	BASIC IDEA	SOLUTION	ANSWER
36.	$\frac{1}{C_{eq}}=\frac{1}{C_1}+\frac{1}{C_2}+...+\frac{1}{C_n}$	capacitors in series.	E
37.	$P=IV=\frac{V^2}{R}$	$1200=\frac{(120)^2}{R}$	C
38.	Gauss' Law	No field within the walls of the conducting shell.	A
39.	$\int_{V_a}^{V_b} dV=-\int_a^b \vec{E}\cdot d\vec{s}$	$\Delta V=-\int_0^5 (ax+b)dx=-\left[a\frac{x^2}{2}+bx\right]_0^5=-[(40)(0.125)+4(0.5)-(0)]=-7 Volts$	B
40.	$\vec{F}=q\vec{v}\times\vec{B}$ $F=ma=m\frac{v^2}{r}$	In order for the positive q to experience a centripetal force the rhr indicates counterclockwise for its motion. $+evB=m\frac{v^2}{r}$ so we have $eBr=mv$	C
41.	vt=distance	$v=\frac{eBr}{m}$ and the distance during one period is $2\pi r$ so we have $\frac{eBr}{m}T=2\pi r$ and then $T=\frac{2\pi m}{eB}$	C
42.	$W=\frac{1}{2}CV^2$	$W=\frac{1}{2}(20\mu)(30)^2=9\times10^{-3}J$	B
43.	Cons. Of Energy $K=\frac{1}{2}mv^2$ $\Delta U=q\Delta V$	$\Delta U+\Delta K=-qV+\frac{1}{2}mv^2=0$; $-eV+\frac{1}{2}m_e v^2=0$ $v=\sqrt{\frac{2eV}{m_e}}$	C
44.	$\oint\vec{B}\cdot d\vec{s}=\mu_o i$	$\oint\vec{B}\cdot d\vec{s}=B2\pi r=\mu_o\frac{\pi r^2}{\pi R^2}I$	B
45.	vector addition of E's	The field caused by the Q is ↗ . That of the -4Q is ↘ . The vector sum is clearly to the right and downward.	E
46.	vector addition of E's $E=\frac{1}{4\pi\varepsilon_o}\frac{Q}{r^2}$	To yield zero they must be in the opposite direction. That rules out the region between the two charges where both fields are to the right. To the right of the -4Q all places are closer to this larger charge so the field is non-zero and to the left. This brings us to A or B. Since one charge is four times as great as the other and the field is a function of the inverse square of the distance, the larger charge must be twice as far away. This gives us A.	A
47.	V=IR $\frac{1}{R_{eq}}=\frac{1}{R_1}+\frac{1}{R_2}+...$ $R_{eq}=R_1+R_2+...$	Since adding a parallel resistor always reduces the equivalent resistance of the parallel resistors below the smallest of them, the total resistance of the circuit is less so the current will increase. In order to double the current the total resistance would have to be half of the original 35Ω or 17.5Ω meaning that the pair would have to be the equivalent of 2.5Ω, where as, from $\frac{1}{R_{eq}}=\frac{1}{20}+\frac{1}{60}$ it is 15Ω.	B
48.	$R=\rho\frac{L}{A}$	$\frac{R_x}{R_y}=\frac{\rho\frac{2L_y}{\pi\left(\frac{2d_y}{2}\right)^2}}{\rho\frac{L_y}{\pi\left(\frac{d_y}{2}\right)^2}}=0.5$	B

49.	$V=\frac{1}{4\pi\varepsilon_o}\frac{q}{r}$ $E=\frac{1}{4\pi\varepsilon_o}\frac{q}{r^2}$ $\varepsilon_o\oint\vec{E}\cdot d\vec{A}=q_{inside}$	Field within the shell is zero (Gauss's Law). Outside the shell not the field weakens with the inverse square so at 2R the field is one fourth as great as it is at R.	C
50.	$\frac{F}{L}=\frac{\mu_o}{2\pi}\frac{I_1 I_2}{d}$	doubling both currents adds a factor of 4 to the right side.	C
51.	$\Phi_B=\vec{B}\cdot\vec{A}$ $\mathcal{E}=-\frac{d\Phi}{dt}$	$A=\pi r^2=\pi(at)^2=\pi a^2t^2$ therefore $\Phi_B=B\pi a^2t^2$. $\mathcal{E}=-\frac{d\Phi}{dt}=-2B\pi a^2 t$	A
52.	V=IR	Add the change in potential from bottom to top for each circuit. Left circuit: -Ir + $\mathcal{E}$ = 10volts. Right circuit: +Ir + + $\mathcal{E}$ = 20volts Adding the two equations gives 2e = 30volts so e = 15volts	C
53.	$\vec{F}=q\vec{v}\times\vec{B}$ $\vec{F}=q\vec{E}$	Because the forces caused by the two fields must be in opposite directions in order to add to zero, and since the force of the magnetic field is perpendicular to the magnetic field and the force of the electric field is in the same line as that of the field, the two fields must be perpendicular.	B
54.	Lenz's Law right hand rule	Induced current opposes the change that caused it. The force on the magnet opposes the withdrawal, that is, the force is to the right. The flux to the right through the loop is decreasing so the induced current will try to maintain it so the magnetic field due to the induced current is to the right as well.	A
55.	$\vec{\tau}=\vec{p}\times\vec{B}$ **or** $\vec{F}=I\vec{\ell}\times\vec{B}$ right hand rule	The torque tends to align the dipole moment with the magnetic field. The force on the top wire is out of the page and on the bottom wire is into the page.	C
56.	if necessary $\frac{1}{R_{eq}}=\frac{1}{R_1}+\frac{1}{R_2}+...$ $R_{eq}=R_1+R_2+\ldots$	The quickest solution is to note that because the 35Ω resistor is in series with the parallel branch the equivalent resistance must be > 35Ω. Because the 60Ω and 20Ω resistors are in parallel their combination must Be < 20Ω. This gives us that the answer is between 35Ω and 55Ω.	D
57.	Symmetry	The field vectors will negate each other for the diametrically opposed pairs.	A
58.	$V=\frac{1}{4\pi\varepsilon_o}\frac{q}{r}$ $\Delta U=q\Delta V$	The potential at the center of the circle is $V=\frac{1}{4\pi\varepsilon_o}\frac{6Q}{R}$ so the potential energy of a sixth charge will be $U=\frac{1}{4\pi\varepsilon_o}\frac{6Q^2}{R}=\frac{3}{2\pi\varepsilon_o}\frac{Q^2}{R}$ so this equals the work required to bring it from "infinity" where the U = 0.	D
59.	$E=-\frac{dV}{dr}$	The field points down slope.	A
60.	$E=-\frac{dV}{dr}$	Where the slope is the greatest, that is, where the equipotential lines are closest together.	B
61.	$W=\Delta U=q\Delta V$	$W=q(V_E-V_C)=-1\mu C(20V-10V)=-10\mu J$	B

62.	alternate statement Faraday's Law of Induction.	$\oint \vec{E} \cdot d\vec{s} = -\frac{d\Phi}{dt}$ ⇦ Rate of change of magnetic flux Line integral of non-electrostatic field	A
63.	$C = \frac{\kappa\varepsilon_o A}{d}$	The equation for the capacitance of a parallel plate capacitor indicates that C will increase if d is decreased.	D
64.	$\frac{F}{L} = \frac{\mu_o}{2\pi}\frac{I_1 I_2}{d}$	The force decreases with distance. Parallel wires with currents in the same direction appear to attract, and those with currents in the opposite direction seem to repel. (See $\vec{F} = I\vec{\ell} \times \vec{B}$ to explain the direction.)	E
65.	free electrons in a metal	In a static situation the charges will move about until the net field in the conductor is zero.	E
66.	$i = \frac{\mathcal{E}}{R}\left(1 - e^{-\frac{Rt}{L}}\right)$	As t → ∞ I approaches 12/6 = 2A	C
67.	V=iR	Since $i = 0$ (see equation in #66) $V_R = 0$ at t = 0.	A
68.	$\varepsilon_o \oint \vec{E} \cdot d\vec{A} = q_{inside}$	Inside the sphere: $\varepsilon_o E 4\pi r^2 = \frac{\frac{4}{3}\pi r^3}{\frac{4}{3}\pi R^3}$ yielding E proportional to r. This fact alone eliminates the other choices.	D
69.	charging by induction	In I the electrons are driven onto the leaves. In II the electrons are allowed to go to ground, so in III the leaves have a net positive charge.	D
70.	The Hall Effect $\vec{F} = q\vec{v} \times \vec{B}$	Negative charge will shift to the left causing the right side to be at a higher potential, since potential is defined in terms of the positive charge.	B