1. Orbital velocity of satellite

\[ v_0 = \sqrt{\frac{GM}{r}} \]

\[ v_o \propto \frac{1}{\sqrt{r}} \]

\[ \frac{V_{th}}{v_o} = \sqrt{\frac{16R}{9R}} = \sqrt{\frac{4}{3}} \]

2. 1 stat volt = 300 volt

\[ \frac{Q}{R} = \frac{1}{10} \text{ or } Q = 10 \text{ stat coulomb} \]

\[ \sigma = \frac{Q}{4\pi R^2} = \frac{10}{4\pi (10)^2} = \frac{1}{40\pi} = 8 \times 10^{-3} \text{ CGS esu} \]

3. \[ U = Q^2 / 2C \]

Now, \[ C' = KC \]

As battery is disconnected, Q remains unaltered.

So, \[ U' = \frac{Q^2}{2C'} = \frac{1}{2} \frac{Q^2}{C} \]

\[ \frac{U}{U'} = \frac{Q^2}{2KC} = K \]

4. Let the resistance of the shorter part MN be x.

Total resistance is 20Ω. Hence, the resistance of longer MN part will be \((20-x)\). With respect to M and N, the two portions are connected in parallel.

Hence,

\[ R_{eq} = \frac{(20-x)x}{(20-x)+x} = 1.8 \]

Solving, we get: \[ x = 2Ω \]

The resistance per unit length is 1Ω/m. So, length of shorter part = 2m.
5. \( qE = qVB \)
\[ V = \frac{E}{B} \]
\[ R = \frac{GM}{\frac{R}{2}} \]
\[ W_p = \frac{mg_e}{mg_e} = \frac{4}{9} \times 9 = 4 \text{ N} \]

7. When a high energy X-ray beam falls on metallic ball, photoelectrons are emitted from the ball and the ball acquires a positive charge. As a result of this, the ball gets deflected in the direction of electric field till equilibrium is reached.

8. Number of capacitors required in series = \( \frac{3000}{500} = 6 \).
The capacitance of series combination = \( (1/6) \mu\text{F} \).
To obtain a capacitor of 2 \( \mu\text{F} \), we should use 12 such combinations.
\( \therefore \) Total number of capacitors required = \( 12 \times 6 = 72 \)

9. \[ A \rightarrow 1 \Omega \rightarrow 1 \Omega \rightarrow B \]
\[ \Rightarrow 8/3 \Omega \]
\[ \Rightarrow R_{AB} = 8/7 \Omega \]

13. \[ C = \frac{\varepsilon_0 A}{d} \]
\[ d \uparrow \Rightarrow C \downarrow \]
\[ V = \frac{\sigma d}{\varepsilon_0} \]
\[ d \uparrow \rightarrow V \uparrow \]

14. The current
\[ I = \frac{6}{400 + 800} = \frac{6}{1200} = \frac{1}{200} = 5 \times 10^{-3} \text{ A} \]
\( \therefore \) Voltage drop across 400\( \Omega \) = \( 5 \times 10^{-3} \times 400 = 2000 \times 10^{-3} = 2 \text{ V} \)
Because of the presence of the voltmeter having resistance \( G = 10,000 \text{ G} \) in parallel with 400\( \Omega \), the effective resistance is,
\[ \frac{400 \times 10,000}{10,400} = \frac{10,000 \Omega}{26} \]
\( \therefore \) Voltage measured = \( \frac{10,000}{26} \times 5 \times 10^{-3} = \frac{50}{26} \text{ V} \)
\( \therefore \) Relative error in the measurement = \( \frac{2 - (50/26)}{2} = \frac{1}{26} = 0.04 \text{ volt} \)

15. \[ B_{net} = \sqrt{\left(\frac{\mu_0 I}{4R}\right)^2 + \left(\frac{\mu_0 I}{4R}\right)^2} = \frac{\mu_0 I}{2\sqrt{2R}} \]

16. \[ V_e = \sqrt{2ge} = \sqrt{2 \times 4 \times \pi \text{R} \text{p} \times \text{R}} \]
\[ V_e = \frac{R}{V_e^1} \Rightarrow V_e^1 = 2V_e = 2 \times 11.2 \]
\[ V_e^1 = 22.4 \text{ km/s} \]

18. A series combination of \( n_1 \) capacitors each of capacitance \( C_1 \) are connected to 4V source as shown in the figure.

Total capacitance of the series combination of the capacitors is,
\[ \frac{1}{C_s} = \frac{1}{C_1} + \frac{1}{C_1} + \frac{1}{C_1} + \ldots \text{ upto } n_1 \text{ terms} = \frac{n_1}{C_1} \]
\[ \text{or } C_s = \frac{C_1}{n_1} \ldots (i) \]
Total energy stored in a series combination of the capacitors is,
\[ U_s = \frac{1}{2} C_1 (4V)^2 = \frac{1}{2} \left( \frac{C_1}{n_1} \right) (4V)^2 \]  
\( \text{(ii)} \)  
[Using eqn. (i)]

A parallel combination of \( n_2 \) capacitors each of capacitance \( C_2 \) are connected to \( V \) source as shown in the figure.

Total capacitance of the parallel combination of capacitors is,
\[ C_p = C_2 + C_2 + \ldots + \text{upto} \ n_2 \ \text{terms} = n_2C_2 \]  
\( \text{(iii)} \)

Total energy stored in a parallel combination of capacitors is,
\[ U_p = \frac{1}{2} C_p (V)^2 \]
\[ = \frac{1}{2} (n_2C_2)(V)^2 \]  
\( \text{(iv)} \)  
[Using eqn. (iii)]

According to the given problem,
\[ U_s = U_p \]
Substituting the values of \( U_s \) and \( U_p \) from equations (ii) and (iv), we get
\[ \frac{1}{2}, \frac{C_1}{n_1} (4V)^2 = \frac{1}{2}, (n_2C_2)(V)^2 \]
or
\[ \frac{C_1}{n_1} 16 = n_2C_2 \text{ or } C_2 = \frac{16C_1}{n_1n_2} \]

19. For maximum current,  
\[ \text{mR} = nr \]  
\( \text{(i)} \)

Given that \( mn = 45 \)

Hence,  
\[ m \times 2.5 = n \times 0.5 \]
or  
\[ n = 5m \]  
\( \text{(iii)} \)

From equation (ii) and (iii), \( 5m^2 = 45 \) or \( m=3 \)
\[ \Rightarrow n = 15 \]

21. \[ \frac{1}{2} mV^2 = \frac{mgh}{R} \]
\[ \frac{1}{2} m \left( \frac{v^2}{2} \right) = \frac{mghR}{R + h} \]
\[ \frac{1}{8} \times 2gR = \frac{ghR}{R + h} \]
\[ \frac{h}{R + h} = \frac{1}{4} \Rightarrow h = \frac{R}{3} \]

22. \[ E = \frac{1}{4\pi\varepsilon_0} \frac{q}{R^2} \]

As \( q \) is constant, so \( E \propto \frac{1}{R^2} \)

Radius is halved. Therefore, electric field will becomes 4 times or 4E.

Further,  
\[ V = \frac{1}{4\pi\varepsilon_0} \frac{q}{R} \]

As \( q \) is constant, so \( V \propto \frac{1}{R} \)

Radius is halved, so potential will becomes two time or 2V.

23.  
\[ I = 2 \times 3.2 \times 10^{18} \times 1.6 \times 10^{-19} \]
\[ + 3.6 \times 10^{18} \times 1.6 \times 10^{-19} \]
\[ = 1.6 \text{ amp to the right} \]

24.  
\[ i = neAV_d \]
\[ V_d \propto \frac{1}{A} \times \frac{1}{r^2} \]

25. for crossing limited mag. field  
\[ R > \text{depth of mag. field} \]
\[ R > (b-a) \]
\[ \frac{mV}{qB} > b-a \]
\[ V > \frac{qB(b-a)}{m} \]

26.  
\[ \Delta U = U_f - U_i = -\frac{GMm}{4R} - \left( -\frac{GMm}{R} \right) \]
\[ \Delta U = \frac{GMm}{R} - \frac{GMm}{4R} = \frac{3 GMm}{4R} \]
\[ = \frac{3}{4} MgR \]
27. This is basically a problem of finding the electric field due to three dipoles. The dipole moment of each dipole is,
\[ p = Q (2a) \]

Electric field due to each dipole will be,
\[ E = \frac{Kp}{x^3} \]
\[ E_{\text{net}} = E + 2E \cos 60^\circ = 2E \]
\[ = 2 \times \frac{1}{4\pi\varepsilon_0} \times \frac{2Qa}{x^3} = \frac{Qa}{\pi\varepsilon_0 x^3} \]

28. \[ I = E(x+n) = \frac{E}{r+n} = \frac{E}{r(n+1)} \]
\[ V = E - Ir = E - \frac{E}{r(n+1)} \times nE \]
\[ = \frac{nE}{n+1} \]

29. \[ B = \frac{\mu_0 I}{2\pi R} + \frac{\mu_0 I}{2\pi R} = \frac{2\mu_0 I}{\pi R} \]

30. \[ M = \frac{q}{2m} \]
\[ M = \frac{qL}{2m} = \frac{qL}{m} = \frac{qL}{2m} \times \frac{mL^2}{3} = \frac{qL^2}{6} \]

31. \[ \frac{mV^2}{\ell^2} = \frac{\sqrt{3}Gm^2}{\ell^2} \]
\[ V = \sqrt{\frac{Gm}{\ell}} \]
\[ T = \frac{2\pi r}{V} = \frac{2\pi \times \ell}{\sqrt{\frac{Gm}{\ell}}} \]
\[ I \propto \ell^{3/2} \]

32. Given, charge on spherical conducting shell \((q_1) = q\)
Radius of shell \((r_1) = R\)
Second charge \((q_2) = Q\)
Distance of point P from the centre \((r_2) = \frac{R}{2}\)

We known that electrostatic potential at P due to the spherical conductor,
\[ (V_1) = \frac{1}{4\pi\varepsilon_0} \frac{q_1}{r_1} = \frac{1}{4\pi\varepsilon_0} \frac{q}{R} \]

Similarly, electrostatic potential at P due to second charge,
\[ (V_2) = \frac{1}{4\pi\varepsilon_0} \frac{Q}{r_2} = \frac{2Q}{4\pi\varepsilon_0 R} \]

There, net electrostatic potential at P,
\[ V = V_1 + V_2 = \frac{q}{4\pi\varepsilon_0 R} + \frac{2Q}{4\pi\varepsilon_0 R} \]

33. Taking loop ABCDA
\[ V = SIR \]
\[ Req = \frac{V}{6I} = \frac{5IR}{6I} = \frac{5R}{6} \]
34. at (0,0,−a) magnetic field due to wire along x-axis is

\[ B_1 = \frac{\mu_0 I}{2\pi a} \]

due to wire along y-axis

\[ B_2 = \frac{\mu_0 I}{2\pi a} \left(-\hat{j}\right) \]

due to wire along Z-axis

\[ B_3 = 0 \]

\[ B_{\text{net}} = \frac{\mu_0 I}{2\pi a} \left(\hat{j} - \hat{i}\right) \]

36. Points 2 and 3 are equipotential points. Hence, potential difference between points 1 and 2 is the same as that between 1 and 3.

\[ \therefore V = Ed \cos 60^\circ \]

37. Due to symmetry, each particle will have same speed,

\[ E_i = \frac{1}{4\pi \varepsilon_0} \frac{q^2}{r_i} + 0 \]

\[ E_1 = \frac{1}{4\pi \varepsilon_0} \frac{q^2}{r_1} + \frac{1}{2} mv^2 + \frac{1}{2} mv^2 \]

As the field is conservative, hence applying law of conservation of energy,

\[ \frac{1}{4\pi \varepsilon_0} \frac{q^2}{r_1} = \frac{1}{4\pi \varepsilon_0} \frac{q^2}{r_2} + mv^2 \]

\[ \therefore v = q \sqrt{\frac{(r_2 - r_1)}{4\pi \varepsilon_0 mr_1 r_2}} \]

38.

39. \[ B_1 = \frac{\mu_0 I (a/2)}{2\pi a^2} \]

\[ B_2 = \frac{\mu_0 I}{2\pi(2a)} \]

\[ \frac{B_1}{B_2} = 1 \]

40. Tangent galvanometers are connected in series so current will be same in both.

\[ k_1 \tan \theta_1 = k_2 \tan \theta_2 \]

\[ k_1 \tan \theta_2 = 1 \]

\[ k = \frac{R}{N} \] (radius is same for both)

\[ \frac{K_1}{K_2} = \frac{N_2}{N_1} \]

\[ \Rightarrow \frac{N_1}{N_2} = \frac{K_2}{K_1} = \frac{\sqrt{3}}{1} \]

41. Force exerted by an electric dipole on a charge is inversely proportional to the cube of distance of the charge from the centre of the dipole.

\[ F \propto \frac{1}{r^3} \]

\[ \therefore \frac{F}{F'} = \left( \frac{r'}{r} \right)^3 \]

42. Potential difference in the circuit = 24−12 =12 volt. This potential difference is divided among two capacitors \( C_1 \) and \( C_2 \) in the inverse ratio of their capacities (as they are joined in series).

\[ \therefore V_1 = \frac{C_2}{C_1 + C_2} \times 12 = 8 \text{volt} \]

As plate of capacitor \( C_1 \) towards point B will be at + ve potential, hence

\[ V_B - V_A = 8 \text{ volt} \]

43. Current through the wire of 5 ohm

\[ \frac{E}{r + R} = \frac{3}{1 + 5} = 0.5 \text{A} \]

Potential difference across the wire of 5Ω=0.5×5=2.5V. Length of wire = 1 m

\[ \therefore \text{Potential gradient} = 2.5 \text{ V/m} \]

44. \( \bar{B}.\bar{a} = 0 \)

\[ 2x - 6 + 4 = 0 \]

\[ 2x = 2 \]

\[ x = 1 \]

45. \( B_{H} = B \cos \phi \)

\[ \left( B_{H} \right)_1 = \cos 30^\circ = \frac{\sqrt{3}}{2} \]

\[ \left( B_{H} \right)_2 = \cos 45^\circ = 1/\sqrt{2} \]

\[ \left( B_{H} \right)_1 = \frac{\sqrt{3}}{2} \]

\[ \left( B_{H} \right)_2 = \frac{1}{\sqrt{2}} \]
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>91.</td>
<td>NCERT (XII) Pg. # E 29-30, H 30-32</td>
</tr>
<tr>
<td>92.</td>
<td>NCERT (XII) Pg # 23 (E), 25 (H)</td>
</tr>
<tr>
<td>93.</td>
<td>NCERT Pg # 202</td>
</tr>
<tr>
<td>94.</td>
<td>NCERT Pg # 130</td>
</tr>
<tr>
<td>95.</td>
<td>NCERT XII, Page # 42, Para-1</td>
</tr>
<tr>
<td>96.</td>
<td>NCERT XII, Page # 71 fig 5.2</td>
</tr>
<tr>
<td>97.</td>
<td>NCERT XII, Page # 116</td>
</tr>
<tr>
<td>98.</td>
<td>NCERT XII, Page # 43, 45 Para-3</td>
</tr>
<tr>
<td>99.</td>
<td>NCERT XII, Page # 60, Para-2</td>
</tr>
<tr>
<td>100.</td>
<td>NCERT (XII) Pg # 23 (para 1&lt;sup&gt;st&lt;/sup&gt;), H 30 (para 4&lt;sup&gt;th&lt;/sup&gt;)</td>
</tr>
<tr>
<td>101.</td>
<td>NCERT XII, Page # 62, Para-3.4.5</td>
</tr>
<tr>
<td>102.</td>
<td>NCERT (XII) Pg # 23,38 (E), 27,41 (H)</td>
</tr>
<tr>
<td>103.</td>
<td>Module Pg # 181</td>
</tr>
<tr>
<td>104.</td>
<td>Module Pg # 179</td>
</tr>
<tr>
<td>105.</td>
<td>NCERT XII, Page # 22</td>
</tr>
<tr>
<td>106.</td>
<td>Module Pg # 201</td>
</tr>
<tr>
<td>107.</td>
<td>NCERT Pg # 134</td>
</tr>
<tr>
<td>108.</td>
<td>NCERT XII, Page # 77</td>
</tr>
<tr>
<td>109.</td>
<td>NCERT XII, Page # 49, Fig. 3.8(a)</td>
</tr>
<tr>
<td>110.</td>
<td>NCERT XII, Page # 289</td>
</tr>
<tr>
<td>111.</td>
<td>NCERT (XII) Pg # 28 (E), 30 (H)</td>
</tr>
<tr>
<td>112.</td>
<td>NCERT Pg # 128</td>
</tr>
<tr>
<td>113.</td>
<td>NCERT Pg # 128</td>
</tr>
<tr>
<td>114.</td>
<td>Module Pg # 188</td>
</tr>
<tr>
<td>115.</td>
<td>NCERT XII, Page # 52, Fig. 3.11(g)</td>
</tr>
<tr>
<td>116.</td>
<td>NCERT XII, Page # 44, Para-3.2</td>
</tr>
<tr>
<td>117.</td>
<td>NCERT XII, Page # 186,187</td>
</tr>
<tr>
<td>118.</td>
<td>NCERT (XII) Pg # 36 (E), 38(H)</td>
</tr>
<tr>
<td>119.</td>
<td>NCERT Pg # 12</td>
</tr>
<tr>
<td>120.</td>
<td>NCERT Pg # 130</td>
</tr>
<tr>
<td>121.</td>
<td>NCERT Pg # 129</td>
</tr>
<tr>
<td>122.</td>
<td>NCERT XII, Page # 60, Para-2</td>
</tr>
<tr>
<td>123.</td>
<td>NCERT XII, Page # 71</td>
</tr>
<tr>
<td>124.</td>
<td>NCERT (XII) Pg # 31 (E), 33 (H)</td>
</tr>
<tr>
<td>125.</td>
<td>NCERT Pg # 190</td>
</tr>
<tr>
<td>126.</td>
<td>NCERT Pg # 181</td>
</tr>
<tr>
<td>127.</td>
<td>NCERT Pg # 131</td>
</tr>
<tr>
<td>128.</td>
<td>NCERT XII, Page # 51, Para-1</td>
</tr>
<tr>
<td>129.</td>
<td>NCERT XII, Page # 72 &amp; module (3) 194</td>
</tr>
<tr>
<td>130.</td>
<td>NCERT XII, Page # 288</td>
</tr>
<tr>
<td>131.</td>
<td>NCERT Pg # 137</td>
</tr>
<tr>
<td>132.</td>
<td>NCERT Pg # 131</td>
</tr>
<tr>
<td>133.</td>
<td>NCERT Pg # 141</td>
</tr>
<tr>
<td>134.</td>
<td>NCERT Pg # 141</td>
</tr>
<tr>
<td>135.</td>
<td>NCERT XII, Page # 50, Para-3.9</td>
</tr>
<tr>
<td>136.</td>
<td>NCERT Pg # 130</td>
</tr>
<tr>
<td>137.</td>
<td>Module Pg # 181</td>
</tr>
<tr>
<td>138.</td>
<td>NCERT Pg # 141</td>
</tr>
<tr>
<td>139.</td>
<td>NCERT XII, Page # 46, Para-2</td>
</tr>
</tbody>
</table>