Q. 1 The potential is constant throughout a given region of space. Is the electrical field zero or non-zero in this region? Explain.

Ans. The electric field E is zero. As electric field is given by the relation $E = - \Delta V / \Delta r$
Since potential is constant, i.e. $\Delta V = 0$ so $E = - 0/ \Delta r = 0$

Q. 2 Suppose that you follow an electric field line due to a positive point charge. Do electric field and the potential increase or decrease?

Ans. Both electric field and potential decreases. To follow electric field line for +ve charge means to move away from the charge. So distance increases, electric field and potential decreases as given from the following relations.

$E = K q / r^2$ or $E \propto 1 / r^2$
$V = K q / r$ or $V \propto 1 / r$

Q. 3 How can you identify that which plate of a capacitor is positively charged?

Ans. Bring a positively charged body near to the capacitor plate. If the charged body is repelled by the capacitor plate then it is positively charged plate and other is negatively charged plate. If the plate is attracted by the capacitor plate then it s negatively charged plate and other is positively charged plate.

Q. 4 Describe the force or forces on a positive point charge when placed between parallel plates (a) with similar and equal charges (b) with opposite and equal charges

Ans. a) With similar and equal charges, the net force will be zero because both the plates will repel/attract the charge with equal and opposite force.

$F = qE + q(-E) = 0$

For both +ve equal charges will repel from both sides and –ve equal charges attract from both sides with equal force so net force will be zero.

b) It will accelerate towards –ve plate due to repulsion from +ve plate and attraction from –ve plate.

$F = qE + qE = 2qE$

Q. 5 Electric lines of force never cross. Why?

Ans. Since E has only one direction at any given point, therefore, if the electric lines cross each other then at the point of intersection E would have more than one direction. This is physical not possible. Hence electric lines can never cross each other.

Q. 6 If a point charge q of mass m is released in a non-uniform electric field with field lines pointing in the same direction, will it make a rectilinear motion?

Ans. It will make a rectilinear motion, because the field lines pointing in the same direction means their directions are not changing. The charge q has to follow the field lines so its motion will also be along the same lines.

Q. 7 Is E necessarily zero inside a charged rubber balloon if balloon is spherical? Assume that charge is distributed uniformly over the surface.

Ans. Yes, E is zero inside a spherical charged rubber balloon due spherical symmetry. If we consider Gaussian surface inside the charged rubber balloon then charged enclosed by this surface is zero.

As $\varphi = q/\varepsilon_0$ since $q = 0$ hence $\varphi = 0/\varepsilon_0 = 0$ ----------(1)

Also $\varphi =$ **E.A** ----------(2) comparing equation (1) and (2) we get **E.A** = 0 since A cannot be zero hence electric intensity will be zero

Q. 8 Is it true that Gauss's law states that the total number of lines of forces crossing any closed surface in the outward direction is proportional to the net positive charge enclosed within surface?

Ans. Yes, it is true.

Electric flux is the measure of number of lines of force passing through the area (closed surface), in outward direction due to +ve charge. Lines of force will be radially moving outward containing the charge. $\varphi \propto Q$ or $\varphi =$ constant (Q)

Inserting $1 / \in o$ as constant of proportionality from the given condition

$\varphi = 1/\in o$ (Q), which is Gauss's law.

Q. 9 Do electrons tend to go to region of high potential or of low potential?

Ans. The positive potential is considered to be the high potential and negative potential is considered to be low potential. Electrons being the negatively charged particles will be repelled by the negative potential and will be attracted by the positive potential. Hence electrons will tend to go from low to high potential.