1. Travels east and slows down

$\overleftarrow{a}$ $\overrightarrow{v}$

2. $a = \frac{V_f - V_i}{\Delta t} = \frac{70 - 0}{10} = 7\ m/s^2$

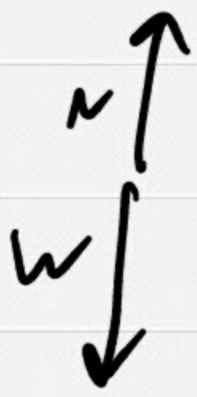
$\langle v \rangle = \frac{\Delta x}{\Delta t} = \frac{\frac{1}{2} a t^2}{t} = \frac{1}{2} a t$

$= \boxed{35\ m/s}$

3. $E = mgh + \frac{1}{2} m v^2 = \text{const.}$

since v^2 doesn't depend on direction, $\boxed{V_f = 30\ km/s}$ for any direction.

4.

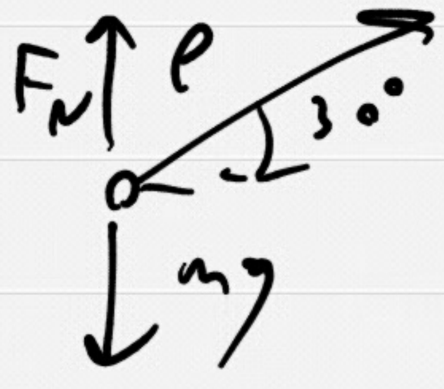


$F_{net} = F_c = \frac{mv^2}{r} = N - w > 0$

$\Rightarrow \boxed{N > w}$

5. $f = \mu F_N$

so to increase friction force we must increase normal force



$F_N + P \sin\theta = mg$

so we need to $\boxed{\text{decrease } P}$

6. $f = \mu F_N = 0.25 F_N$

$= 0.25 mg$

$W_{net} = \Delta KE$

$= 0 - \frac{1}{2} m v_i^2$

$= -\frac{1}{2} m \cdot 10^2$

$= -50 m$

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

$= -f \Delta x$

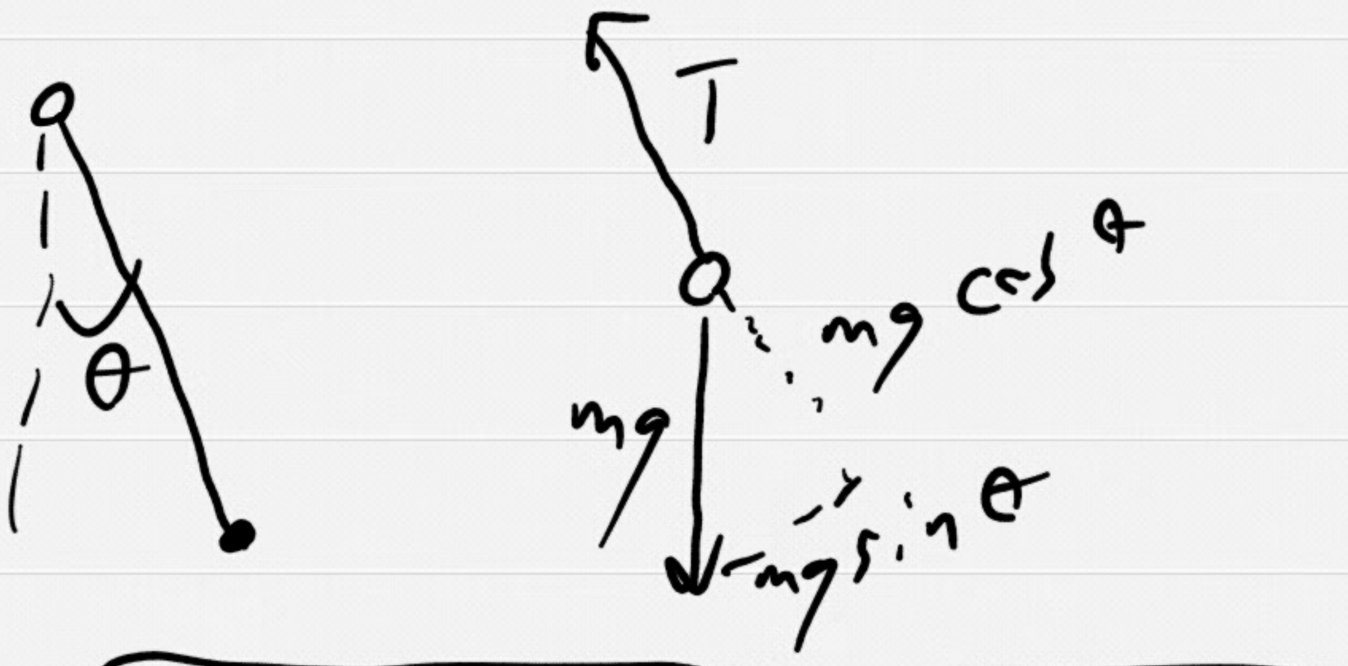
$= -0.25 mg \Delta x = -2.5 m \Delta x$

$-2.5 m \Delta x = -50 m$

$\Delta x = -50 / -2.5$

$\boxed{\Delta x = 20 m}$

7.



$\boxed{|\overline{T}| = mg \cos\theta}$

8. $v_{iy} = v_i \sin 30^\circ$

$= v_i \cdot \frac{1}{2} = 10 \text{ m/s}$

$v_{fy}^2 = v_{iy}^2 + 2a \Delta y = 0$

$= 10^2 - 2gh = 10^2 - 20h$

$\Rightarrow 100 = 20h \Rightarrow \boxed{h = 5m}$

9. $\Delta p_{rubber} \sim 2 \cdot \Delta p_{putty}$

so force by rubber ball is twice that of putty ball

10. $p_{1i} + p_{2i} = p_{1f} + p_{2f}$

$30 \cdot 4 + 0 = 30 \cdot v_f + 10 \cdot v_f$

$120 = 40 v_f$

$\boxed{v_f = 3 \text{ km/s}}$

11. 1. $\tau = 3m$ CW

2. $\tau = 4m - m = 3m$ CW

3. $\tau = 3m - m = 2m$ CW

4. $\tau = 3m + 2m - m = 4m$ CW

$\boxed{\tau_4 \text{ is largest}}$

12. $\omega^2 = \omega_0^2 + 2\alpha\Delta\theta$

$= 0 + 2 \cdot 1 \cdot 8$

$= 16$

$\Rightarrow \boxed{\omega = 4 \text{ rad/s}}$

13. $I = mr^2$

$KE = \frac{1}{2} I \omega^2 = \frac{1}{2} m r^2 \omega^2$

$= \frac{1}{2} \cdot 1 \cdot 0.5^2 \cdot 20^2$

$= 50 \text{ J}$

$W = \Delta KE = \tau \Delta\theta = -10 \cdot \Delta\theta$

$-10\Delta\theta = -50 \Rightarrow \boxed{\Delta\theta = 5 \text{ radians}}$

14. $E = KE + PE = \text{const.}$

$= 3 + 2$

$= 5\ J$

(c) $-X_m$, $E = PE = \boxed{5\ J}$

15.

$F_B = m_f g$

$= \rho_f (2/3 V) g$

$F_W = m_b g$

$= \rho_b V g$

$\rho_f \cdot 2/3 \cdot g = \rho_b \cdot V g$

$\boxed{\rho_b = 2/3\ \rho_f}$

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

neglect atmosphere

$P_2 = \rho g d = 1000 \cdot 10 \cdot 1000$

$= 10^7 P_a$

$F = PA = \boxed{10^8\ N}$

Note correct area of $10\ m^2$ and depth of $1\ km$.

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

$\Delta L = \alpha \Delta T L$

$= 1 \times 10^{-5} \cdot 40 \cdot 10^5$

$= \boxed{40 \text{ cm}}$

18. $Q_w = mc\Delta T$

$= 1 \cdot 1 \cdot 100 = 100 \text{ J}$

$Q_i = 1 \cdot 0.5 \cdot 100 = 50 \text{ J}$

$Q_{melt} = mL$

$= 1 \cdot 80 = 80 \text{ J}$

$Q_{vaporize} = 0.1 \cdot 500 = 50 \text{ J}$

$\boxed{Q_w \text{ greatest}}$ (heat water)

19. $PV = nRT$

so $T_0 = P_0 V_0 / nR$

$T_1 = 2P_0 \cdot V_0/4 / nR$

$= P_0 V_0 / 2nR$

$= T_0 / 2$

$T_0 = 300 \text{ K}$

so $T_1 = 150 \text{ K}$

$= \boxed{-123^\circ C}$

20. $P_0 = P_1 + \rho g d$

$= 10^5 + 1000 \cdot 10 \cdot 20$

$= 10^5 + 2 \times 10^5$

$= 3 \times 10^5$

$P_1 V_1 = P_0 \cdot V_0$

$10^5 \cdot V_1 = 3 \times 10^5 \cdot 0.02$

$V_1 = 3 \cdot 0.02$

$= \boxed{0.06\ m^3}$

21. $\Delta U = -2200\ J$

$= Q - W$

$= Q - 1100\ J$

$Q = -2200 - (-1100)$

$= \boxed{-1100\ J}$

22. On isotherm $U = const.$

so $\Delta U_{ab} = 0$

on adiabat $Q = 0$

so $\Delta U = -W$

$\Delta U_{bc} = -4\ J$

$\Delta U = \Delta U_{ab} + \Delta U_{bc} = \boxed{-4\ J}$

23. $eff. = W / Q_H$

$= mgh / Q_H$

$= 2 \cdot 10 \cdot 2 / 200$

$= 40 / 200$

$= 1/5 = \boxed{0.20}$

24. $PV = nRT$

$\Rightarrow T_0 = P_0 V_0 / nR$

$T_1 = P_0 V_0/2 / nR$

$= T_0/2$

$V_s = \sqrt{\frac{\gamma kT}{m}}$

So $\frac{V_{s1}}{V_{s0}} = \frac{\sqrt{\frac{\gamma k T_1}{2}}}{\sqrt{\frac{\gamma k T_0}{2}}} = \sqrt{\frac{T_1}{T_0}}$

$= \boxed{1/\sqrt{2}}$