The current I in the circuit is

(a) 10.0 mA (b) 9.3 mA (c) 6.2 mA (d) 6.7 mA

Ans: (c)

Solution: Applying K.V.L. $-10+1000\times I+V=0 \Rightarrow -10+1000\times(V-0.7)/500+V=0$

$\Rightarrow -10+2(V-0.7)+V=0 \Rightarrow 3V=11.4 \Rightarrow V=3.8\ Volts$

Thus $I=(V-0.7)/500=(3.8-0.7)/500=3.1/500=6.2\ mA$

Q32. In a measurement of the viscous drag force experienced by spherical particles in a liquid, the force is found to be proportional to $V^{1/3}$ where V is the measured volume of each particle. If V is measured to be $30\,mm^3$, with an uncertainty of $2.7\,mm^3$, the resulting relative percentage uncertainty in the measured force is

(a) 2.08 (b) 0.09 (c) 6 (d) 3

Ans: (b)

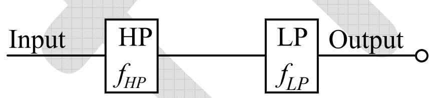
Solution: The relative percentage uncertainty in the measure force is $\sigma_F^2=\left(\frac{\partial F}{\partial V}\right)^2\sigma_V^2$

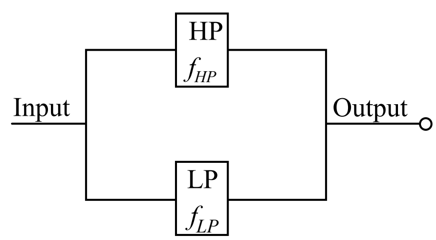
$\Rightarrow \sigma_F=\left(\frac{\partial F}{\partial V}\right)\sigma_V$ where σ_V is the uncertainty in the measurement of volume.

$\because F=V^{1/3} \Rightarrow \frac{\partial F}{\partial V}=\frac{1}{3}V^{-2/3}$

$\therefore \sigma_F=\frac{1}{3V^{2/3}}\times\sigma_V=\frac{1}{3(30)^{2/3}}\times 2.7=\frac{1}{3\times(900)^{1/3}}\times 2.7=\frac{1}{3\times 9.7}\times 2.7 \Rightarrow \sigma_F=0.09$

Q33. Consider a Low Pass (LP) and a High Pass (HP) filter with cut-off frequencies f_{LP} and f_{HP}, respectively, connected in series or in parallel configurations as shown in the Figures A and B below.

(A) 

(B) 

Which of the following statements is correct?

(a) For $f_{HP}<f_{LP}$, A acts as a Band Pass filter and B acts as a band Reject filter

(b) For $f_{HP}>f_{LP}$, A stops the signal from passing through and B passes the signal without filtering

(c) For $f_{HP}<f_{LP}$, A acts as a Band Pass filter and B passes the signal without filtering

(d) For $f_{HP}>f_{LP}$, A passes the signal without filtering and B acts as a Band Reject filter

Ans: (c)

Q34. The power density of sunlight incident on a solar cell is $100\, mW/cm^2$. Its short circuit current density is $30\, mA/cm^2$ and the open circuit voltage is $0.7\, V$. If the fill factor of the solar cell decreases from 0.8 to 0.5 then the percentage efficiency will decrease from

(a) 42.0 to 26.2 (b) 24.0 to 16.8 (c) 21.0 to 10.5 (d) 16.8 to 10.5

Ans: (d)

Solution: The efficiency of a solar cell is determined as the fraction of incident power which is converted to electricity and is defined as

$$\eta = \frac{V_{oc} I_{sc} FF}{P_{in}} \text{ and } P_{\max} = V_{oc} I_{sc} FF$$

where V_{oc} is the open circuit voltage, I_{sc} is the short circuit current density, FF is the Fill factor, P_{in} is the input power and η is the efficiency of the solar cell.

Given $P_{in} = 100\, mW/cm^2$, $I_{sc} = 30\, mA/cm^2$, $V_{oc} = 0.7V$

Let η_1 is the efficiency of solar cell when $FF = 0.8$

$$\therefore \eta_1 = \frac{(0.7V)\times\left(30\times 10^{-3} A/cm^2\right)\times 0.8}{100\times 10^{-3} W/cm^2} = \frac{16.8}{100} \Rightarrow \eta_1 = 0.168$$

Let η_2 is the efficiency of solar cell when $FF = 0.5$

$$\therefore \eta_2 = \frac{(0.7V)\times\left(30\times 10^{-3} A/cm^2\right)\times 0.5}{100\times 10^{-3} W/cm^2} = \frac{10.5}{100} \Rightarrow \eta_2 = 0.105$$

Thus efficiency decreases from $\eta_1 = 16.8\%$ to $\eta_2 = 10.5\%$

NET/JRF (JUNE-2015)

Q35. The concentration of electrons, n and holes p, for an intrinsic semiconductor at a temperature T can be expressed as $n = p = AT^{\frac{3}{2}} \exp\left(-\frac{E_g}{2k_BT}\right)$, where E_g is the band gap and A is a constant. If the mobility of both types of carries is proportional to $T^{\frac{-3}{2}}$, then the log of the conductivity is a linear function of T^{-1}, with slope

(a) $\frac{E_g}{(2k_B)}$ (b) $\frac{E_g}{k_B}$ (c) $\frac{-E_g}{(2k_B)}$ (d) $\frac{-E_g}{k_B}$

Ans. (c)

Solution: $\sigma_i = n_i e(\mu_e + \mu_p) \propto T^{\frac{3}{2}} \exp\left(\frac{-E_g}{2k_B T}\right) \times T^{-\frac{3}{2}} \Rightarrow \sigma_i = C \exp\left(\frac{-E_g}{2k_B T}\right)$

$$\ln(\sigma_i) = \frac{E_g}{2k_B T} + \ln C \Rightarrow \text{slope is} \frac{-E_g}{2k_B}$$

Q36. The viscosity η of a liquid is given by Poiseuille's formula $\eta = \frac{\pi P a^4}{8lV}$. Assume that l and V can be measured very accurately, but the pressure P has an rms error of 1% and the radius a has an independent rms error of 3%. The rms error of the viscosity is closest to

(a) 2% (b) 4% (c) 12% (d) 13%

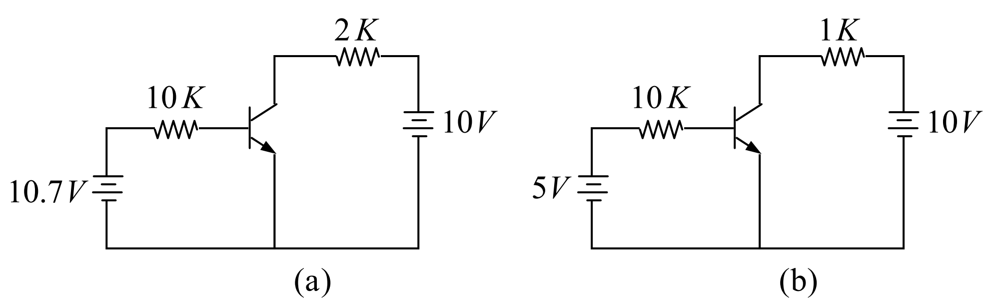
Ans. (d)

Solution: $\eta = \frac{\pi p a^4}{8lv} = k\,pa^4$ (where k is a constant)

$$\ln\eta = \ln p + 4\ln a + \ln k$$

$$\Rightarrow \frac{\Delta\eta}{\eta} = \frac{\Delta p}{p} + 4\frac{\Delta a}{a} + 0 \Rightarrow \frac{\Delta\eta}{\eta} = 1\% + 4\times 3\% = 13\%$$

Q37. Consider the circuits shown in figures (a) and (b) below



If the transistors in Figures (a) and (b) have current gain (β_{dc}) of 100 and 10 respectively, then they operate in the

(a) active region and saturation region respectively

(b) saturation region and active region respectively

(c) saturation region in both cases

(d) active region in both cases

Ans. (b)

Solution: In both case input section is F.B.

For figure (a) $I_B = \frac{10.7-0.7}{10} = 1\ mA \Rightarrow I_C = BI_B = 100\ mA$

Thus $V_{CB} = V_C - V_B = (10 - 2\times 100) = 0.7 = -ve$

$\Rightarrow$ output section is F.B.

since both section are F.B. so it is in saturation region.

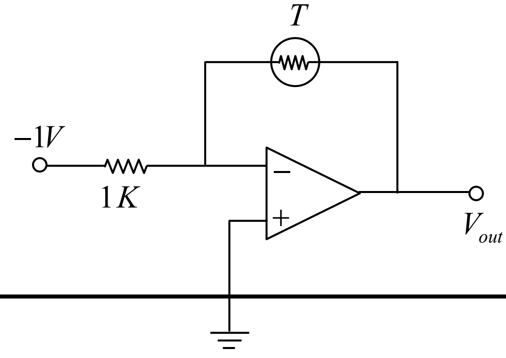
For Figure (b) $I_B = \frac{5-0.7}{10} = 0.43\ mA \Rightarrow I_C = BI_B = 4.3\ mA$

Thus $V_{CB} = V_C - V_B = (10 - 4.3) - 0.7) = +ve$

$\Rightarrow$ out put section is R.B.

Thus it is in active region

Q38. In the circuit given below, the thermistor has a resistance $3\ k\Omega$ at $25^0 C$. Its resistance decreases by 150Ω per ^0C upon heating. The output voltage of the circuit at $30^0 C$ is



(a) $-3.75\ V$ (b) $-2.25\ V$ (c) $2.25\ V$ (d) $3.75\ V$

Ans. (c)

Solution: At $30^0 C$ Resistance

$$= 3000 - 150\times 5 = 2250\ \Omega$$

$$\Rightarrow V_0 = -\frac{R_F}{R_1}v_i = \frac{-2250}{1000}\times -1 \Rightarrow V_0 = 2.25 \text{ volts}$$

NET/JRF (DEC-2015)

Q39. If the reverse bias voltage of a silicon varactor is increased by a factor of 2, the corresponding transition capacitance

(a) increases by a factor of $\sqrt{2}$ (b) increases by a factor of 2

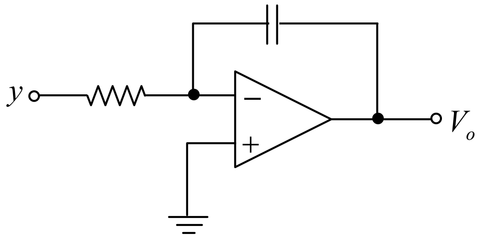
(c) decreases h a factor of $\sqrt{2}$ (d) decreases by a factor of 2

Ans.: (c)

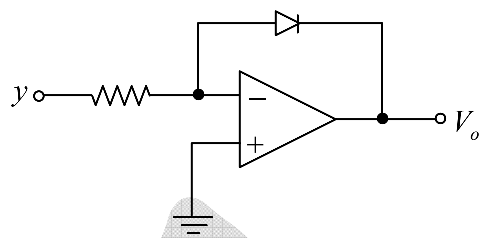
Solution: $C_T \propto \frac{1}{\sqrt{V}} \Rightarrow \frac{C_T'}{C_T} = \sqrt{\frac{V}{V'}} \Rightarrow \frac{C_T'}{C_T} = \sqrt{\frac{V}{2V}} \Rightarrow C_T' = \frac{1}{\sqrt{2}}C_T$

Q40. If the parameters y and x are related by $y = \log(x)$, then the circuit that can be used to produce an output voltage V_0 varying linearly with x is

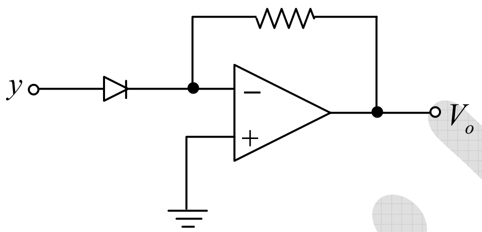
(a)



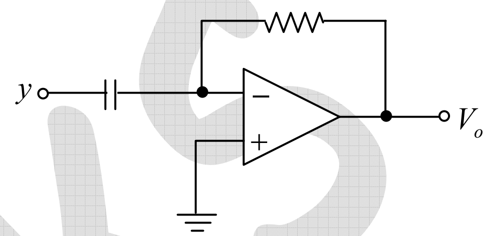
(b)



(c)



(d)



Ans.: (c)

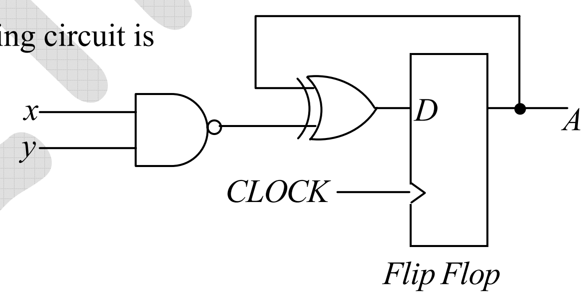
Solution: (1) Integrator

(2) Logarithmic Ampere $\left(V_0 \propto \log y\right)$

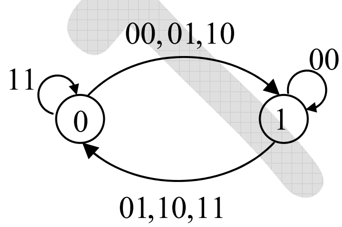
(3) Anti-log $\left(V_0 \propto e^y \propto x\right)$

(4) Differentiator

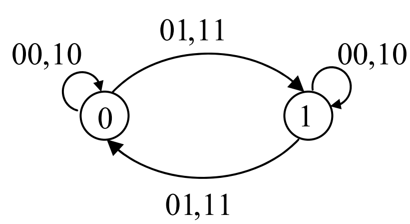
Q41. The state diagram corresponding to the following circuit is



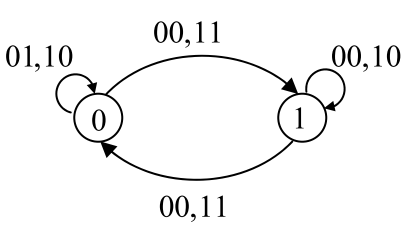
(a)



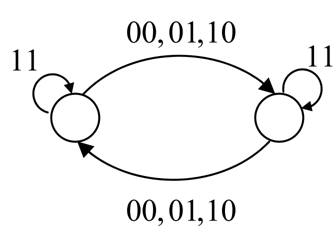
(b)



(c)



(d)

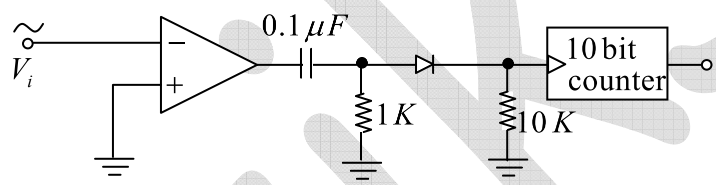


Ans.: (d)

Solution: Let verify option (d)

x	y	A	x	y	A
0	0	$0\to1$	0	0	$1\to0$
0	1	$0\to1$	0	1	$1\to0$
1	0	$0\to1$	1	0	$1\to0$
1	1	$0\to0$	1	1	$1\to1$

Q42. A sinusoidal signal of peak to peak amplitude $1V$ and unknown time period is input to the following circuit for 5 seconds duration. If the counter measures a value $(3E8)_H$ in hexadecimal then the time period of the input signal is



(a) $2.5\,ms$ (b) $4\,ms$ (c) $10\,ms$ (d) $5\,ms$

Ans.: (d)

Solution: $(3E8)_H \to 3\times16^2+14\times16+8\times1=(1000)_{10}$

In 5 sec, number of counts is 1000

Then count per sec is $=200$ count/sec

So $T=\frac{1}{200}\sec=5ms$