Energy 4

① $k = 50\ N/m$

$\Delta E_K = -\Delta E_S$

$\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 = -\left(\frac{1}{2}kx_f^2 - \frac{1}{2}kx_i^2\right)$

$\frac{1}{2}mv_f^2 = -\left(-\frac{1}{2}kx_i^2\right)$ $\quad v_i = 0$ and $x_f = 0$

$\frac{1}{2}mv_f^2 = \frac{1}{2}kx_i^2$

$(0.4)v_f^2 = (50)(0.2)^2$

$v_f = \boxed{2.24\ m/s}$

② This is essentially the same as question 1, so we can skip to the end.

$mv_f^2 = kx_i^2$

$(0.01)v_f^2 = (500)(0.05)^2$

$v_f = \boxed{11.2\ m/s}$

③ This is similar to question 1, but $x_f = 0.02\ m$.

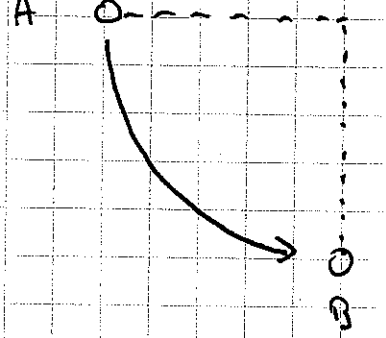
$\frac{1}{2}mv_f^2 = -\left(\frac{1}{2}kx_f^2 - \frac{1}{2}kx_i^2\right)$

$\frac{1}{2}mv_f^2 = \frac{1}{2}kx_i^2 - \frac{1}{2}kx_f^2$

$(3)\ v_f^2 = (350)(0.12)^2 - (350)(0.02)^2$

$v_f = \boxed{1.28\ m/s}$

④



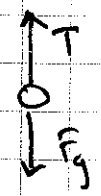
a) $E_A = E_B$

$\cancel{m}gh_A = \frac{1}{2}\cancel{m}v_B^2$

$(9.8)(5) = \frac{1}{2}v_B^2$

$v_B = \boxed{9.9 \text{ m/s}}$

b)



$\Sigma F = T - F_g$

$\frac{mv^2}{r} = T - mg$

$T = mg + \frac{mv^2}{r}$

$= (1)(9.8) + (1)\frac{(9.9)^2}{5}$

$T = \boxed{29.4 \text{ N}}$

⑤ $\Delta E_K = -\Delta E_g$

$\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 = -(mgh' - mgh)$

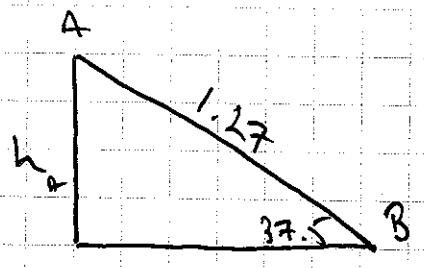
$\frac{1}{2}mv_f^2 = -(-mgh)$ $\quad v_i = 0$ and $h' = 0$

$\frac{1}{2}\cancel{m}v_f^2 = \cancel{m}gh$

$\frac{1}{2}v_f^2 = (9.8)(6.46)$

$v_f = \boxed{11.25 \text{ m/s}}$

⑥



$\sin 37.5 = \frac{h}{1.27}$

$h_A = 1.27 \sin 37.5 = 0.773$ m

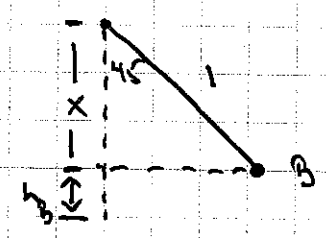
$E_A = E_B$

$mgh_A = \frac{1}{2}mv_B^2$

$(9.8)(0.773) = \frac{1}{2}v_B^2$

$v_B = \boxed{3.89 \text{ m/s}}$

⑦



$\cos 45 = \frac{x}{1}$

$x = \cos 45$

$x = 0.707$ m

$x + h_B = 1$

$h_B = 1 - x$

$= 1 - 0.707$

$h_B = 0.293$ m

$E_A = E_B$

$mgh_A = \frac{1}{2}mv_B^2 + mgh_B$

$(9.8)(1) = \frac{1}{2}v_B^2 + (9.8)(0.293)$

$9.8 = \frac{1}{2}v_B^2 + 2.87$

$\frac{1}{2}v_B^2 = 6.93$

$v_B^2 = 13.859$

$v_B = \boxed{3.72 \text{ m/s}}$

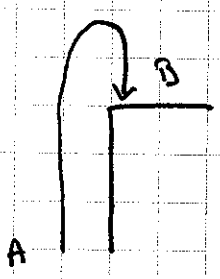
(8) $E_{rest} = E_{0.5}$

$mgh = \frac{1}{2}mv^2 + mgh'$

$(9.8)(3.08) = \frac{1}{2}v^2 + (9.8)(0.5)$

$v = \boxed{7.11 \text{ m/s}}$

(9)



$E_A = E_B$

$\frac{1}{2}mv_A^2 = \frac{1}{2}mv_B^2 + mgh_B$

$\frac{1}{2}(12.3)^2 = \frac{1}{2}v_B^2 + (9.8)(5.42)$

$75.645 = \frac{1}{2}v_B^2 + 53.116$

$\frac{1}{2}v_B^2 = 22.529$

$v_B = \boxed{6.71 \text{ m/s}}$

(10) $E_A = E_B$

$mgh_A = \frac{1}{2}kx_B^2$

$(0.75)(9.8)(0.552) = \frac{1}{2}k(0.0264)^2$

$4.0572 = 0.00034848\,k$

$k = \boxed{11\,643 \text{ N/m}}$

(11) c) Point B

$E_A = E_B$

$mgh_A = mgh_B + \frac{1}{2}mv_B^2$

$(9.8)(10) = (9.8)(3) + \frac{1}{2}v_B^2$

$v_B = \boxed{11.7 \text{ m/s}}$

Point C

$E_A = E_C$

$mgh_A = mgh_C + \frac{1}{2}mv_C^2$

$(9.8)(10) = (9.8)(6) + \frac{1}{2}v_C^2$

$v_C = \boxed{8.9 \text{ m/s}}$

Point D

$E_A = E_D$

$mgh_A = mgh_D + \frac{1}{2}mv_D^2$

$(9.8)(10) = (9.8)(5) + \frac{1}{2}v_D^2$

$v_D = \boxed{9.9 \text{ m/s}}$

(11) b) $\Sigma W = \Delta E_K$

$\Sigma F \cdot d = 0 - \frac{1}{2} m v_i^2$

$ma \cdot d = -\frac{1}{2} m v_i^2$

$a(30) = -\frac{1}{2}(9.9)^2$

$a = \boxed{-1.63 \text{ m/s}^2}$