

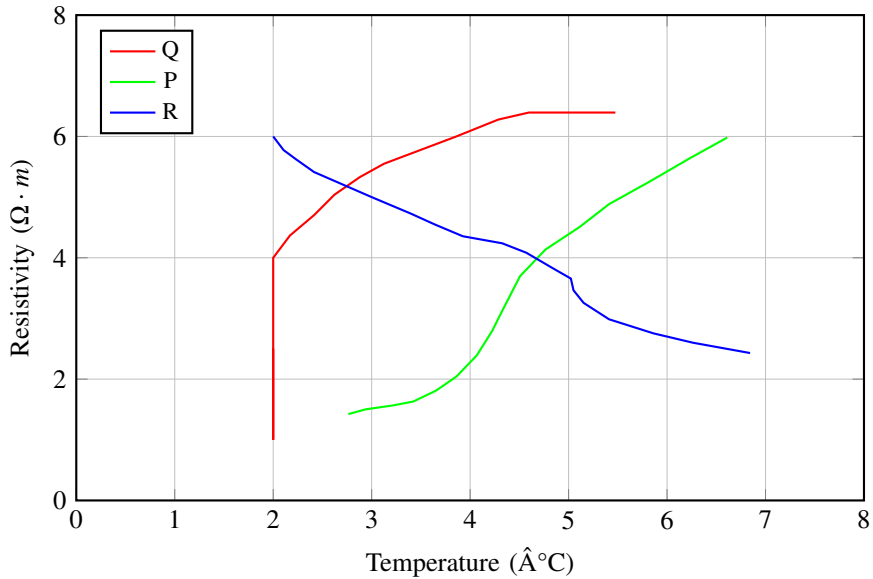
GateAssignment1

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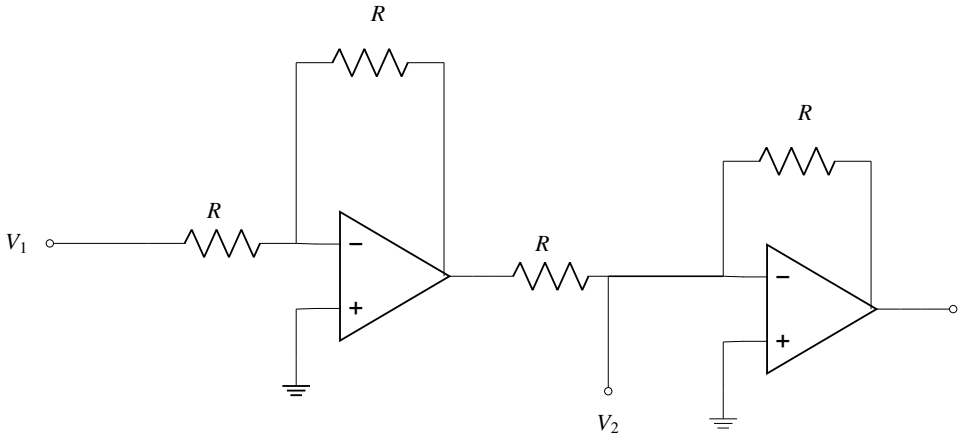
1 Q.21 TO Q.75 CARRY TWO MARKS EACH.

- 1) The solid phase of an element follows van der Waals bonding with inter-atomic potential $V(r) = -\left(\frac{P}{r^6}\right) + \left(\frac{Q}{r^{12}}\right)$, where P and Q are constants. The bond length can be expressed as
 - a) $\left(\frac{2Q}{P}\right)^{-6}$
 - b) $\left(\frac{Q}{P}\right)^{-6}$
 - c) $\left(\frac{P}{2Q}\right)^{-6}$
 - d) $\left(\frac{P}{Q}\right)^{-6}$
- 2) Consider the atomic packing factor (APF) of the following crystal structures:
P. Simple Cubic
Q. Body Centred Cubic
R. Face centred Cubic
S. Diamond
T. Hexagonal Close Packed
Which two of the above structures have equal APF?
 - a) P and Q
 - b) S and T
 - c) R and S
 - d) R and T
- 3) In a powder diffraction pattern recorded from a face-centred cubic sample using x-rays, the first peak appears at 30° . The second peak will appear at
 - a) 32.8°
 - b) 33.7°
 - c) 34.8°
 - d) 35.3°
- 4) Variation of electrical resistivity ρ with temperature T of three solids is sketched (on different scales) in the figure, as curves P, Q and R. Which one of the following statements describes the variations most appropriately?



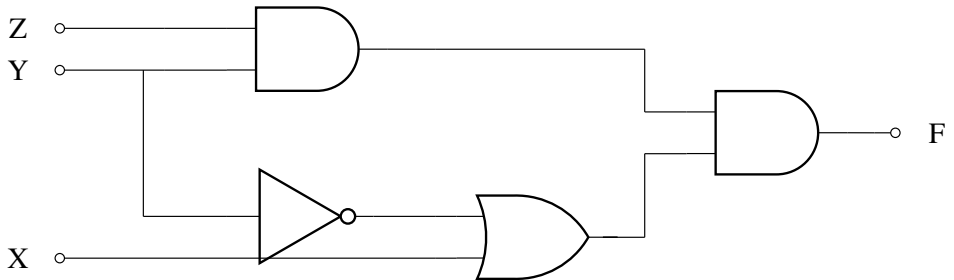
- a) P is for a superconductor, and R for a semiconductor.
 b) Q is for a superconductor, and P for a conductor.
 c) Q is for a superconductor, and R for a conductor.
 d) R is for a superconductor, and P for a conductor.
- 5) An extrinsic semiconductor sample of cross-section A and length L is doped in such a way that the doping concentration varies as $N_D(x) = N_0 \exp\left(-\frac{x}{L}\right)$, where N_0 is a constant. Assume that the mobility μ of the majority carriers remain constant. The resistance R of the sample is given by
- a) $R = \frac{L}{A\mu e N_0} [\exp(1.0) - 1]$
 b) $R = \frac{L}{\mu e N_0} [\exp(1.0) - 1]$
 c) $R = \frac{L}{A\mu e N_0} [\exp(-1.0) - 1]$
 d) $R = \frac{L}{A\mu e N_0}$
- 6) A ferromagnetic mixture of iron and copper having 75% atoms of Fe exhibits a saturation magnetisation of $1.3 \times 10^6 \text{ Am}^{-1}$. Assume that the total number of atoms per unit volume is $8 \times 10^{28} \text{ m}^{-3}$. The magnetic moment of an iron atom, in terms of the Bohr Magnetron, is
- a) 1.7
 b) 2.3
 c) 2.9
 d) 3.8
- 7) Half life of a radio-isotope is 4×10^8 years. If there are 10^3 radioactive nuclei in a sample today, the number of such nuclei in the sample 4×10^9 years ago were
- a) 128×10^3
 b) 256×10^3

- c) 512×10^3
 d) 1024×10^3
- 8) In the deuterium + tritium ($d + t$) fusion more energy is released as compared to deuterium + deuterium ($d + d$) fusion because
- tritium is radioactive.
 - more nucleons participate in fusion.
 - the Coulomb barrier is lower for the $d+t$ system than $d+d$ system.
 - the reaction product ${}^4\text{He}$ is more tightly bound.
- 9) According to the shell model the ground state spin of the ${}^{17}\text{O}$ nucleus is
- $\frac{3}{2}^+$
 - $\frac{5}{2}^+$
 - $\frac{5}{2}^-$
 - $\frac{3}{2}^-$
- 10) A relativistic particle travels a length of $3 \times 10^{-3}\text{m}$ in air before decaying. The decay process of the particle is dominated by
- strong interactions.
 - electromagnetic interactions.
 - weak interactions.
 - gravitational interactions.
- 11) The strange baryon Σ^+ has the quark structure
- uds
 - uud
 - uus
 - $u\bar{s}$
- 12) A neutron scatters elastically from a heavy nucleus. The initial and final states of the neutron have the
- same energy.
 - same energy and linear momentum.
 - same energy and angular momentum.
 - same linear and angular momentum.
- 13) The circuit shown is based on ideal operational amplifiers. It acts as a



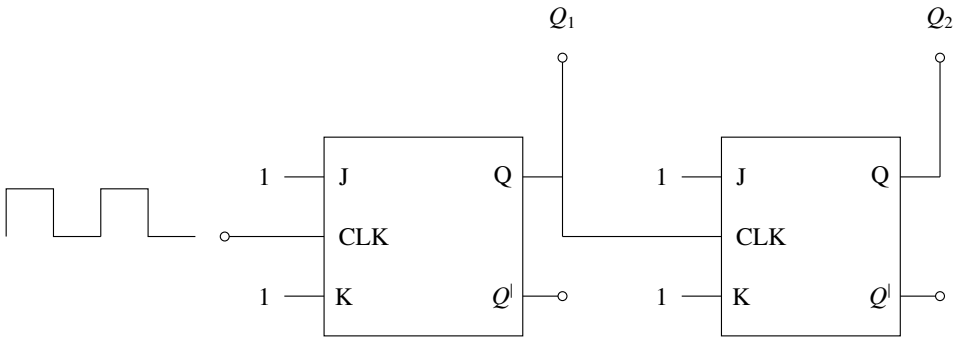
- a) subtractor.
- b) buffer amplifier.
- c) adder.
- d) divider.

14) Identify the function F generated by the logic network shown



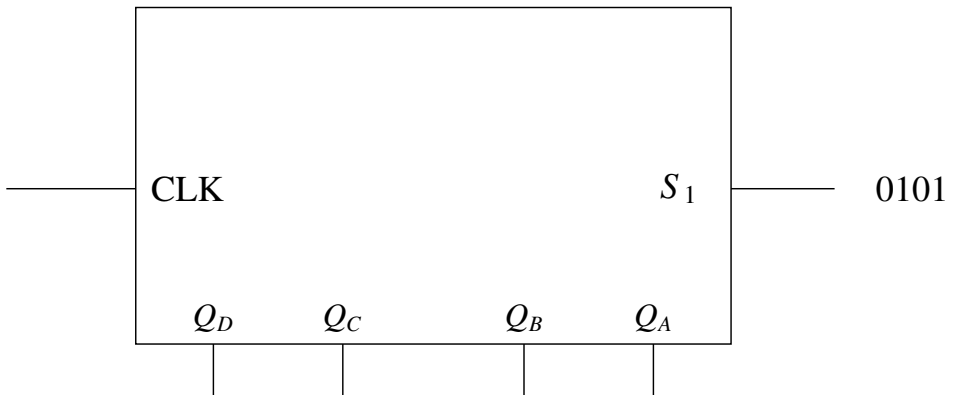
- a) $F = (X + Y)Z$
- b) $F = Z + Y + \bar{Y}X$
- c) $F = ZY(Y + X)$
- d) $F = XYZ$

15) In the circuits shown, the ports Q_1 and Q_2 are in the state $Q_1 = 1$, $Q_2 = 0$. The circuit is now subjected to two complete clock pulses. The state of these ports now becomes



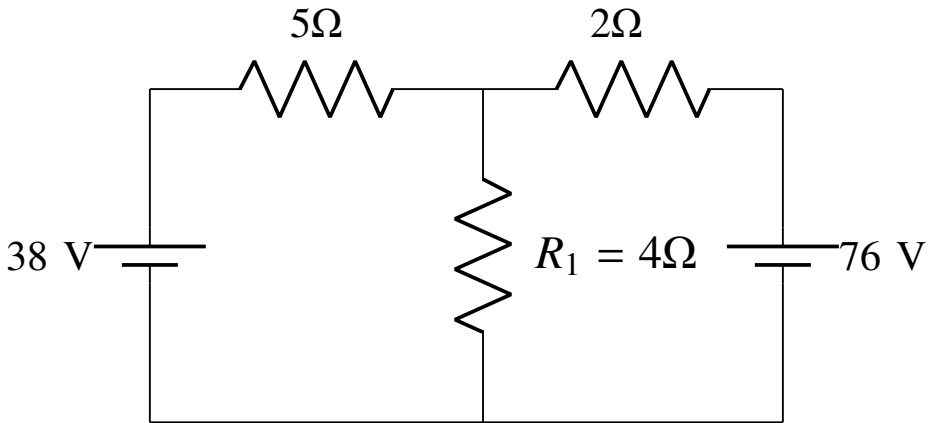
- a) $Q_2 = 1, Q_1 = 0$
- b) $Q_2 = 0, Q_1 = 1$
- c) $Q_2 = 1, Q_1 = 1$
- d) $Q_2 = 0, Q_1 = 0$

16) The registers Q_D , Q_C , Q_B and Q_A shown in the figure are initially in the state 1010 respectively. An input sequence $S_1 = 0101$ is applied. After two clock pulses, the state of the shift registered (in the same sequence $Q_D Q_C Q_B Q_A$) is



- a) 1001
- b) 0100
- c) 0110
- d) 1010

17) For the circuit shown, the potential difference (*inVolts*) across R_L is



- a) 48
- b) 52
- c) 56
- d) 65