AP2 X4 2015 MG SOLUTIONS

2. E is uniform between charged parallel plates therefore the force on a charge is also uniform between the plates — B

3. The electric field vectors from the two charges point down and to the left (away from the charges) so the resultant field points down and left — C

4. The potential energy of a particle at a location is the potential at that location times the charge. In this case, the potential is $kQ/d + kQ/d = (2kQ/d)$ — D

5. The field lines point away from Y and toward Z making Y positive and Z negative. — D

6. By symmetry $V_R = V_S$ so $\Delta V_{RS} = 0$ and $W = q\Delta V$ — D

7. Since the electron and the proton have equal charge, the forces on them are equal. Since they have different masses, the accelerations, speeds and displacements will not be equal. — E

8. $C_1/C_2 = (\varepsilon_0 A_1/d_1)/(\varepsilon_0 A_2/d_2) = A_1 d_2/A_2 d_1 = s^2(2d)/[(2s)^2 d] = ½$ — B

9. The electric field between charged parallel plates is uniform, which means the potential changes uniformly with distance. For a change of 8 V over 4 cm means the change of potential with position (and the electric field strength) is 2 V/cm, which gives the potential 1 cm away from the 2 V plate as 4 V — D

10. $E = V/d$ — D

11. $\Sigma F = 0$ so we have $T + k(q)(q)/d^2 – Mg = 0$ giving $T = Mg – kq^2/d^2$ — E

12. Resistance of the 2000 Ω and 6000 Ω in parallel = 1500 Ω, adding the 2500 Ω in series gives a total circuit resistance of 4000 Ω. $I_{total} = I_1 = E/R_{total}$ — D

13. I_1 is the main branch current and is the largest. It will split into I_2 and $I_3$and since I_2 moves through the smaller resistor, it will be larger than I_3. — A

14. Use a 1 second time period, the field would decrease to 2.5 T in that time.
Then apply $\varepsilon = \Delta\Phi / t$
$\varepsilon = (BA_f – BA_i) / t$ … $\varepsilon = A (B_f – B_i)$ … $\varepsilon = (0.4)(3 – 2.5) / 1$ — A

15. Since the wire is not cutting across the field lines, there is no force and no charge separation — E

16. Above the wire is a B field which is directed into the page based on RHRcurl. That B field has a decreasing magnitude as you move away from the wire. Loop 1 is pulled up and therefore is loosing flux lines into the page. By Lenz Law current flows to maintain those lines into the page and by RHR–solenoid current would have to flow CW to add lines into the page and maintain the flux. Loop 2 is moving in a direction so that the magnitude of flux lines is not changing and therefore there is no induced current — C

17. As long as the flux inside the loop is changing, there will be an induced current. Since choice E has both objects moving in the same direction, the flux through the loop remains constant so no need to induce a current. E

18. When the switch is closed, the circuit behaves as if the capacitor were just a wire and all the potential of the battery is across the resistor. As the capacitor charges, the voltage changes over to the capacitor over time, eventually making the current (and the potential difference across the resistor) zero and the potential difference across the capacitor equal to the emf of the battery. A

19. See reason #18 B

20. I=Qt, t=d/v, So, $I = \frac{Qd}{v}$ and $v = \frac{Qd}{I} = \frac{\left(1.6x10^{-19}\,C/p\right)\left(10^{9}\,p\right)(1m)}{1.6x10^{-3}}$ C

21. Focus on + charge direction and use RHRcurl and you get into page A

22. In region I, the electric field pushes the negative electron with a force opposite the direction of the E field (out of the page). For the charge to not be pushed out, the magnetic field must create a force into the page to resist this. Based on LHRflat the B field must point up. Then in region II based on how the charge gets pushed, its magnetic force is up initially. Using LHRflat again in region II gives B field direction out of the page. C

23. Charges moving without energy loss have to maintain a constant radius circle. For the circle to decrease in radius, energy would be radiated out from it. Since it's a proton we use RHRflat to get a force pointing up making it follow path B B

24. When moving in a circle at constant velocity, no work is done as explained in FdcosA A

25. Choose 1 proton moving in the circle. For this proton. $F_{net(C)} = mv^2/r$ $F_b = mv^2/r$ C
$qvB = mv^2/r$ $v = qBr/m = 1.6x10^{-19}\,(0.1)(0.1) / (1.67x10^{-27}) \sim 10^{-21} / 10^{-27}$

26. Focus on a single + charge in the wire that gets pushed to the right. So this + charge is moving in a magnetic field pointing into the page with a force directed right, based on RHRflat, the charge must be moving down. E

27. Using RHRcurl, we get into the page C

28. Due to action reaction the forces must be the same. Another way to look at it is that wire A creates the field that wire B is sitting in based on its current I, $B_a = \mu_o I_a / 2\pi R$. The force on wire B is dependent on the field from A, and also the current in wire B itself and is given by $F_b=B_a I_b L$
$F_b = (\mu_o I_a / 2\pi R)\, I_b\, L$. So since both currents from A and B affect each respective force, they should share the same force E

29. Use RHRflat C

30. Based on the axis given. The left side wire is on the axis and makes no torque. The top and bottom wires essentially cancel each other out due to opposite direction forces, so the torque can be found from the right wire only. Finding the force on the right wire … B

$F_b = BIL = (0.05)(2)(0.3) = .03$ N, then torque = Fr = (0.03)(0.3).

31. Pick any small segment of wire. The force should point to the center of the circle. For any small C

segment of wire, use RHRflat and you get velocity direction is CCW. Equation is
$F_{net(C)} = mv^2/r$ … $F_b = mv^2/r$ … $qvB = mv^2/r$ … $v = qBr/m$ … $qvB = mv^2/r$ … $eBr = mv$.

32. First we have … $F_{net(C)} = mv^2/r$ … $F_b = mv^2/r$ … $qvB = mv^2/r$ … $v = qBr/m$ C
Then using $v = 2\pi R / T$ we have $qBr/m = 2\pi R / T$ …

33. Using RHRflat for the magnetic field direction given, the magnetic force would be up (+z). E
To counteract this upwards force on the + charge, the E field would have to point down (– z).