AP Physics — **MC – Energy – Answers** — Mr. McMullen

1. B — Conservation of Energy, $U_{sp} = K$, $\frac{1}{2} kA^2 = \frac{1}{2} mv^2$ solve for v

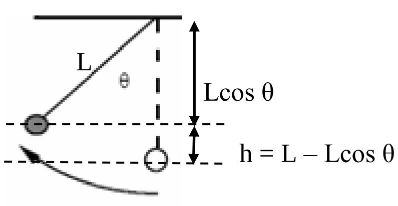
2. A — Constant velocity → $F_{net}=0$, $f_k = Fx = F\cos\theta$ $W_{fk} = -f_k d = -F\cos\theta\, d$

3. A — Try out the choices with the proper units for each quantity.
Choice A … FVT = (N) (m/s) (s) = Nm which is work in joules same as energy.

4. A — Two step problem. Do $F = k\Delta x$, solve for Δx then sub in the $U_{sp} = \frac{1}{2} k\Delta x^2$

5. E — In a circle moving at a constant speed, the work done is zero since the Force is always perpendicular to the distance moved as you move incrementally around the circle

6. A



The potential energy at the first position will be the amount "lost" as the ball falls and this will be the change in potential. $U=mgh = mg(L-L\cos\theta)$

7. D — The work done by friction equals the loss of kinetic energy
$-f_k\, d = \frac{1}{2} mv_f^2 - \frac{1}{2} mv_i^2$ $v_f = 0$, plug in values to get answer

8. E — P = Fd / t. Since there is no distance moved, the power is zero

9. C — $P = F\,d / t$ $= (ma)d / t$ $= (kg)(m/s^2)(m) / (s)$ $= kg\ m^2 / s^3$

10. A — P = Fv, plug in to get the pushing force F and since its constant speed, $F_{push} = f_k$

11. C — Total energy is always conserved so as the air molecules slow and lose their kinetic energy, there is a heat flow which increases internal (or thermal) energy

12. B — Same relationship as above … double the v gives 4x the distance

13. E — Half way up you have gained half of the height so you gained ½ of potential energy. Therefore you must have lost ½ of the initial kinetic energy so $E_2 = (E_k/2)$.
Subbing into this relationship
$$E_2 = (E_k/2)$$
$$\frac{1}{2} mv_2^2 = \frac{1}{2} m v^2 / 2$$
$$v_2^2 = v^2 / 2$$ …. Sqrt both sides gives answer

14. C — Based on $F = k\,\Delta x$. The mass attached to the spring does not change the spring constant so the same resistive spring force will exist, so the same stretching force would be required

15. B — The work done must equal the total gain in potential energy
10 boxes * mgh (25)(10)(1.5) of each

16. E — Since the ball is thrown with initial velocity it must start with some initial K. As the mass falls it gains velocity directly proportional to the time (V=Vi+at) but the K at any time is equal to $1/2\ mv^2$ which gives a parabolic relationship to how the K changes over time.

17. B — To find work we use the parallel component of the force to the distance, this gives $F\cos\theta\ d$

18. E — Only conservative forces are acting which means mechanical energy must be conserved so it stays constant as the mass oscillates

19. D The box momentarily stops at x(min) and x(max) so must have zero K at these points. The box accelerates the most at the ends of the oscillation since the force is the greatest there. This changing acceleration means that the box gains speed quickly at first but not as quickly as it approaches equilibrium. This means that the K gain starts of rapidly from the endpoints and gets less rapid as you approach equilibrium where there would be a maximum speed and maximum K, but zero force so less gain in speed. This results in the curved graph

20. D Two steps. I) use hookes law in the first situation with the 3 kg mass to find the spring constant (k). $F_{sp}=k\Delta x$, $mg=k\Delta x$, $k = 30/.12 = 250$. II) Now do energy conservation with the second scenario (note that the initial height of drop will be the same as the stretch Δx).
U top = U_{sp} bottom, $mgh = ½ k \Delta x^2$, $(4)(10)(\Delta x) = ½ (250) (\Delta x^2)$

21. D Simple application of $F_g=mg$

22. C $F_n = F_{gy} = mg \cos \theta$. Since you are given the incline with sides listed, $\cos \theta$ can be found by using the dimensions of the incline … $\cos \theta$ = adj / hyp = 4/5 to make math simple. This is a good trick to learn for physics problems

23. B As the box slides down the incline, the gravity force is parallel to the height of the incline the whole time so when finding the work or gravity you use the gravity force for F and the height of the incline as the parallel distance. Work = $(F_g)(d) = (20)(3)$

24. D As the object oscillates its total mechanical energy is conserved and transfers from U to K back and forth. The only graph that makes sense to have an equal switch throughout is D

25. A At the top, the ball is still moving (v_x) so would still possess some kinetic energy