1. $V_{y0} = 0$ in both cases
Vertical motion independent of horizontal.

same time

2. $\Delta x = V_0 t + \frac{1}{2} a t^2$

$= \frac{1}{2} \cdot 4 \cdot t^2$

$= 5\,t^2$

$\Rightarrow 2 = t^2$

$t = 5\,s$

3. $\Delta x = V_x \cdot t = 10$

$= 10 \cdot t \Rightarrow t = 1\,s$

$\Delta y = \frac{1}{2} a_y t^2$

$= \frac{1}{2} a_y = 10$

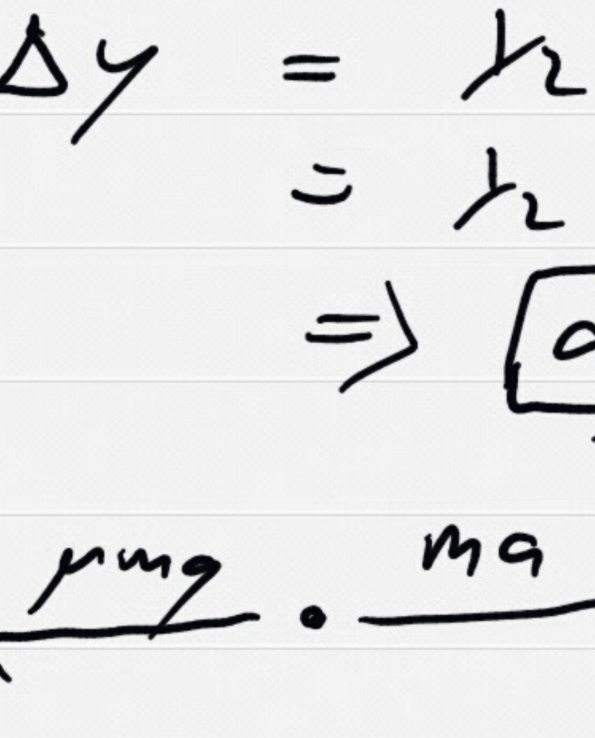
$\Rightarrow a_y = 20\,m/s^2$

4. $\leftarrow \mu mg \quad \bullet \quad ma \rightarrow$

$\mu g > a$

$\Rightarrow a < 2\,m/s^2$

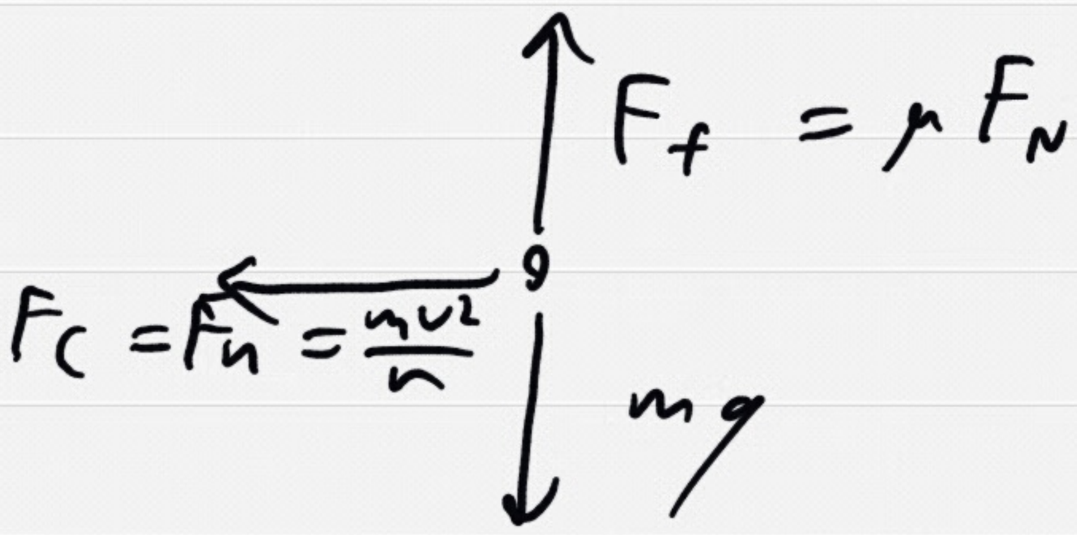
5.



$T = mg \sin\theta$

$N = mg \cos\theta$

6.



7. $W = F \Delta x \cos\theta$

$W_D > 0$, $W_G < 0$

$W_{net} = 0$ since $\Delta KE = 0$

8. $W = F \Delta x \cos\theta = \Delta KE$

$-10 \cdot 4 = -\frac{1}{2} \cdot 0.2 \cdot v^2$

$-40 = -0.1 v^2$

$400 = v^2$

$\boxed{v = 20 \text{ m/s}}$

9. Want $p_{tot} = 0$

$= m_p v_{xp} + m_c v_{xc}$

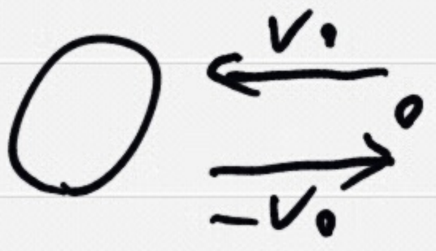
$= 50 \cdot v_{xp} + 10 \cdot (-10)$

$= 0$

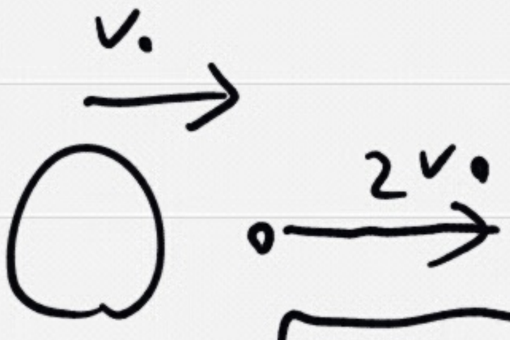
$\Rightarrow 50 v_{xp} = 100$

$\boxed{v_{xp} = 2 \text{ m/s}}$

10. In center of mass frame



In rest frame



$\boxed{20 \text{ m/s}}$

11.

12. $W = \Delta KE$

$\tau \Delta\theta = \Delta(\frac{1}{2} I \omega^2)$

$-50 \cdot \Delta\theta = -\frac{1}{2} \cdot 100 \cdot 10^2$

$= -5000$

$\boxed{\Delta\theta = 100 \text{ rad}}$

13. Treat board as point mass @ CM

$\tau_{board} = (x_{max} - 5) \cdot 10$ CCW

$\tau_{mass} = (10 - x_{max}) \cdot 2.5$ CW

$(x_{max} - 5) \cdot 10 = (10 - x_{max}) \cdot 2.5$

$10 x_{max} - 50 = 25 - 2.5 x_{max}$

$12.5 x_{max} = 75$

$\boxed{x_{max} = 6 \text{ m}}$

14. $v_m = A\sqrt{k/m} = A\sqrt{16/4} = 2A$

$= 2 \Rightarrow \boxed{A = 1 \text{ m}}$

15. $F_B = W_{disp} = \rho_f \cdot Vol \cdot g$

$= (\rho_{B/2}) \cdot Vol \cdot g$

$= mg/2 = 10 \text{ N}$

water exerts F_B up

so equal force exerted down

scale E $\boxed{\text{increases by } 10 \text{ N}}$

16. $A_1 v_1 = A_2 v_2$

$4 \cdot 2 = 1 \cdot v_2$

$\boxed{v_2 = 8 \text{ m/s}}$

17. $\Delta L = \alpha L_0 \Delta T$

$.001 = 1 \times 10^{-5} \cdot 10 \cdot \Delta T$

$10^{-3} = 10^{-4} \Delta T$

$\boxed{\Delta T = 10^\circ C}$

18. Heat exchanged is equal
Given heat changes T
of water less. Final
T $\boxed{\text{closer to water.}}$

19. $PV = nRT = \text{const.}$ so $\langle KE \rangle = \text{const.}$

$P_0 V_0 = P_f V_0/2$

$P_f = 2P_0$

$\boxed{\text{collisions increase}}$

20. $P_2 = P_1 + \rho g d$

$= 10^5 + 1000 \cdot 10 \cdot 40$

$= 5 \times 10^5 = 5 P_1$

$PV = nRT = \text{const.}$

$P_2 V_f = P_1 V_0$

$V_f = P_1 V_0 / P_2 = V_0/5 = \boxed{.04 \text{ m}^3}$

21. $\Delta U = \Delta U_{food} + Q - W$

$= 38000 - 13000 - W$

$= 0$

$\boxed{W = 25{,}000\ J}$

22. Same ΔU on either path

$\Delta U_{ab} = 0$ since $T = const.$

$\Delta U_{bc} = -10\ J$ since $W = 0$

$\Delta U_{abc} = \Delta U_{ac} = \boxed{-10\ J}$

23. $Q = nC\Delta T$

$C = C_p = 5/2\,R$

$Q = 5/2\,nR\Delta T$

$W = nR\Delta T$

$W/Q = nR\Delta T / 5/2\,nR\Delta T$

$= 1/5/2 = 2/5 = \boxed{0.4}$

24. Need $C_s = C_{s0}/4$

but $C_s = \sqrt{\frac{\gamma kT}{m}}$

So $\sqrt{\frac{\gamma kT}{m}} = \sqrt{\frac{\gamma kT_0}{m}} / 4$

or $\frac{\gamma kT}{m} = \frac{\gamma kT_0}{m} \cdot \frac{1}{16}$

$T = T_0 / 16$

$= \boxed{20\ K}$