1. B
2. C
3. C
4. C
5. A
6. D
7. D
8. C
9. E
10. B
11. C
12. D
13. D
14. D
15. D
16. B
17. C
18. B
19. E
20. A
21. C
22. C
23. C
24. C
25. E
26. B
27. A
28. B
29. A
30. C

1. B $\frac{1}{2} mv^2=mgh$, $h=\frac{1}{2}gt^2$, solve for t.
2. C C = kappa*epsilon_o*A/d. 2A/2d = 1.
3. C The greatest product of x*y will be its final position. It will still be rolling when it reaches that position because there is no friction on the last segment. The rotational kinetic energy will be 1/3 of its total energy since the rotational inertia of a uniform disk is $(1/2)mR^2$ so it will only reach a final height of 2/3. At this height x is 11/3 and x*y is 22/9.
4. C Q/V is capacitance which is farads.
5. A $r = 1.5R_e$ so $a_g = 10/1.5^2$
6. D 40/9*4 = 160/9, then the mass inside is only $(.75)^3$ as much so 160/9 * 27/64 = 7.5
7. D $4/3*pi*r^3 *rho*k/r^2 \propto r$
8. C inner + inner of outer =0 and inner of outer plus outer of outer = outer
9. E work = q*the integral of E(x)dx from 0 to 2.
10. B ½ r means ¼ Inertia and 4x omega. 4x omega means ¼ time.
11. C each V=kq/r, and each vertex is s/(sqrt3) from the centroid, 6x*k*sqrt3/s
12. D the sphere would contain all the charges so by gauss' law flux=Qin/ε_o
13. D it would be the difference of the potential on the two sphere's which would be Q_1/r_1-Q_2/r_2 where Q is σ*surface area
14. D C=Q/V so Q=CV
15. D 150/(100+50)=1, $1*100-5(1)^2=95$
16. B integral simplifies to kQ/r where r is the distance from a point on the ring to (x,0)
17. C $V_c(t)$=EMF(1-e^(-t/RC)). EMF is 9, R is 1, C is 1. Take the derivative at 2.
18. B max force on top is 40 so net max is 80 but friction on bottom is 80,
19. E $(m/2)v^2$=mgLsin45+1*mgLcos45 L=45/(sqrt2)
20. A Tau = RC, $C = (1/1+\frac{1}{2}+\frac{1}{3})^{-1}=6/11$, R = 2+3=5, RC=30/11
21. C 9V=ir+iR, iR=6, so ir=3, 3V=1Ar, r=3ohms
22. C F=qvB, B=Mu_o*I/(2*pi*r)
23. C $g=10=GM_e/r_e^2$, ⅖ r --> 8/125 the volume and 16/125 the mass. 10*(16/125)/(4/25)=8.
24. C $v_a r_a=v_p r_p$ so 29.25x = 13(2a-x) & a=42.25 now use vis viva v=sqrt(GM(2/r-1/a))
25. E A&B add to $3C_A$, to add that in series with C_C get $C_{eq}=(1/(3C_A)+1/(3C_A))^{-1}=3C_A/2$.
26. B $B=\mu_o I/2\pi r$ and I is I_{tot}*the portion of the area inside the loop=r^2/R^2
27. A mag of emf = dΦ/dt = d(A*Bcosθ)/dt, θ is the angle with the moment of the plane so it will be 0 and we have $d\Phi/dt=B*1*d(\pi R^2)/dt$
28. B torque=B(t)*I(t)*A(t)*sinθ. Take the derivative at 2. sinθ is always 1.
29. A rate of work is P=F*V. $F = GmM/(5r)^2$ & $.5mV^2=GMm/(5r)$ so $P=(2GM/(5r))^{½}*GmM/(25r^2)=(2G^3M^3m^2/3125r^5)^{1/2}$
30. C Fnet/M=a=dv/dt=Mg-bV/M then solve the separable differential equation.