1. a) If an object accelerates from rest, the distance it travels is $d = \frac{1}{2}at^2 = \frac{1}{2}\left(\frac{F}{m}\right)t^2$

so d is inversely proportional to m: B travels further.

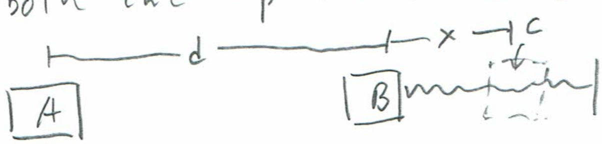
b) $W = \Delta K = K_f - K_i = K_f$ since $K_i = 0$ (at rest).

Also $W = Fd$: since B travels further and F is the same, B will have more KE.

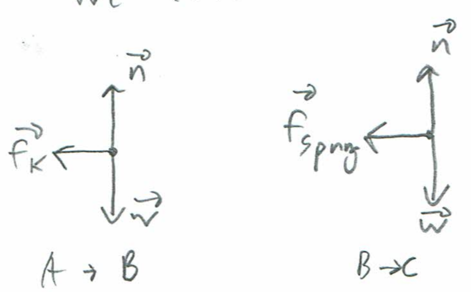
c) $J = \Delta p = p_f - p_i = p_f$ since $p_i = 0$ (at rest)

Also $J = F\Delta t$. this is the same for both, so both end up with the same momentum.

2.



We can write $E_C = E_A + W_{other}$



these are the FBDs. $\vec{n}$ and $\vec{w}$ are perpendicular to $\vec{d}$ so do no work. $\vec{f}_{spring}$ is conservative - we'll account for it using potential energy.

So $W_{other} = W_{f_K}$

since f_K is constant and always opposite $\vec{d}$, $W_{f_K} = -f_K d$
$= -\mu_K mg d$

(I use d since friction acts over distance d. $f_K = \mu_K mg$ here, since $n = w = mg$ from the FBD and $a_y = 0$)

so $E_C = E_A - \mu_K mg d$

$U_C + \cancel{K_C}^{\,0} = \cancel{U_A}^{\,0} + K_A - \mu_K mg d$

(at rest) (Not attached to spring)

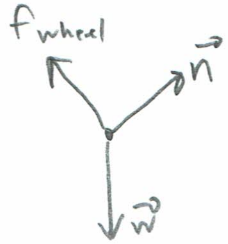
$\frac{1}{2}kx^2 = \frac{1}{2}mv_A^2 - \mu_K mgd$

(24 J) − (4.41 J)

$x = \sqrt{\dfrac{mv_A^2 - 2\mu_K mgd}{k}}$

$= 0.198$ m

3.



$\vec{n}$ is always perpendicular to the path, so does no work. We'll use pot. energy to account for $\vec{w}$. So $W_{other} = W_{wheel} = -f_{wheel} \cdot d$ since the force always opposes motion.

$$E_f = E_i + W_{other}$$

$$U_f + K_f = U_i + \cancel{K_i}^{\,0} - f_{wheel} \cdot d$$

(cat rest)

$$mgh_f + \frac{1}{2}mv_f^2 = mgh_i - f_{wheel}\, d$$

$$v_f = \sqrt{\frac{2(mg(h_i - h_f) - f_{wheel} \cdot d)}{m}} = \overset{9.62}{\cancel{6.80}} \text{ m/s}$$

4. Momentum is conserved in any collision.

$$P_f = P_i$$

$$P_{Gf} + P_{Pf} = P_{Gi} + P_{Pi}$$

$$m_G v_{Gf} + m_P v_{Pf} = m_G v_{Gi} + m_P v_{Pi}$$

$$\Rightarrow \quad v_{Gf} = \frac{m_G v_{Gi} + m_P v_{Pi} - m_P v_{Pf}}{m_G} = 0.4 \text{ m/s}$$