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

MAGNETIC FIELD (MAGNETISM)

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.

469. **STATEMENT – 1**
Acceleration of a moving charged particle in a magnetic field is non–zero.

STATEMENT – 2
Inside magnetic field region, the particle may be moving on curved path.

470. **STATEMENT – 1**
Any rod of length ℓ moving with velocity v in a magnetic field B has an induced emf of $Bv\ell$.

STATEMENT – 2
Induced emf in rod is given by $Bv\ell \sin\theta$.

471. **STATEMENT – 1**
The net force on a closed circular current carrying loop placed in uniform magnetic field is zero.

STATEMENT – 2
The torque produced in a conducting circular ring is zero when it is placed in a uniform magnetic field such that magnetic field is perpendicular to the plane of loop.

472. **STATEMENT – 1**
For a charged particle describing uniform circular motion in a magnetic field $T^2 \propto r^3$ (symbols have their usual meanings)

STATEMENT – 2
The relation $T^2 \propto r^3$ is valid only when $F \propto \frac{1}{r^2}$.

473. **STATEMENT – 1**
The Lorentz force $\vec{F} = q\ \vec{v} \times \vec{B}$ is a non–conservative force.

STATEMENT – 2
The work done by the Lorentz force is always zero.

474. **STATEMENT – 1**
A current loop is a magnetic dipole.

STATEMENT – 2
The net force on a current loop in a uniform magnetic field is zero.

475. **STATEMENT – 1**
Magnetic monopoles do not exist.

STATEMENT – 2
$\oint \vec{B}.d\vec{s} = 0$
Symbols have their usual meanings.

476. **STATEMENT – 1**
A rectangular current loop is in an arbitrary orientation in an external uniform magnetic field. No work is required to rotate the loop about an axis perpendicular to its plane.

STATEMENT – 2
All positions represent the same level of energy.

477. **STATEMENT – 1**
Magnitude of $\vec{B}$ is constant along a magnetic field line.

STATEMENT – 2
$\vec{B}$ is tangent to a magnetic field line.

478. **STATEMENT – 1**
If a charged particle passes through a region without getting any change in its velocity implies that region is free from electric field as well as magnetic field.

STATEMENT – 2
Whenever a charged particle is placed in magnetic field or [and] electric field it may experience a net force.

479. **STATEMENT – 1**
In electric circuits, wires carrying currents in opposite directions are often twisted together.

STATEMENT – 2
If the wires are not twisted together, the combination of wires forms a current loop. The magnetic field generated by the loop might affect adjacent circuits or components.

480. **STATEMENT – 1**
If a proton and an α–particle enter a uniform magnetic field perpendicularly with the same speed, the time period of revolution of α–particle is double than that of proton.

STATEMENT – 2
In a magnetic field, the period of revolution of a charged particle is directly proportional to the mass of the particles and inversely proportional to charge of particle.

481. **STATEMENT – 1**
A direct current flows through a metallic rod. If produces magnetic field only outside the rod.

STATEMENT – 2
The charge carriers flow through whole of the cross–section.

482. **STATEMENT – 1**
A loosely bound helix made of stiff wire is suspended vertically with the lower end just touching a dish of mercury. When a current is passed though the wire, the wire executes oscillatory motion with the lower end jumping out of and into the mercury.
STATEMENT – 2
When electric current is passed through helix, a magnetic field is produced both inside and outside the helix.

483. **STATEMENT – 1**
In Ampere's law for magnetostatics $\oint \vec{B}.d\vec{\ell} = \mu\Sigma i$, the current outside the curve is not included on the right side.
STATEMENT – 2

Magnetic field calculated using Ampere's law is field due to current inside closed loop as well current outside the closed loop.

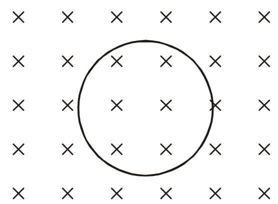
484. **STATEMENT – 1**
If an electron is not deflected in passing through a certain region of space, then other electron is moving parallel to magnetic field or there is no magnetic field in region.
STATEMENT – 2
If a charge particle is moving with a velocity u at an angle θ with magnetic field. Magnitude of force acting on it is $F = quB\sin\theta$.

485. **STATEMENT – 1**
Two parallel wires carrying current in same direction, attract each other while if two similar charge moving parallel to each other repel each other.
STATEMENT – 2
Electric force is stronger than magnetic force.

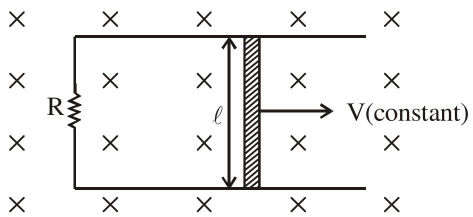
486. **STATEMENT – 1 :** A charged particle moves perpendicular to magnetic field. Its kinetic energy will remain constant but momentum charges.
STATEMENT – 2 : Force acts perpendicular to velocity of particle.

487. **STATEMENT – 1 :** A beam of electron passes undeflected through region $\vec{E} \,\&\, \vec{B}$.
STATEMENT – 2 : In the region $\vec{E} \,\&\, \vec{B}$, both are present and perpendicular to each other and the particle is moving perpendicular to both of them.

488. **STATEMENT – 1 :** A charged particle is moving in a circular path under the action of a uniform magnetic field as shown in the figure. During motion kinetic energy of charged particle is constant.
STATEMENT – 2 : During the motion magnetic force acting on the particle is perpendicular to instantaneous velocity.



489. **STATEMENT – 1 :** Consider the situation shown in the figure. A conductor is moved with constant velocity by an external agent. A force is required to move the conductor with constant velocity.
STATEMENT – 2 : As conductor is moved a current is induced in the circuit. A magnetic force acts on conductor opposite to its velocity.



490. **STATEMENT – 1 :** When radius of circular loop carrying current is doubled its magnetic moment becomes four times.
STATEMENT – 2 : Magnetic moment depends on area of the loop.

491. **STATEMENT – 1 :** The poles of magnet cannot be separated by breaking into two pieces.
STATEMENT – 2 : The magnetic moment will be reduced to half when a magnet is broken into two equal pieces.

492. **STATEMENT – 1 :** A magnetic field independent of time can change the velocity of a charged particle.

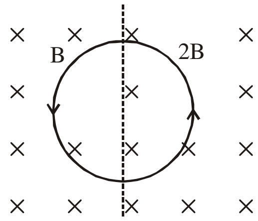
STATEMENT – 2 : It is not possible to change the velocity of a particle in a magnetic field as magnetic field does no work on charged particle.

493. **STATEMENT – 1 :** The current constituted by electrons in a metallic wire creates only electric while electron beam creates both, electric and magnetic fields.

STATEMENT – 2 : The electron beam contains only electrons while metallic wire carries both positive and negative charges and also the wire is electrically neutral.

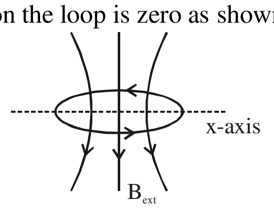
494. **STATEMENT – 1 :** The magnetic field on the closed loop in figure is zero.

STATEMENT – 2 : Force (magnetic) on the wire is $\int dF = \int i d\vec{\ell} \times \vec{B}$



495. **STATEMENT – 1 :** A closed current carrying loop behave like a magnetic dipole.

STATEMENT – 2 : Force and torque on the loop is zero as shown in figure.



496. **STATEMENT – 1 :** A current I flows along the length of an infinitely long straight and thin walled pipe. Then the magnetic field at any point inside the pipe is zero.

STATEMENT – 2 : $\oint \vec{B}.d\vec{l} = \mu_0 I$

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

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

498. A charge is projected in a region of magnetic field. (no other field is present)
STATEMENT – 1 : Kinetic energy of charge particle will remain constant.

STATEMENT – 2 : Work done by magnetic force on moving charge particle is zero.

499. A semicircular ring is present in the uniform magnetic field. Magnetic field is perpendicular to loop of ring.

STATEMENT – 1 : Force $\vec{F}$ on each element of ring is different.

STATEMENT – 2 : Net force on ring must be perpendicular to magnetic field.

500. **STATEMENT – 1 :** Magnetic field at a point on the surface of long cylindrical wire is maximum.

STATEMENT – 2 : For any other point, closed loop perpendicular to the wire and of radius equal to the distance between axis of wire and given point will enclose less current.

501. **STATEMENT – 1 :** Magnitude of force acting on a current carrying loop placed in uniform magnetic field will be equal to zero whether magnetic field is in the plane or perpendicular to the plane of loop.

STATEMENT – 2 : Magnitude of force does not depend upon the direction of magnetic field.

502. **STATEMENT – 1 :** A linear solenoid carrying current is equivalent to a bar magnet.
STATEMENT – 2 : The magnetic field lines of both are same.

Hint & Solution

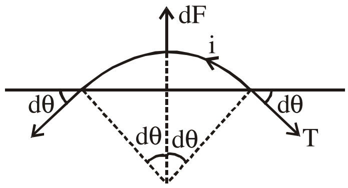
469.	(A)	470.	(D)	471.	(C)	472.	(D)
473.	(B)	474.	(B)	475.	(A)	476.	(A)
477.	(D)	478.	D	479.	(A)	480.	(A)
481.	(D)	482.	(B)	483.	(B)	484.	(D)
485.	(A)	486.	(A)	487.	(A)	488.	(A)
489.	(A)	490.	(A)	491.	(B)	492.	(C)
493.	(D)	494	D)	495.	(B)	496.	(D)
497.	(B)	498.	(A)	499.	(B)	500.	(C)
501.	(C)	502.	(A)				

469. $\frac{mv^2}{r} = v_0B$

$\frac{v^2}{r} = \frac{qvB}{m}$ is called a centripetal acceleration.

470. $\varepsilon = Bv\ell \sin\theta$
If $\theta = 0$
$\varepsilon = 0$.

471.



$2T \sin d\theta = BiR\,(2d\theta)$
$T = iBR$.

476. $U = -\vec{\mu}.\vec{B} = -\mu B\cos\theta$
Since, μ, B as well as θ remains constant, U does not change.

477. $|\vec{B}|$ is proportional to number of magnetic field lines per unit area (area should be normal to field).

480. The period of a charged particle in a magnetic field is given by
$T = \frac{2\pi m}{qB}$.

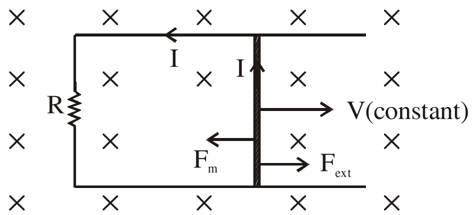
481. Magnetic field exists both inside and outside as well.

482. The winding of helix carry currents in same direction. Hence they experience an attractive force pulling the lower and out of mercury. As a result of this the circuit breaks and so the force of attraction vanishes and the helix comes back to its initial position, completing the circuit again.

488. $\vec{F} = q\vec{V}\times\vec{B}$
$\Rightarrow$ $\vec{F} \perp \vec{V}$
So power produced by magnetic force is zero.

⇒ Kinetic energy of particle will remain conserved.

489.



$$\varepsilon = B\ell V$$
$$I = \frac{B\ell V}{R}$$
$$F_B = I\ell B = \frac{B^2\ell^2 V}{R}.$$

490. Initially moment M = I π r^2
And afterwards M′ = I π (2r)^2
= 4I (πr^2) = 4M
So magnetic moment becomes four times when radius is doubled.

491. As we know every atom of a magnet acts as a dipole. So poles cannot be separated. When magnet is broken into two equal pieces. Magnetic moment of each part will be half of the original magnet.

492. Velocity is a vector quantity even if direction changes, velocity is said to be changing, no matter speed remains same or different.

493. Due to both positive and negative charges the wire is electrically neutral and hence no electric field is present and only magnetic field is created.

494. Force on the loop is not zero; because magnetic field is not constant.

495. Use $\left.\begin{array}{l}\vec{F} = \oint i\, d\vec{\ell} \times B = 0 \\ \vec{\tau} = MB\sin\theta = 0\end{array}\right|.$

497. For a solenoid Bend $= \frac{1}{2}$Bin, also for a long solenoid magnetic field is uniform within it but this reason is not explaining the statement (I)

498. Work done by magnetic force on moving charge is zero.

499. Magnetic force is always perpendicular to magnetic field and small element.

500. For any point outside the wire enclosed current will be same.

501. F = 0 in both case.

502. The magnetic lines of force due to current carrying straight solenoid is as that of bar magnet.