विध्न विचारत भीरु जन, नहीं आरम्भे काम,
विपति देख छोड़े तुरंत मध्यम मन कर श्याम।
पुरुष सिंह संकल्प कर, सहते विपति अनेक,
'बना' न छोड़े ध्येय को, रघुबर राखे टेक।।

रचितः मानव धर्म प्रणेता
सद्गुरु श्री रणछोड़दासजी महाराज

ELECTROMAGNETIC INDUCTION

Some questions (Assertion–Reason type) are given below. Each question contains STATEMENT – 1 (Assertion) and STATEMENT – 2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct. So select the correct choice :

Choices are :

(A) Statement – 1 is True, Statement – 2 is True; Statement – 2 **is** a correct explanation for Statement – 1.
(B) Statement – 1 is True, Statement – 2 is True; Statement – 2 **is NOT** a correct explanation for Statement – 1.
(C) Statement – 1 is True, Statement – 2 is False.
(D) Statement – 1 is False, Statement – 2 is True.

503. **STATEMENT – 1**
An inductor acts as perfect conductor for DC.

STATEMENT – 2
DC remains constant in magnitude and direction.

504. **STATEMENT – 1**
The direction of the induced electric field is always perpendicular to the direction of the (changing) magnetic field.

STATEMENT – 2
The induced electric field is a non–conservative field.

505. **STATEMENT – 1**
The self inductance (volume) of an ideal solenoid is proportional to square of number of turns per unit length.

STATEMENT – 2
The magnetic field inside an ideal solenoid is proportional to number of turns per unit length.

506. **STATEMENT – 1**
In a LC circuit, the charge on the capacitor oscillates simple harmonically.

STATEMENT – 2
The total energy in a LC circuit is a constant.

507. **STATEMENT – 1**
The magnetic flux through a loop of conducting wire of a fixed resistance changes by $\Delta\phi_B$ in a time Δt. Then $\Delta\phi_B$ is proportional to the current through the loop.

STATEMENT – 2

$$I = -\frac{\Delta\phi_B}{R}$$

508. **STATEMENT – 1**
An emf is induced in a long solenoid by a bar magnet that moves while totally inside it along the solenoid axis.

STATEMENT – 2
As the magnet moves inside the solenoid the flux through individual turns of the solenoid changes.

509. **STATEMENT – 1**
If a conducting wire is moved in a non–uniform magnetic field emf must be induced across it.

STATEMENT – 2
In non–uniform magnetic field force experienced by a charged particle is non–zero.

510. **STATEMENT – 1**
If a charged particle is released from rest in a time varying magnetic field, it moves in a circle.

STATEMENT – 2
In time varying magnetic field electric field is induced.

511. **STATEMENT – 1**
If electric current, changes through a circuit, eddy currents are induced in nearby iron piece.

STATEMENT – 2
Due to change of electric current, the magnetic flux through iron piece changes, so eddy currents are induced in the iron piece.

512. **STATEMENT – 1**
A capacitor blocks direct current in the steady state.

STATEMENT – 2
The capacitive reactance of the capacitor is inversely proportional to frequency f of the source of emf.

513. **STATEMENT – 1**
Two identical co–axial circular loops carry equal currents in same direction. When both loops start approaching each other, the current in both coil will decreases.

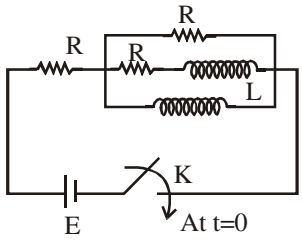
STATEMENT – 2
Current in a circuit is independent of any other circuit.

514. **STATEMENT – 1**
If a coil is rotated in uniform magnetic field about an axis perpendicular to the field, emf induced in coil is maximum for orientation of coil in which magnetic flux through the coil is zero.

STATEMENT – 2
Work done to rotate the coil will get converted into electrical energy.

515. **STATEMENT – 1 :** At t = 0, current through emf source $i = \frac{E}{2R}$; and at t = ∞; i (through emf source will be) = E/R.

STATEMENT – 2 : At t = 0; inductor will behave like open circuit and at t = ∞; inductor will behave like short circuit.



516. **STATEMENT – 1 :** A system cannot have mutual inductance without having self inductance.

STATEMENT – 2 : If mutual inductance of system is zero, its self inductances must be zero.

517. **STATEMENT – 1 :** Lenz's law violates the principle of conservation of energy.

STATEMENT – 2 : Induced e.m.f. always opposes the change in magnetic flux responsible for its production.

518. **STATEMENT – 1 :** Only a change in magnetic flux will maintain an induced current in the coil.

STATEMENT – 2 : The presence of large magnetic flux through a coil maintains a current in the coil if the circuit is continous.

519. **STATEMENT – 1 :** An electric lamp is connected in series with a long solenoid of copper with air core and then connected to AC source. If an iron rod is inserted in solenoid the lamp will become dim.

STATEMENT – 2 : If an iron rod is inserted in solenoid, the inductance of solenoid increases.

520. **STATEMENT – 1 :** A capacitor allows AC but blocks DC.

STATEMENT – 2 : When AC passes through a capacitor, there is local oscillation of bound charges of dielectric.

521. **STATEMENT – 1 :** The self inductance (L) is given by ϕ (magnetic flux) = L i (current).

STATEMENT – 2 : When current is increased; self inductance increases.

522. **STATEMENT – 1 :** The work done by a charge in a closed (induced) current carrying loop is non–zero.

STATEMENT – 2 : Induced electric field is non–conservative in nature.

523. **STATEMENT – 1 :** Lenz's law violates the principle of conservation of energy.

STATEMENT – 2 : Induced e.m.f. opposes always the change in magnetic flux responsible for its production.

524. **STATEMENT – 1 :** The growth of current in R-L circuit is uniform.

STATEMENT – 2 : Inductor (L) opposes the growth of current.

525. **STATEMENT – 1 :** Magnetic flux linked to closed surface is zero.

STATEMENT – 2 : Direction of induced current due to change of magnetic flux is given by Faraday's Law.

526. **STATEMENT – 1 :** Time dependent magnetic field generates electric field.

STATEMENT – 2 : Direction of electric field generated from time variable magnetic field does not obey Lenz's law.

527. **STATEMENT – 1 :** Varying magnetic field produces an electric field, which is non–conservative.

STATEMENT – 2 : Charge particles in motion produces only magnetic field.

528. **STATEMENT – 1 :** Induced potential across a coil and therefore induced current is always opposite to the direction of current due to external source.

STATEMENT – 2 : Lenz law states that it always opposes the cause due to which it is being produced.

529. **STATEMENT – 1 :** The magnetic field at the ends of a very long current carrying solenoid is half of that at the center.

STATEMENT – 2 : If the solenoid is sufficiently long, the field with in it is uniform.

530. **STATEMENT – 1 :** The energy of charged particle moving in a uniform magnetic field does not change.

STATEMENT – 2 : Work done by magnetic field on the charge is zero.

531. **STATEMENT – 1 :** When two coils are wound on each other, the mutual induction between the coils is maximum.

STATEMENT – 2 : Mutual induction does not depend on the orientation of the coils.

532. **STATEMENT – 1 :** The induced emf in a conducting loop of wire will be non–zero when it rotates in a uniform magnetic field.

STATEMENT – 2 : The emf may be induced due to change in magnetic field.

533. **STATEMENT – 1 :** The direction of induced e.mf. is always such as to oppose the change that causes it.

STATEMENT – 2 : The direction of induced e.m.f. is given by Lenz's Law.

534. **STATEMENT – 1 :** Capacitor serves as a block for d.c. and offers an easy path to a.c.

STATEMENT – 2 : Capacitive reactance is inversely proportional to frequency.

Hint & Solution

503.	(A)	504.	(B)				
505.	(A)	506.	(B)	507.	(A)	508.	(D)
509.	Both are false.	510.	(D)	511.	(A)	512.	(A)
513.	(C)	514.	(B)	515.	(A)	516.	(C)
517.	(D)	518.	(C)	519.	(A)	520.	(A)
521.	(C)	522.	(A)	523.	(D)	524.	(D)
525.	(C)	526.	(C)	527.	(C)	528.	(D)
529.	(B)	530.	(A)	531.	(C)	532.	(D)
533.	(B)	534.	(A)				

503. As, $\varepsilon = -\dfrac{d\phi}{dt}$

$\therefore$ there will be no change in the flux in DC.

507. $$I = -\frac{\Delta\phi_B}{R}$$

As R is constant, $I \propto \Delta\phi_B$.

508. Even though flux through individual lines changes, it remains unchanged for the solenoid as a whole. Therefore no emf is induced in the long solenoid.

517. Lenz's law is based on conservation of energy and induced e.m.f. always opposes the cause of it i.e., change in magnetic flux.

518. Presence of magnetic flux cannot produce current.

519. If inductance of solenoid increases, than reactance of circuit too increases then obviously current will decrease and light becomes dim.

520. When AC passes, due to local oscillations of bound charges current is conducted but in DC, as there are no free charge carriers in dielectric, the current cannot be conducted.

521. L is dependent only upon geometrical parameter.

522. $\Delta W = q(\Delta V)$
Here ΔV = non zero in a closed loop.

523. The statement (I) is false because Lenz's law according to the principle of conservation of energy.

524. The current in R-L circuit grows exponentially $I = I_0\left(1 - e^{-Rt/L}\right)$.

525. Magnetic line are present in closed loop.

526. Electric field generated from time dependent magnetic field obeys Lenz's law.

528. When current due to external source decreases. Induced current will be in same direction.

529. For solenoid $B_{end} = \frac{1}{2}(B_{in})$
Also for long solenoid the magnetic field is uniform within it but this reason is not explaining the assertion.

530. The force on a charged particle moving in a uniform magnetic field always acts in direction perpendicular to the direction of motion of charge. As work done by magnetic field on the charge is zero, W = FS cos θ. So the energy of charged particle does not change.

531. Coefficient of coupling between them
$M = K^2 . L_1L_2$
When 2 coils are wound on each other, the coefficient of coupling is maximum and hence mutual inductance between the coils is maximum.

532. As the coil rotates, the magnetic flux linked with the coil (being $\vec{B}.\vec{A}$) will change and emf may be induced in the loop.

533. According to Lenz's Law when a magnet is moved towards the coil the direction of induced current is such that the coil repels the magnet and when the magnet moves away from the coil, the coil attracts the magnet.

534. The capacitive reactance of capacitor is given by
$$X_C = \frac{1}{\omega C} = \frac{1}{2\pi fc}$$
So this is infinite for d.c. (f = 0) and has a very small value for a.c. therefore a capacitor blocks d.c. Hence (A) is true.