Phys 131 2023

Review3

Thurs: Seminar 12:30 WS 203

Fri: Exam 3

Covers Ch 7, 8, 9

Lectures 23-31

HW 8-9

Discussions 7-8

Bring: * Calculator

* Original two note cards 3"x5" single side
* Third note card 3"x5" single side.

Early section: Stay until 10:50am

Study: 2018, 2022 Exam 3 all questions

HW

Discussion problems

Quizzes

Class quizzes

Ch 7.1 → 7.4, 8.1 → 8.4

$W = \vec{F}\cdot\Delta\vec{r} = F\Delta r\cos\theta$

$\vec{A}\cdot\vec{B} = A_xB_x + A_yB_y + A_zB_z$

$= AB\cos\theta$

$P = \dfrac{W}{\Delta t} = \dfrac{\Delta E}{\Delta t}$

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

$W_{net} = \Delta K$.

$U_{grav} = mgy$

$U_{sp} = \frac{1}{2}kx^2$

$F_{sp} = kx$

$E = K + U_{grav} + U_{sp}$

$\Delta E = W_{nc}$

$\Delta E = 0$ (if $W_{nc} = 0$)

Conservative forces $W = -\Delta U$

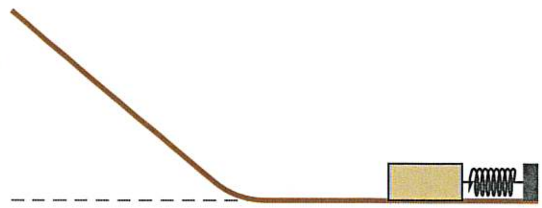
$F_x = -\dfrac{dU}{dx}$ = − slope graph U vs x

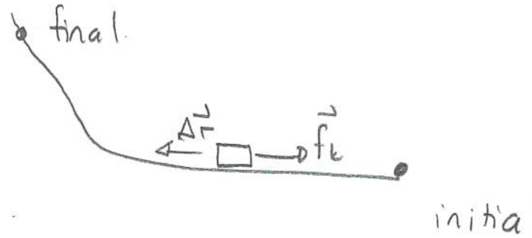
Quiz 1: − Change ? to $v_A < v_B$. { 50% − 90% } 40% − 70%

Quiz 2: 3 to $x_A < x_B$ { 70% − 90%

252 Spring-launched crate

An 8.0 kg crate is held at rest against a spring with spring constant 1600 N/m compressing it by by 0.25 m. It is released and then travels along the illustrated surface. The lower 0.50 m long horizontal portion of the surface is rough with coefficient of friction 0.35. The rest of the surface is frictionless. Ignoring air resistance determine the maximum vertical height reached by the crate. *(131Sp2023)*





Answer: $\Delta E = W_{nc}$

$E_f - E_i = W_{nc}$

$E_f = E_i + W_{nc}$ credit

$y_f = ?$ $y_i = 0\,m$

$x_f = 0\,m$ $x_i = 0.25\,m$ (spring compression)

$V_f = 0\,m/s$ $V_i = 0\,m/s$

Now

$W_{nc} = W_{norm} + W_{fric}$ (with $W_{norm} = 0$) credit

$= f_k \Delta r \cos 180^\circ = -f_k \Delta r$

$= -\mu_k m g\, \Delta r$

$= -0.35 \times 8.0\,kg \times 9.8\,m/s^2 \times 0.50\,m$

$= -14\,J.$

$\Sigma F_y = m a_y = 0$

$\Rightarrow n = mg$

$f_k = \mu_k n$

$= \mu_k m g$

Then $E_f = E_i + W_{nc}$

credit

$\Rightarrow K_f + U_{gf} + U_{spf} = K_i + U_{gi} + U_{spi} + W_{nc}$

$\Rightarrow \frac{1}{2} m v_f^2 + m g y_f + \frac{1}{2} k x_f^2 = \frac{1}{2} m v_i^2 + m g y_i + \frac{1}{2} k x_i^2 + W_{nc}$

$\Rightarrow m g y_f = \frac{1}{2} k x_i^2 - 14\,J$

$\Rightarrow 8.0\,kg \times 9.8\,m/s^2\, y_f = \frac{1}{2}\, 1600\,N/m\, (0.25\,m)^2 - 14\,J = 36\,J$

$\Rightarrow y_f = \frac{36\,J}{8.0\,kg \times 9.8\,m/s^2} \Rightarrow y_f = 0.46\,m$

Quiz 3

Note that $W = \vec{F} \cdot \Delta \vec{r} = F \Delta r \cos\theta$

Quiz 4

257 Force for a quadratic potential

A particle moves subject to an interaction described by the potential

$$U(x) = ax^2 + bx + c$$

where $a = -4.0\,\mathrm{J/m^2}$, $b = 10.0\,\mathrm{J/m}$ and $c = 5.0\,\mathrm{J}$ are constants. *(131Sp2023)*

a) Determine any locations where the force on the particle is zero.

b) Suppose that the particle is held at rest at $x = 0.0\,\mathrm{m}$. In which direction will it begin to move? Explain your answer.

Answer:

a) $F_x = -\frac{dU}{dx} = -\left[2ax + b\right]$

We need $F_x = 0 \Rightarrow \frac{dU}{dx} = 0 \Rightarrow 2ax + b = 0$

$\Rightarrow 2ax = -b$

$\Rightarrow x = -\frac{b}{2a}$

Thus $x = -\frac{10.0\,\mathrm{J/m}}{-4.0\,\mathrm{J/m^2}}$

$x = 1.25\,\mathrm{m}$

b) We need the force when $x = 0$

$F_x = -\frac{dU}{dx} = -2ax - b = -(-4.0\,\mathrm{J/m^2})x - 10.0\,\mathrm{J/m}$

$= 4.0\,\mathrm{J/m^2}\,x - 10.0\,\mathrm{J/m}$

At $x = 0$ $F_x = -10.0\,\mathrm{J/m}$. Force is left $\Rightarrow$ object moves left.

Ch 9.1 → 9.5

$\vec{p} = m\vec{v}$

$\vec{p}_{tot} = \sum m_i \vec{v}_i = \sum \vec{p}_i$

Vector addition!

$\vec{F}_{net} = \frac{d\vec{p}}{dt}$

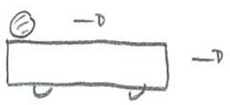
Conservation of momentum

Quiz 5 70% -90% } 70% -95%

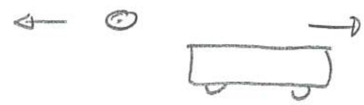
269 Ball launched from a moving cart

A 400 g cart slides along a laboratory bench with velocity 10.0 m/s to the right. A 100 g ball is initially on the cart and at rest relative to the cart. It is subsequently fired to the left and, after this, the velocity of the ball relative to the laboratory is 10.0 m/s to the left. Determine the velocity of the cart after the ball has been fired. *(131Sp2023)*

Before



After



$V_{bi} = 10.0\,m/s$

$V_{ci} = 10.0\,m/s$

$V_{bf} = -10.0\,m/s$ ← important credit!

$V_{cf} =$

$$\vec{p}_{tot\,f} = \vec{p}_{tot\,i}$$

$$m_b V_{bf} + m_c V_{cf} = m_b V_{bi} + m_c V_{ci}$$

$$m_c V_{cf} = m_b V_{bi} + m_c V_{ci} - m_b V_{bf}$$

$$= 0.100\,kg \times 10.0\,m/s + 0.400\,kg \times 10.0\,m/s - 0.100\,kg\,(-10.0\,m/s)$$

$$0.400\,kg\; V_{cf} = 1.00\,kg\,m/s + 4.0\,kg\,m/s + 1.0\,kg\,m/s$$

$$0.400\,kg\; V_{cf} = 6.00\,kg\,m/s$$

$$\Rightarrow V_{cf} = \frac{6.00\,kg\,m/s}{0.400\,kg} = 15.0\,m/s$$