PR 4 Energy

Black 13 Blank + Blue 19
Blue 6
Red 3
Total 22

1) A ✓

2) $W = \frac{1}{2}m(v_f^2 - v_0^2)$

$= \frac{1}{2}(4kg)(6\frac{m}{s}^2 - 3\frac{m}{s}^2)$

$= 54\,J$ (B) ✓

3) $PE_g = mgh$ (B) ✓

4) $W = 0$; $\perp$ (C) ✓

5) $W = -\Delta PE = -mgh = -(2kg)(10)(1.5)$

$= -30\,J$ (A) ✓

6) $\frac{1}{2}mv_f^2 = mgl\sin\theta$

$v_f = \sqrt{2gl\sin\theta}$

$= \sqrt{2(10\frac{m}{s^2})(6m)(\frac{1}{2})}$ ✓

$= \sqrt{60}\frac{m}{s} = 7.7\frac{m}{s}$ (B)

7) $mgh = \frac{1}{2}mv_f^2 - \mu mg\cos\theta l$

$v_f^2 = \sqrt{2gh + 2\mu g\cos\theta l}$

$= \sqrt{2(10)(6\sin 60) + 2(0.3)(10)(6m)}$

$= 13.4\,m/s$ (C)? × E

8) $\frac{1}{2}mv_f^2 = mgh - (20N)40m$

$v_f^2 = 2gh - \frac{20N \cdot 40m \cdot 2}{m}$

$v_f = 20\,m/s$ (E) ✓

9) $mgh_0 = \frac{1}{2}mv_m^2 + mg\frac{1}{2}h_0 = \frac{1}{2}mv_f^2$

$2gh_0 = v_m^2 + gh_0 = v_f^2$

✓ $v_m^2 = 2gh_0 - gh_0$ $\quad v_f^2 = 2gh_0$

(E)/(C) $v_m^2 = gh_0$ $\quad v_m^2 = \frac{1}{2}v_f^2$ $\quad v_m = \frac{\sqrt{2}}{2}v_f$

10) $P = \frac{W}{t} = F \cdot v\cos\theta = Fv = 400W$ (D) ✓

FRQ

1) A) $mgH = \frac{1}{2}v_m^2 + \frac{1}{2}mgH$

$v^2 = gH$

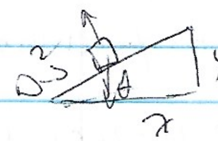
$v = \sqrt{gH}$ ✓

B) $v_f = \sqrt{2gH}$ ✓

C) $mgH = \mu mg x$

$\mu = \frac{H}{x}$ ~

d) $mgH = mgy + \mu mg x\cos\theta$



Dividing $H = y + \mu x\cos\theta$

$= y + \mu x \frac{x}{\sqrt{x^2+y^2}}$

$= y + \mu \frac{x^2}{\sqrt{x^2+y^2}}$

$\mu = \frac{H - y\sqrt{x^2+y^2}}{x^2}$ ~

e) $mgH = \frac{1}{2}mv_f^2 + W_f$

$mgH = \frac{1}{2}m\left(\frac{1}{2}\sqrt{2gH}\right)^2 + W_f$

$mgH = \frac{1}{8}m \cdot 2gH + W_f$

$W_f = mgH\left(1 - \frac{1}{4}\right)$

$W_f = \frac{3}{4}mgH$

dissipates energy 3

2) A) $\cancel{m}gH = \cancel{m}gr + \frac{1}{2}\cancel{m}v_c^2$

$v_c^2 = 2gH - 2gr$

$a_c = \frac{v_c^2}{r} = \frac{2gH}{r} - 2g = 2g\left(\frac{H}{r} - 1\right)$

B) $mgH = mgl + \frac{1}{2}mv^2$

$l = r + r\sin(\theta - 90)$

$h = r\sin\theta$

$= r(1 - \cos\theta)$

$\cancel{m}gH = \cancel{m}g\, r(1-\cos\theta) + \frac{1}{2}\cancel{m}v^2$

$2gH - 2gr(1-\cos\theta) = v^2$

$v = \sqrt{2g(H - r(1-\cos\theta))}$

C) $\frac{1}{2}\cancel{m}v_b^2 = \cancel{m}g2r$

$v_b^2 = 4gr$

$v = 2\sqrt{gr}$

d) $mgH = mg2r$

$H = 2r$

e) $\cancel{mg}6r = \mu\cancel{mg}l$

$l = \frac{6r}{\mu}$ $\quad \frac{.6r}{\mu} = 12r?$

2

3) $y(x_3) - y(x_2) = y(x_2) - y(x_1)$

$x_3 - x_2 = x_2 - x_1$

$2x_2 = x_3 + x_1$??

4) $W = F \cdot d = (3x+5)x$

$= 3x^2 + 5x$

$= 3(4^2) + 5(4) = 16 \cdot 3 + 20$

$= 68\ J$

$\frac{1}{2}mv_f^2 = 68\ J$

$\Delta v = \sqrt{\frac{2 \cdot 68}{m}}$

$= \sqrt{\frac{136}{6}}$

$= 4.7\ \frac{m}{s}$

$v_f = 4.7\ \frac{m}{s}$

1) d) $mgH = mgy + \mu N l$

$= mgy + \mu mg\cos\theta\, l$

$x = l\cos\theta$

$H = y + \mu x$

$\mu = \frac{H - y}{x}$

1) c) is the solution using the same thing as the problem?

2) c) $F_c = \frac{mv^2}{r} = mg$

$v = \sqrt{rg}$

2) d) $PE_0 + KE_0 = PE_f + KE_f$

$mgh_0 = mg2r + \frac{1}{2}mv_c^2$

2

$mgh_0 = mg2r + \frac{1}{2}mv_c^2$

$\cancel{m}gh_0 = \cancel{m}g2r + \frac{1}{2}\cancel{m}gr$

$\boxed{h_0 = \frac{5}{2}r}$ ✓

3) at x_1 & x_3, $\frac{dU}{dx} = 0$

a) $\frac{dU}{dx} = -3(x-3)^2 + 3 = 0$

$(x-3)^2 = 1$

$x - 3 = \pm 1$

$x = 2, 4$

$x_1 = 2 \quad x_3 = 4$ ✓

b) E_2 is between E_1 and E_3, which means it's inbetween x_1 and x_3

if U is a function of x, U is directly proportional to its height, but energy is conserved. we assume it comes in the form of kinetic energy. ~

It is higher than at x_1, but faster than at x_3.

c) $U(x_1) = 3(1) - (-1)^3$

$= 4\ J$ PE

$KE = 54\ J = \frac{1}{2}mv^2$

$v = \sqrt{\frac{2(54\ J)}{3\ kg}} = 6\ m/s$ ✓ 3

d) $U = mgh \quad KE = \frac{1}{2}mv_f^2$

$E_{total} = mgh + \frac{1}{2}mv^2$ ~

e) $x = 1 \quad E = E_3 = 58\ J$

$U_3 = 3(3) - (1)^3 = 8\ J$

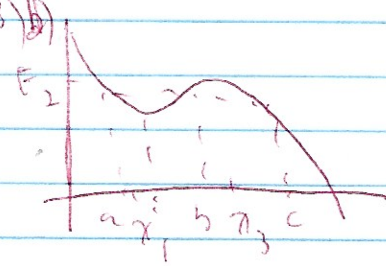
$mgh_0 + \cancel{\frac{1}{2}mv_0^2} = mgh_f + \frac{1}{2}mv_f^2$

$8\ J + \ldots$

$= 4\ J + \frac{1}{2}mv_f^2$

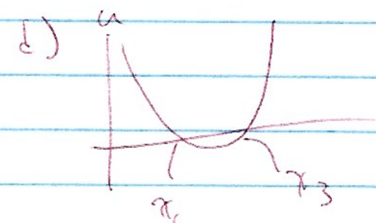
$v_f = \sqrt{\frac{8\ J}{m}} = \sqrt{\frac{8}{3}} = \boxed{1.63\ m/s}$ ✓ 1

3) b)



the obj. oscillates b/w a & b ✓

d)



✓

MC 7) $\cancel{KE_0} + PE_0 + W_f = KE_f + \cancel{PE_f}$

$mgh - F_f l = \frac{1}{2}mv_f^2$

$mgl\sin\theta - \mu mg\cos\theta\, l = \frac{1}{2}mv_f^2$

$v_f = 9.2\ m/s$ (c) ✓

3