# 2015-EE-"14-26"

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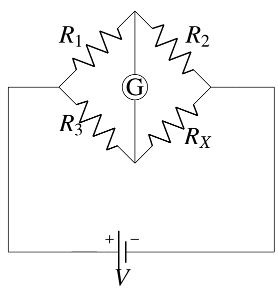
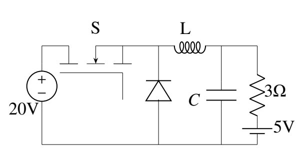
1) Consider a function $\overrightarrow{f} = \frac{1}{r^2}\hat{r}$, where r is the distance from the origin and $\hat{r}$ is the unit vector in the radial direction. The divergence of this function over a sphere of radius R, which includes the origin is
   a) 0
   b) $2\pi$
   c) $4\pi$
   d) $R\pi$
2) When the wheatstone bridge shown in the figure is used to find the value of resistor $R_X$, the galvanometer G indicates zero current when $R_1 = 50\Omega, R_2 = 65\Omega$ and $R_3 = 100\Omega$. If $R_3$ is known with $\pm 5\%$ tolerance on its nominal value of $100\Omega$, what is the range of $R_X$ in Ohms?

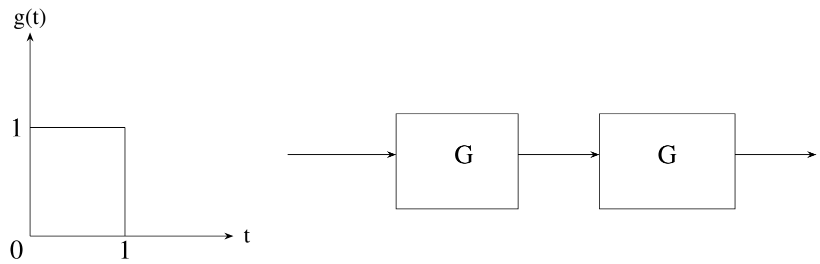



   a) $[123.50, 136.50]$
   b) $[125.89, 134.12]$
   c) $[117.00, 143.00]$
   d) $[120.25, 139.75]$
3) A $(0 - 50A)$ moving coil ammeter has a voltage drop of 0.1V across its terminals at full scale deflection. The external shunt resistance (in milliohms) needed to extend its range to (0-500 A) is __________
4) Of the four characteristics given below, which are the major requirements for an instrumentation amplifier? P. High common mode rejection ratio Q. High input impedance R. High linearity S. High output impedance
   a) P, Q and R only
   b) P and R only
   c) P, Q and S only
   d) Q, R and S only
5) In the following chopper, the duty ratio of swithc S is 0.4. If the inductor and capacitor are sufficiently large to ensure continous inductor current and ripple free capacitor voltage, the changing current(in Ampere) of the 5V battery, under steady-state, is __________



6) A moving average function is given by $y(t) = \frac{1}{T}\int_{t-T}^{t} u(\tau)\,d\tau$. If the input $u$ is a sinusoidal signal of frequency $\frac{1}{2T}$Hz, then in steady state, the output y will lag $u$ (in degree) by __________

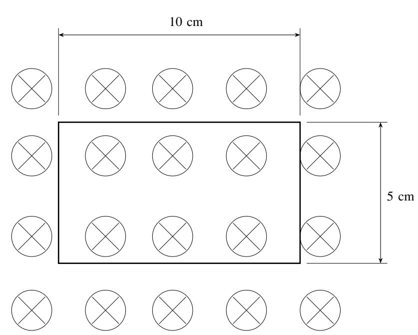
7) The impulse response $g(t)$ of a system, G, is as shown in Figure(a). What is the maximum value attained by the impulse response of two cascaded blocks of G as shown in Figure(b)



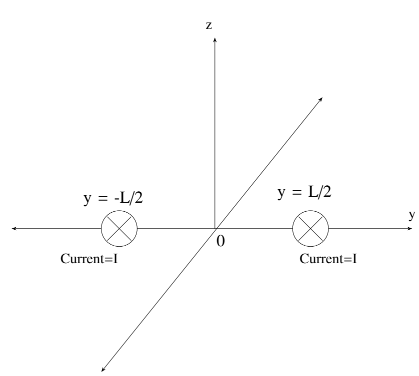

(a) (b)

   a) $\frac{2}{3}$
   b) $\frac{3}{4}$
   c) $\frac{4}{5}$
   d) 1

8) Consider a one-turn rectangular loop of wire placed in a uniform magnetic field as shown in the figure. The plane of the loop is perpendicular to the field lines. The resistance of the loop is 0.4Ω, and its inductance negligible. The magnetic flux density(in Tesla) is a function of time and is given by $B(t) = 0.25 sin\omega t$, where $\omega = 2\pi \times 50$ radian/second. The power absorbed (in Wat) by the loop from the magnetic field is



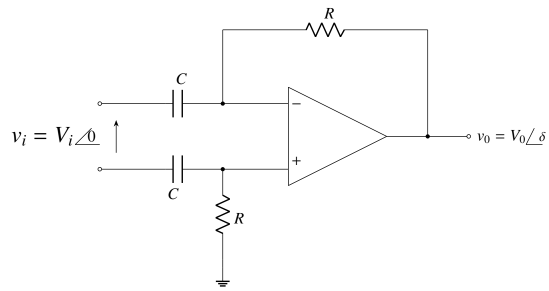

9) A steady current I is flowing in -x direction through each of the two infinitely long wires at $y = \pm\frac{L}{2}$ as shown in the figure. The permeability of the medium is $\mu_0$. The $\overrightarrow{B}$- field at $(0, L, 0)$ is




   a) $-\frac{4\mu_0 I}{3\pi L}\hat{Z}$
   b) $+\frac{4\mu_0 I}{3\pi L}\hat{Z}$

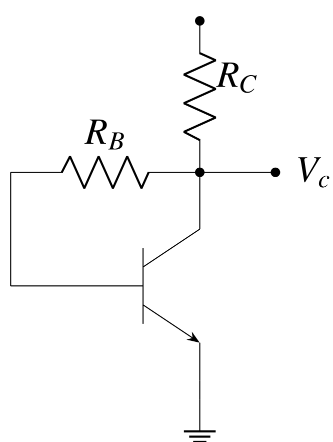
c) 0
d) $-\frac{3\mu_0 I}{4\pi L}\hat{Z}$

10) Consider the circuit shown in the figure. In this circuit $R = 1k\Omega$ and $C = 1\mu F$. The input voltage is sinusoidal with a frequency of 5-Hz, represented as a phasor with magnitude $V_i$ and phase angle 0 radian as shown in the figure. The output voltage is represented as phasor with magnitude $V_0$ and phase angle $\delta$ radian. What is the value of the output phase angle $\delta$(in radian) relative to the phase angle of the input voltage?

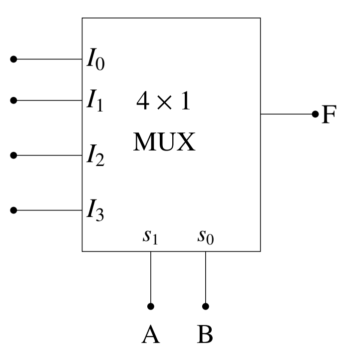



a) 0
b) $\pi$
c) $\frac{\pi}{2}$
d) $-\frac{\pi}{2}$

11) In the given circuit, the silicon tranistor has $\beta = 75$ and a collector voltage $V_C = 9V$. Then the ratio of $R_B$ and $R_C$ is __________



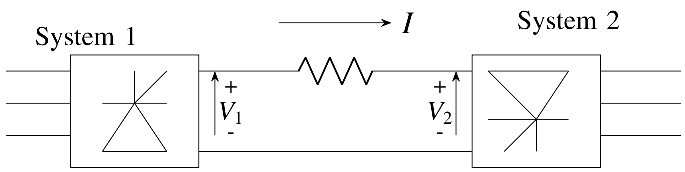

12) In the $4 \times 1$, the output F is given by $F = A \oplus B$. Find the required input $'I_3 I_2 I_1 I_0'$




a) 1010

b) 0110
c) 1000
d) 1110

13) Consider a HVDC link which used thryistor based line-commutated converters as shown in the figure. For a power flow of 750 MW from a System 1 to System 2, the voltage at the two ends, and the current, are given by : $V_1 = 500kV, V_2 = 485kV$ and $I = 1.5kA$. If the direction of power flow is to be reversed(that is, from System 2 to System 1) without changing the electrical connections, then which one of the following combinations is feasible?




a) $V_1 = -500kV, V_2 = -485kV$ and $I = 1.5kA$
b) $V_1 = -485kV, V_2 = -500kV$ and $I = 1.5kA$
c) $V_1 = 500kV, V_2 = 485kV$ and $I = -1.5kA$
d) $V_1 = -500kV, V_2 = -485kV$ and $I = -1.5kA$