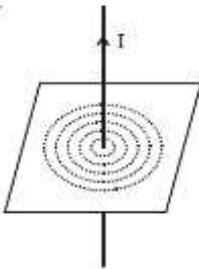
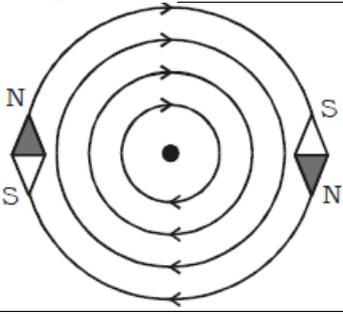
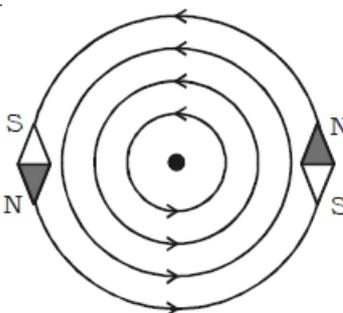
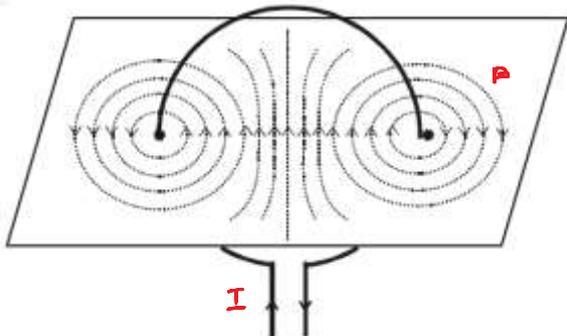
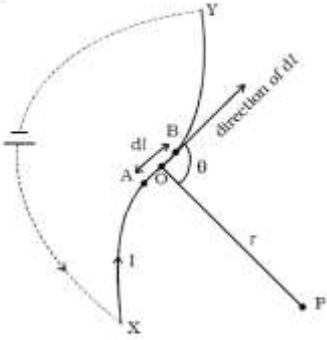
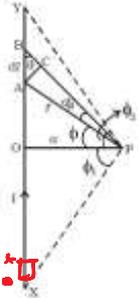
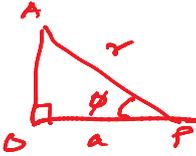
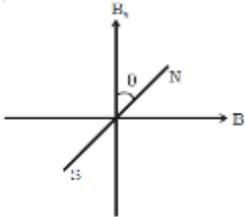


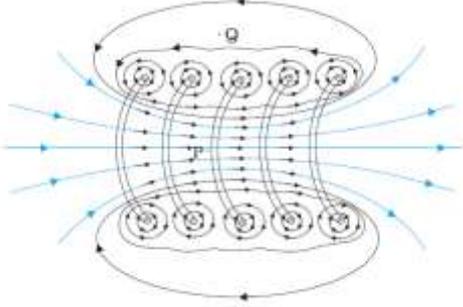
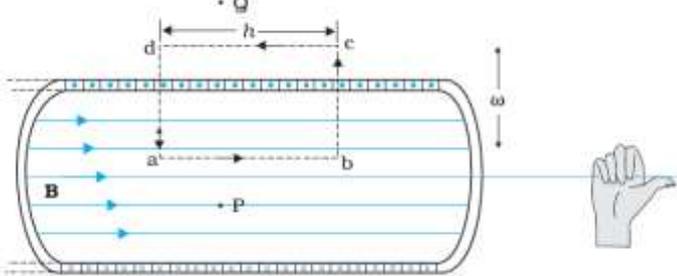
#		NOTE: vectors are indicated in bold letters <span style="color:red">↗</span>
1.	Lorentz force	The total force on a charge $q$ , moving with a velocity $\underline{v}$ in the presence of magnetic and electric fields $\mathbf{B}$ and $\mathbf{E}$ . $\mathbf{F} = q(\mathbf{v} \times \mathbf{B} + \mathbf{E})$ <span style="color:red"><math>\mathbf{F} = q(\underline{v} \times \underline{B} + \underline{E})</math></span>
2.	Magnetic force	$q(\mathbf{v} \times \mathbf{B})$ is normal to $\mathbf{v}$ and work done by it is zero
3.	Force experienced by a straight conductor, $\mathbf{F}$ $l$ = length of the conductor $\vec{l} = \underline{l}$	$\mathbf{F} = I \mathbf{l} \times \mathbf{B}$ <span style="color:red"><math>\rightarrow q(\underline{v} \times \underline{B})</math></span> <span style="color:red"><math>q = ne</math></span> <span style="color:red"><math>\mathbf{F} = l \underline{l} \times \underline{B}</math></span> <span style="color:red"><math> \underline{l}  = l</math></span>
4.	Magnetic field around a straight conductor carrying current $I$ = Current	
5.	Current inwards $\mathbf{B}$ is clockwise around the straight conductor carrying current	
6.	Current outwards $\mathbf{B}$ is anticlockwise around the straight conductor carrying current	
7.	Maxwell's Right hand cork screw rule	If a right handed cork screw is rotated to advance along the direction of the current through a conductor, then the direction of rotation of the screw gives the direction of the magnetic lines of force around the conductor.
8.	Magnetic field due to a circular loop carrying current	

<p>9.</p>	<p>Biot – Savart Law</p> $dB = \frac{\mu}{4\pi} \frac{I dl \sin \theta}{r^2}$ <p>XY = current carrying conductor  I = current strength, A  AB = dl = a small element of the conductor  P = a point a distance r from the mid-point (O) of AB  <math>\theta</math> = angle between dl and the line joining element dl and the point P</p>	
<p>10.</p>	<p>The magnetic field or magnetic induction element (dB) at P due to the length element (dl)</p>	<p>i) directly proportional to the current (I)  ii) directly proportional to the length element (dl)  iii) directly proportional to <math>\sin \theta</math>  iv) inversely proportional to the square of the distance between the point P and the centre of the length element. (<math>r^2</math>)</p>
<p>11.</p>		$dB \propto \frac{I dl \sin \theta}{r^2}$
<p>12.</p>	<p>K = constant of proportionality</p> $K = \frac{\mu}{4\pi}$	$dB = K \frac{I dl \sin \theta}{r^2}$
<p>13.</p>	<p><math>\mu</math> = permeability of the medium</p>	$dB = \frac{\mu}{4\pi} \frac{I dl \sin \theta}{r^2}$
<p>14.</p>	<p><math>\mu = \mu_r \mu_o</math>  <math>\mu_r</math> = relative permeability of the medium  <math>\mu_o</math> = permeability of free space.  <math>\mu_o = 4\pi \times 10^{-7}</math> henry/metre  For air, <math>\mu_r = 1</math>.</p>	<p>in air medium <math>dB = \frac{\mu_o}{4\pi} \frac{I \cdot dl \sin \theta}{r^2}</math></p>
<p>15.</p>	<p>Vector form</p> <p>Please note the difference between r cap and r vector.  Unit of B = tesla or <math>wb \cdot m^{-2}</math>  wb= weber</p>	$\overline{dB} = \frac{\mu_o}{4\pi} \frac{\overline{Idl} \times \overline{r}}{r^3}$ <p>or</p> $\overline{dB} = \frac{\mu_o}{4\pi} \frac{\overline{Idl} \times \hat{r}}{r^2}$

16.	<p>Magnetic induction due to infinitely long straight conductor                  XY = infinitely long straight conductor                  AB = length element of the conductor = dl</p>	 
17.	According to Biot-Savart law	$dB = \frac{\mu_0}{4\pi} \frac{Idl \cdot \sin \theta}{r^2}$
18.	AC is drawn perpendicular to BP from A	$\angle OPA = \phi, \quad \angle APB = d\phi$
19.	In $\Delta ABC$	$\sin \theta = \frac{AC}{AB} = \frac{AC}{dl}$ $\therefore AC = dl \sin \theta$
20.		<p>From <math>\Delta APC</math>, <math>AC = rd\phi</math></p> $rd\phi = dl \sin \theta$
21.		$dB = \frac{\mu_0}{4\pi} \frac{I rd\phi}{r^2} = \frac{\mu_0}{4\pi} \frac{I d\phi}{r}$
22.		<p>In <math>\Delta OPA</math>, <math>\cos \phi = \frac{a}{r}</math></p> $\therefore r = \frac{a}{\cos \phi}$  $dB = \frac{\mu_0}{4\pi} \frac{I}{a} \cos \phi d\phi$ <p style="text-align: right;"><i>[sin phi] phi_2</i> <i>- phi_1</i></p>
23.	On integration the total magnetic field or induction at P due to the conductor XY	$B = \int_{-\phi_1}^{\phi_2} dB = \int_{-\phi_1}^{\phi_2} \frac{\mu_0 I}{4\pi a} \cos \phi d\phi$ <p style="text-align: right;"><i>sin phi_2 - (-sin phi_2)</i></p>
24.		$B = \frac{\mu_0 I}{4\pi a} [\sin \phi_1 + \sin \phi_2]$
25.	<p>For infinitely long conductor  <math>\phi_1 = \phi_2 = 90^\circ</math>                  When the conductor is placed in a medium of permeability <math>\mu</math>,</p>	$B = \frac{\mu_0 I}{2\pi a}$ <div style="border: 2px solid red; padding: 5px; display: inline-block;"> <math display="block">B = \frac{\mu I}{2\pi a}</math> </div>
26.	Magnetic induction along the axis of a	

	circular coil carrying current	
27.	Circular coil AB = length element of the coil = dl C = centre of the length element O = centre of circular coil CP = r = distance between the centre of the length element and the point P	
28.	Biot Savart law	$dB = \frac{\mu_0}{4\pi} \frac{I dl \sin \theta}{r^2}$
29.	$\theta$ is the angle between Idl and r Here, $\theta = 90^\circ$	$dB = \frac{\mu_0}{4\pi} \frac{I dl}{r^2}$
30.	The direction of dB is perpendicular to the current element Idl and CP. It is therefore along PR perpendicular to CP.	
31.	Considering the diametrically opposite element A' B' , the magnitude of dB at P due to this element is the same as that for AB but its direction is along PM.	
32.	Alpha = angle between the axis of the coil and their line joining the element dl and the point P	$B = \int dB \sin \alpha = \int \frac{\mu_0}{4\pi} \frac{I dl}{r^2} \frac{a}{r} = \frac{\mu_0 I a}{4\pi r^3} \int dl$ $= \frac{\mu_0 I a}{4\pi r^3} 2\pi a$ $= \frac{\mu_0 I a^2}{2(a^2 + x^2)^{\frac{3}{2}}} \quad (\because r^2 = a^2 + x^2)$
33.		If the coil contains n turns, the magnetic induction is $B = \frac{\mu_0 n I a^2}{2(a^2 + x^2)^{\frac{3}{2}}}$ At the centre of the coil, $x = 0$ $B = \frac{\mu_0 n I}{2a}$

<p>34. Tangent Galvanometer A device used for measuring current. Principle: tangent law</p> $B = B_h \tan \theta$  <p><math>B</math> = magnetic field due to the current in the coil <math>B_h</math> = Horizontal component of Earth's magnetic induction</p>		 <p>A magnetic needle suspended at a point where there are two crossed fields at right angles to each other will come to rest in the direction of the resultant of the two fields.</p>
<p>35. Tangent law</p>		$B = B_h \tan \theta$
<p>36. Magnetic field due to the current passing through circular coil</p>		$B = \frac{\mu_0 n I}{2a}$
<p>37. <math>K</math> = reduction factor of the tangent Galvanometer</p> $I = K \tan \theta$		$\frac{\mu_0 n I}{2a} = B_h \tan \theta$ $\therefore I = \frac{2a B_h}{\mu_0 n} \tan \theta$ $I = K \tan \theta$ $I = K \tan \theta$ <p>where <math>K = \frac{2a B_h}{\mu_0 n}</math></p>
<p>38. Ampere's Circuital Law</p>		$\oint \vec{B} \cdot d\vec{l} = \mu_0 I_0$ <p>The line integral <math>\oint \vec{B} \cdot d\vec{l}</math> for a closed curve is equal to <math>\mu_0</math> times the net current <math>I_0</math> through the area bounded by the curve.</p>
<p>39. The magnetic induction due to infinitely long straight current carrying conductor, <math>B</math></p>		$B = \frac{\mu_0 I}{2\pi a}$ $B (2\pi a) = \mu_0 I$
<p>40. Perimeter, <math>L = 2\pi a</math> <math>BL = \mu_0 I_0</math></p>		<p><math>B (2\pi a)</math> is the product of the magnetic field and the circumference of the circular of radius 'a' on which the <math>B</math> is constant.</p>
<p>41. In a more generalized way, Ampere's circuital law</p>		$\oint \vec{B} \cdot d\vec{l} = \mu_0 I_0$

<p>42.</p>	<p><b>Solenoid</b> It consists of a long wire wound in the form of helix where neighbouring turns are closely spaced. Each turn is regarded as a circular loop. NOTE: Enamelled wires are used for winding so that turns are insulated from each other.</p>	 <p>The diagram shows a cylindrical solenoid with current entering from the top-left and exiting from the bottom-right. Individual current loops are shown as circles with arrows indicating the direction of current. Blue magnetic field lines are shown passing through the center of the solenoid, with some lines curving around the ends.</p>
<p>43.</p>	<p><b>Right hand palm rule</b> The coil is held in the right hand so that the fingers point in the direction of the current in the windings. The extended thumb, point the direction of the magnetic field.</p>	 <p>The diagram shows a solenoid with current flowing into the page (indicated by dots) on the top half and out of the page (indicated by crosses) on the bottom half. A rectangular loop is drawn inside the solenoid with vertices labeled a, b, c, and d. Blue magnetic field lines (B) are shown pointing to the right. A right hand is shown to the right of the solenoid, with fingers curled in the direction of the current and the thumb pointing to the right, indicating the direction of the magnetic field.</p>
<p>44.</p>	<p>The solenoid is used to obtain uniform magnetic field. By inserting a soft iron core inside the solenoid, a large magnetic field is created. <math>B = \mu n I = \mu_0 \mu_r n I</math> When a current carrying solenoid is freely suspended, it comes to rest like a suspended bar magnet along north – south. The magnetic polarity of the current carrying solenoid is given by End rule.</p>	<ul style="list-style-type: none"> <li>Let us consider an infinitely long solenoid.</li> <li>It has n number of turns per unit length carrying a current of I (in ampere).</li> <li>Length of the solenoid is very large compared to its radius.</li> <li>Magnetic field outside the solenoid is zero.</li> <li>A long solenoid appears like a long cylindrical metal sheet.</li> <li>The dots in the upper part indicate the current sheet coming out of the paper.</li> <li>The lower cross marks indicate the current sheet going into the plane of the paper.</li> <li>To find the B at point inside solenoid, Ampere's circuital law can be applied.</li> <li>For the abcd rectangular loop</li> </ul> $\oint \vec{B} \cdot d\vec{l} = \int_a^b \vec{B} \cdot d\vec{l} + \int_b^c \vec{B} \cdot d\vec{l} + \int_c^d \vec{B} \cdot d\vec{l} + \int_d^a \vec{B} \cdot d\vec{l}$ <ul style="list-style-type: none"> <li>If l is the length of the loop,</li> </ul> $\oint \vec{B} \cdot d\vec{l} = Bl$ <ul style="list-style-type: none"> <li>Since the path of integration includes nl turns, the net current enclosed by the closed loop is given by</li> </ul> $I_0 = Inl$ <ul style="list-style-type: none"> <li>Ampere's circuital law for the closed loop is given by</li> </ul> $\oint \vec{B} \cdot d\vec{l} = \mu_0 I_0$ <ul style="list-style-type: none"> <li></li> </ul> $Bl = \mu_0 Inl$ $B = \mu_0 nI$ <ul style="list-style-type: none"> <li></li> </ul>