A

Student #1 [redacted] D# [redacted] Section # [redacted]

Problem 3

To raise money for a University scholarship fund, the new IT dean has volunteered to bungee jump from a crane if contributions can be found for 10 scholarships. To add some interest, the jump will be made from 42m above a pool of water. A 30m bungee cord would be attached to the dean. First you must convince the dean that your plan is safe for a person of his mass, 70kg. The dean knows that as the bungee cord begins to stretch, it will exert a force which has the same properties as the force exerted by a spring. Your plan has the dean stepping off a platform and being in free fall for 30m before the cord begins to stretch.

(a) Determine the spring constant of the bungee cord so that it stretches only 12m, which will just keep the dean out of the water. (Assume that the dean is a point-like object).

(b) Using the result of (a), find the dean's speed 7m above the water.

apply second law:

$F = ma = RX - mg$

Because the system has no acceleration at the bottom of the jump:

$0 = RX - mg$

$mg = RX$

$R = \frac{mg}{X} = 52.225\ N/m$

a) 52.225 N/m

$h_1 = 42m$
$h_2 = 7m$
$d = 12m$

$mgh_1 = \frac{1}{2}Rd^2 = \frac{1}{2}R(d-7)^2 + mgh_2 + \frac{1}{2}mv^2$

$mgh_1 = \frac{1}{2}R\cdot 25 + mgh_2 + \frac{1}{2}mv^2$

$2mg(h_1 - h_2) = 25R + mv^2$

$\frac{2mg(h_1-h_2) - 25R}{m} = v^2$

$V = \sqrt{\frac{2mg(h_1-h_2) - 25R}{m}}$

b) V= 25.847

A

Student #2

ID# [redacted] Section # [redacted]

[redacted]

Problem 3

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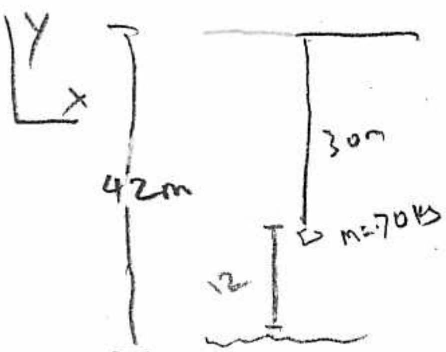
(b) Using the result of (a), find the dean's speed 7m above the water.

(a)



V_f at 30m

1) $V_f^2 = V_0^2 + 2ax$

$V_f^2 = 0 + 2(9.8)(30)$

$V_f = \sqrt{588} = 24.25 \, m/s$

cons. of energy

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

$\sqrt{kx^2} = \sqrt{2mgh + mv_i^2}$

$kx = \frac{\sqrt{2mgh + mv^2}}{x}$

$k = \frac{\sqrt{2mgh + mv^2}}{x}$

k? 12m

$k = \frac{\sqrt{2(70)(9.8)(12) + 70(24.25)^2}}{12}$

$k = 20 \, N/m$

(b) Cons of energy

$mgh = \frac{1}{2}mv_f^2 + \frac{1}{2}kx^2$

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

$\sqrt{\frac{2mgh - kx^2}{m}} = V_f$

$V_f = \sqrt{\frac{2(70)(9.8)(42) - (20)(35)^2}{70}}$

$V_f = 21.75 \, m/s$

A

Student #3 [redacted] # [redacted] Section # [redacted]

Problem 3

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(a) Determine the spring constant of the bungee cord so that it stretches only 12m, which will just keep the dean out of the water. (Assume that the dean is a point-like object).

(b) Using the result of (a), find the dean's speed 7m above the water.

$F_T = kx$ $\quad F_T = F_g$

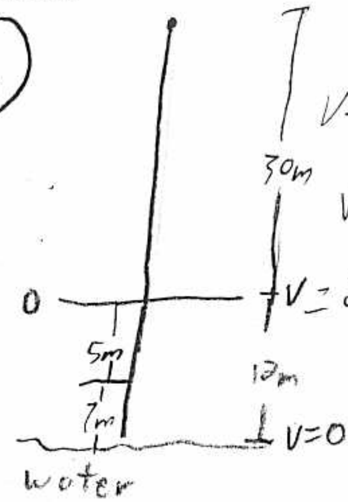
$F_{g\,Dean} = mg$ $\quad kx = mg$

$k\,12 = 70g$

$k = \frac{70g}{12m}$

a) $k = 57.23 \frac{N}{m}$

b)



$v = \sqrt{2gy}$

$v = \sqrt{60g}$

$v = 24.26 \frac{m}{s}$

$v_f^2 = v_0^2 + 2ay$

$0 = 588.6 + 24a$

$a = -24.5 \frac{m}{s^2}$

$v_f^2 = 588.6 - 245.25$

$v_f = 18.53 \frac{m}{s}$ 7m above the water

A

Student #4 [redacted] Section # [redacted]

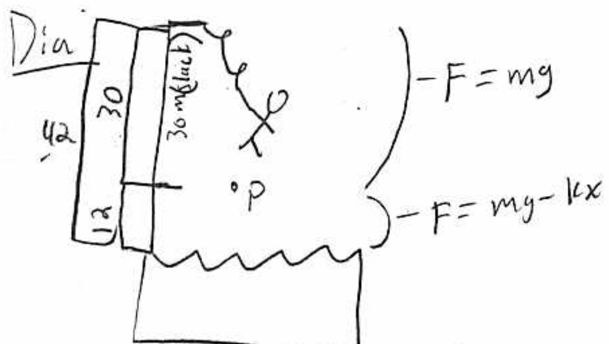
Problem 3

To raise money for a University scholarship fund, the new IT dean has volunteered to bungee jump from a crane if contributions can be found for 10 scholarships. To add some interest, the jump will be made from 42m above a pool of water. A 30m bungee cord would be attached to the dean. First you must convince the dean that your plan is safe for a person of his mass, 70kg. The dean knows that as the bungee cord begins to stretch, it will exert a force which has the same properties as the force exerted by a spring. Your plan has the dean stepping off a platform and being in free fall for 30m before the cord begins to stretch.

(a) Determine the spring constant of the bungee cord so that it stretches only 12m, which will just keep the dean out of the water. (Assume that the dean is a point-like object)

(b) Using the result of (a), find the dean's speed 7m above the water.

Dia



Physics:
energy

Variables:
$h_{tot} = 42$
$D = 7$
$m = 70$

equ^n:
$U_{pot} = Mgh$
$U_{kine} = \frac{1}{2}mv^2$
$U_{spring} = \frac{1}{2}kx^2$

manipulate:
$U_{sys} = Mgh$
@ water surface

$Mgh = \frac{1}{2}kx^2$

$k = \frac{2Mgh}{x^2}$

$k = \frac{2(70)(9.8)(42)}{(12)^2}$

$k = 400$

Part B: Potential = spring + kinetic + potential

$mgh = \left(\frac{1}{2}kx^2\right) + \left(\frac{1}{2}mv^2\right) + (mgd)$

$\frac{1}{2}mv^2 = mgh - \frac{1}{2}kx^2 - mgd$

$V = \sqrt{\frac{2(mgh - \frac{1}{2}kx^2 - mgd)}{m}}$

$V = \sqrt{\frac{2(70 \cdot 9.8 \cdot 42 - \frac{1}{2}(400)5^2 - 70 \cdot 9.8 \cdot 7)}{70}}$

$V = 23.31 \frac{m}{s}$

analysis,
this answer is reasonable seeing as his velocity @ point P was 24.25

Student # 5 D# [redacted] [redacted] Section # [redacted] A

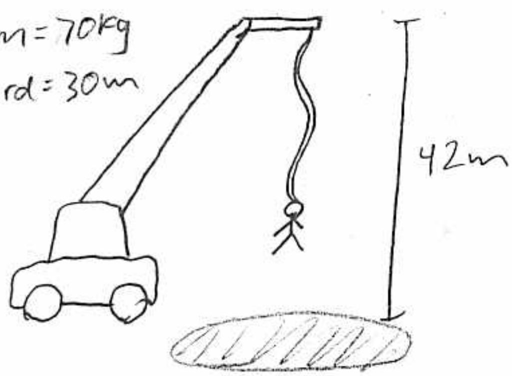
Problem 3

To raise money for a University scholarship fund, the new IT dean has volunteered to bungee jump from a crane if contributions can be found for 10 scholarships. To add some interest, the jump will be made from 42m above a pool of water. A 30m bungee cord would be attached to the dean. First you must convince the dean that your plan is safe for a person of his mass, 70kg. The dean knows that as the bungee cord begins to stretch, it will exert a force which has the same properties as the force exerted by a spring. Your plan has the dean stepping off a platform and being in free fall for 30m before the cord begins to stretch.

(a) Determine the spring constant of the bungee cord so that it stretches only 12m, which will just keep the dean out of the water. (Assume that the dean is a point-like object).

(b) Using the result of (a), find the dean's speed 7m above the water.

m = 70kg
ord = 30m



$F = -kx$

a) $ma = -kx$

$(70kg)(9.8m/s^2) = k(12m)$

$k = \frac{ma}{x} = 57.2 \text{ N/m}$

b) $v^2 = v_0^2 + 2a(\Delta x)$

$v_0 = \sqrt{mgh}$ (where h = 30m)

$\Delta x = 5m$

$a = \frac{-\sqrt{mgh}}{12m}$

$v = \sqrt{\sqrt{mgh} + 2\left(\frac{-\sqrt{mgh}}{12m}\right)(5)}$

$v = \sqrt{143 + 2(-12)(5)} = 16m/s$

A

Student #6

D# [redacted] [redacted] Section # [redacted]

Problem 3

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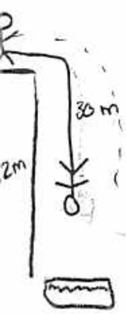
(a) Determine the spring constant of the bungee cord so that it stretches only 12m, which will just keep the dean out of the water. (Assume that the dean is a point-like object).

$k = \frac{N}{m}$

(b) Using the result of (a), find the dean's speed 7m above the water.



a. $x = 12\ m$, $F = ma$, $a = -9.8\ m/s^2$

$F = -kx$

$ma = -kx$ ✗

$(70\ kg)(-9.8\ m/s^2) = -k(12\ m)$

$\boxed{k = 57.167\ \frac{N}{m}}$

b. Use conservation of Energy

$PE_{top} = KE_{bottom} + PE_{bottom}$

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

* The dean will have PE at the top of his jump and then KE and PE ~~at the bottom~~ be... the bungee will shoot him ba...

∴ x equals 12 m − 7 m = 5 m because that is the distance the spring will be stretched

$(70kg)(57.167)(42m) = \frac{1}{2}(70\ kg)(v^2) + \frac{1}{2}(57.167)(5\ m)^2$

$v^2 = \frac{(70\ kg)(57.167)(42) - \frac{1}{2}(57.167)(5)^2}{\frac{1}{2}(70\ kg)}$

$\boxed{v = 69.15\ m/s}$

Student #7 ID# [redacted] [redacted] Section # [redacted] A

Problem 3

To raise money for a University scholarship fund, the new IT dean has volunteered to bungee jump from a crane if contributions can be found for 10 scholarships. To add some interest, the jump will be made from 42m above a pool of water. A 30m bungee cord would be attached to the dean. First you must convince the dean that your plan is safe for a person of his mass, 70kg. The dean knows that as the bungee cord begins to stretch, it will exert a force which has the same properties as the force exerted by a spring. Your plan has the dean stepping off a platform and being in free fall for 30m before the cord begins to stretch.

(a) Determine the spring constant of the bungee cord so that it stretches only 12m, which will just keep the dean out of the water. (Assume that the dean is a point-like object).

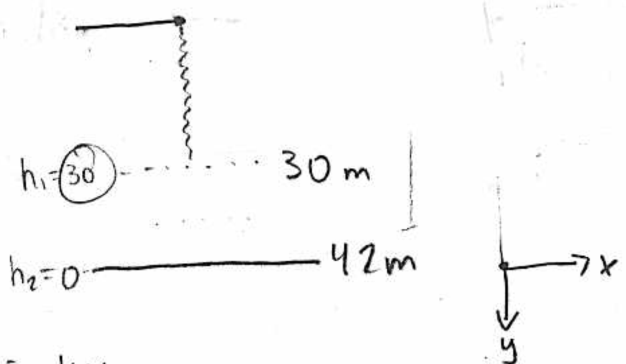
(b) Using the result of (a), find the dean's speed 7m above the water.

Know

$h = 42m$

Cord = 30m

$m = 70kg$



Want

"k" so $x = 12m$

a) $F_{spring} = -kx$

$E_{spring} = \frac{1}{2}kx^2$

$E_i = E_f$

$E_i = mgh_1 + \frac{1}{2}kx^2$

$E_f = mgh_2 + \frac{1}{2}kx^2$

$mgh_1 + \frac{1}{2}kx^2 = \frac{1}{2}kx^2$

$mgh_1 = \frac{1}{2}kx^2$

$k = \frac{mgh_1}{\frac{1}{2}x^2} \Rightarrow k = \frac{(70)(9.8)(30)}{\frac{1}{2}(12)^2} \Rightarrow$ $\boxed{k = 285.8}$

b) 7m above water $\Rightarrow x = 5$

$\omega = \sqrt{\frac{k}{m}}$ $\omega = \sqrt{\frac{285.8}{70}} =$ $\boxed{2 \text{ rad/sec}}$

Student #8 [redacted] ID# [redacted] Section # [redacted]

A

Problem 3

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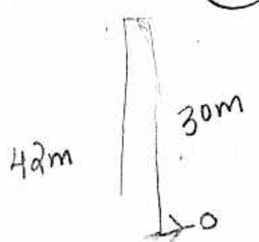
(b) Using the result of (a), find the dean's speed 7m above the water.

(a) Given:



$D = 42m$
$\ell = 30m$
$m = 70kg$

X = stretches 12m
original x = 30m
so, 30m + 12m = 42m

Force exerted by spring
$F = k\Delta x$
in this case: $F = k\Delta y = 32.6\,\frac{N}{m} * 42m = 1369N$

Conservation of energy
$KE + PE = E$
$PE_{rope} + KE_i + PE_i = KE_f + PE_f$
$\frac{1}{2}kx^2 + 0 - mgh = \frac{1}{2}mv^2 + mgh$
$\frac{1}{2}kx^2 = mgh$
$k = \frac{2mgh}{x^2} = \frac{2 * 70kg * 9.8m/s^2 * 42m}{(42m)^2} = 32.6\ N/m$

(b) bungee rope length = 30m
total length = 42m
$42m - 7m = 35m$
$KE + PE = KE + PE$
$\frac{1}{2}mv^2 + 0 = 0 + \frac{1}{2}kx^2$
$v^2 = \frac{kx^2}{m}$
$v = \sqrt{\frac{kx^2}{m}} = \frac{32.61\frac{N}{m}(35m)^2}{70kg} = 24.0\ m/s$

A

Student #9 [redacted] ID# [redacted] Section # [redacted]

Problem 3

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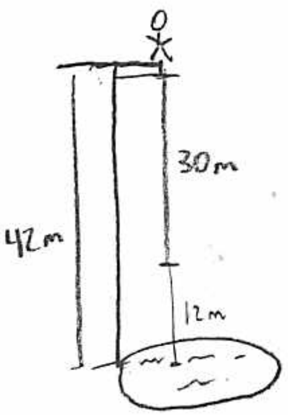
(b) Using the result of (a), find the dean's speed 7m above the water.



mass = 70kg

Find k?

$F = K\Delta x$ $\Delta x = 12m$

F = that of him Falling 30m

$F = mg = (70)(9.8) = 686\ N$

$K = \frac{F^N}{\Delta x} = \frac{686}{12} = \boxed{57.16\ N/m}$

$x = 12 - 7 = 5$

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

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

$(70)(9.8)(42) = \frac{1}{2}(57.16)(5)^2 + \frac{1}{2}70v^2 + (70)(9.8)(7)$

$28812 = 714.5 + 35v^2 + 4802$

$\frac{35v^2}{35} = \frac{23295.5}{35}$

$v^2 = 665.58$

$\boxed{V = 25.8\ m/s}$

A

Student #10 [redacted] Section [redacted]

Problem 3

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(a) Determine the spring constant of the bungee cord so that it stretches only 12m, which will just keep the dean out of the water. (Assume that the dean is a point-like object).

(b) Using the result of (a), find the dean's speed 7m above the water.

x_1 30

x_2 12

a) Conservation of Energy

$PE = KE \Rightarrow Mgh = \frac{1}{2}Mv^2$

$gh = \frac{1}{2}v^2$

$\sqrt{2gh} = v$

$\sqrt{2(9.8)30} = v$

$24.25 = v$

$KE = SE$

$\frac{1}{2}mv^2 = \frac{Kx^2}{2}$

$\frac{mv^2}{x^2} = K$

$K = \frac{(70)(24.25)^2}{(12)^2}$

$K = 285.86$

$SE = \frac{Kx^2}{2}$

b) 30, 5

$KE = SE = PE$?

$\frac{1}{2}mv^2 = \frac{Kx^2}{2}$

$v^2 = \frac{Kx^2}{m}$

$v = \sqrt{\frac{Kx^2}{m}}$

$v = \sqrt{\frac{(285.86)(5)^2}{70}}$

$v = 10.1$ m/s at 7m above water

Student #11 D# [redacted] A Section # [redacted]

Problem 3

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(a) Determine the spring constant of the bungee cord so that it stretches only 12m, which will just keep the dean out of the water. (Assume that the dean is a point-like object).

(b) Using the result of (a), find the dean's speed 7m above the water.

a. $x = A\cos(\omega t)$ $\omega = \sqrt{k/m}$

$v = -A\omega\sin(\omega t)$

$a = -A\omega^2\cos(\omega t)$

$m = 70kg$

$L = 30m$ $s = 12m$

~~equilibrium at mg = kx~~

$v_1^2 = 0 - 2Lg$ $v_1 = -\sqrt{2Lg} = v_{max}$

$v_{max} = -A\omega \Rightarrow \sqrt{2Lg} = A\sqrt{k/m} \Rightarrow 2Lg = \frac{A^2 k}{m}$

$x_{max} = \frac{s}{2} \Rightarrow \frac{s}{2} = A \Rightarrow A^2 = \frac{s^2}{4} \Rightarrow 2Lg = \frac{s^2 k}{4m}$

$k = \frac{8Lgm}{s^2} \Rightarrow \frac{8(30m)(9.8m/s^2)(70kg)}{(12m)^2} = \boxed{1100N/m}$

b. $x = A\cos(\omega t)$ $A = \frac{s}{2}$, $\omega = \sqrt{k/m} \Rightarrow x = \frac{s}{2}\cos(\omega t)$

$1m = \frac{12m}{2}\cos\left(\sqrt{\frac{1100N/m}{70kg}}\,t\right)$ $t = .35s$ $x = 7m - 12m + 6m = 1m$

$v = \sqrt{2Lg}\sin\left(\sqrt{k/m}\,t\right) = \sqrt{2 \times 30m \times 9.8m/s^2}\sin\left(\sqrt{\frac{1100N/m}{70kg}} \times .35\right) = \boxed{24m/s}$

A

Student #12 ID# [redacted] Section # [redacted]

Problem 3

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(a) Determine the spring constant of the bungee cord so that it stretches only 12m, which will just keep the dean out of the water. (Assume that the dean is a point-like object).

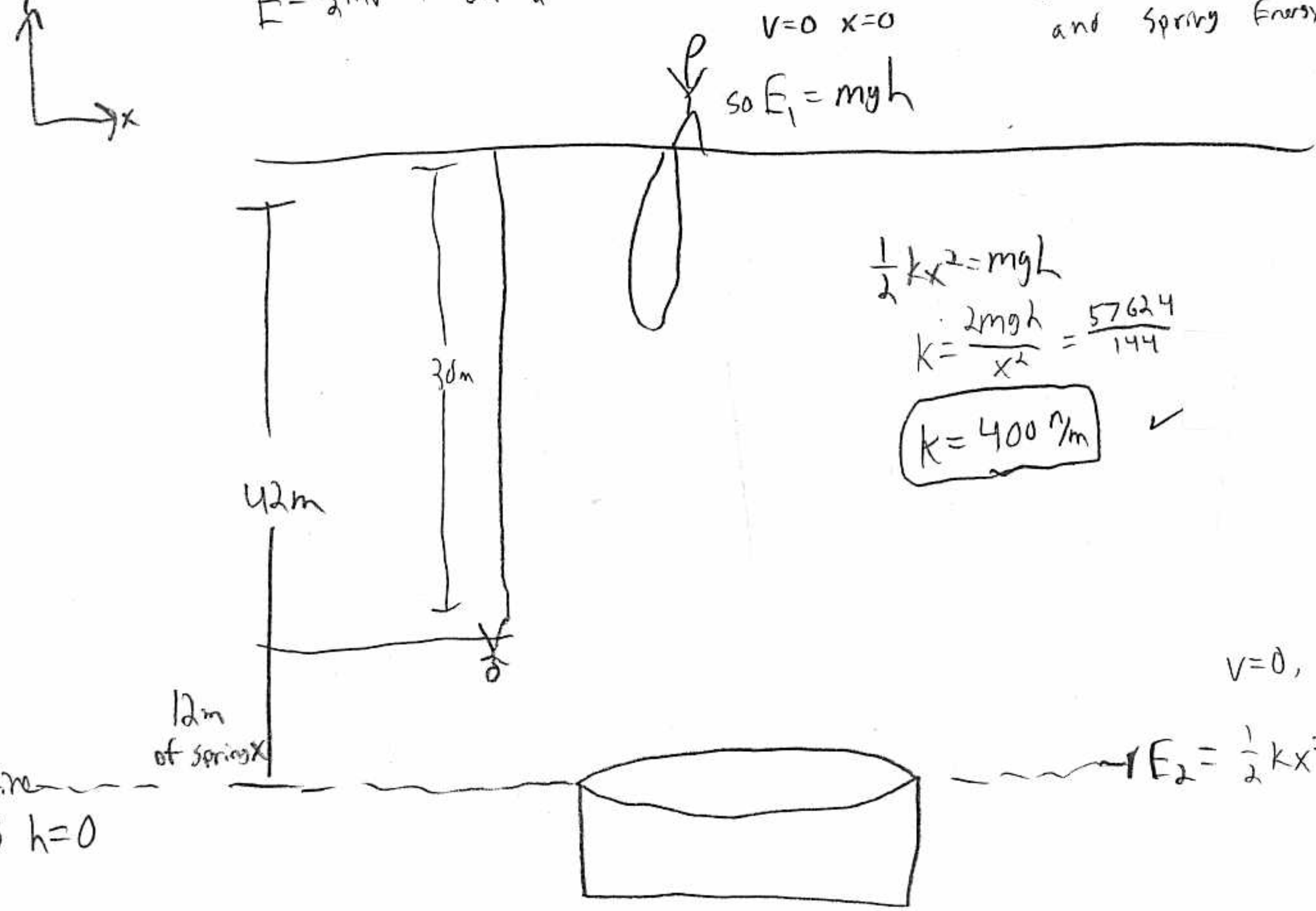
(b) Using the result of (a), find the dean's speed 7m above the water.

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

Use conservation of PE, KE and Spring Energy

$V=0 \quad x=0$

so $E_1 = mgh$



$\frac{1}{2}kx^2 = mgh$

$k = \frac{2mgh}{x^2} = \frac{57624}{144}$

$k = 400 \, N/m$ ✓

$v=0, \; h=0$

$E_2 = \frac{1}{2}kx^2$

…s $h=0$

Speed 7m above H_2O: $\frac{1}{2}mv^2 + \frac{1}{2}kx^2 = E$ $\quad \sqrt{v^2} = \sqrt{\frac{kx^2}{m}}$ $\quad v = \sqrt{\frac{10{,}000}{70}} = 12 \, m/s$

Student #13 [redacted] ID# [redacted] Section #

A

Problem 3

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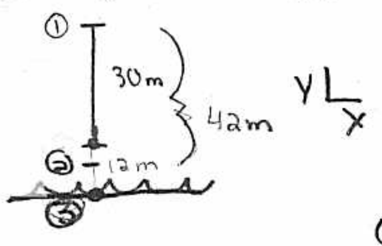
(b) Using the result of (a), find the dean's speed 7m above the water.



a) conservation of energy

$① \; mgh = ③ \; \frac{1}{2}kx^2$

$(70kg)(9.8 m/s^2)(42m) = \frac{1}{2}k(12m)^2$

$k = 400.167$

a) $F_{spring} = -kx$

$PE = \frac{1}{2}kx^2$

$12 - 7 = 5$

b) $② \; \frac{1}{2}mv^2 + mgh + \frac{1}{2}k(5m)^2 = ① \; mgh$

$\frac{1}{2}(70kg)v^2 + (70kg)(35m)(9.8 m/s^2) + \frac{1}{2}(400.167)(5m)^2$

$= 70kg(42m)(9.8 m/s^2)$

$\frac{1}{2}(70kg)v^2 = 47819.9 \; N$

$v = 36.963 m/s$