Phys 131 2024

Review 3

Thurs: Seminar, 12:30 Wubber 203

Fri: Exam 3

* Covers: Ch 9, 10, 11

  Lectures 23 → 31, 32

  HW 8, 9

  Discussions 8, 9

* Bring
  * Calculator
  * Original two note cards plus one new 3" x 5" single side
  *
* Study
  * 2022, 2023 Exam 3 all questions
  * HW
  * Discussion problems
  * Quizzes
  * Class quizzes

Early section * stay until 10:50am

Ch 9, 10

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

$\vec{A} \cdot \vec{B} = A_x B_x + A_y B_y + A_z B_z$

$= AB\cos\theta$

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

$K = \frac{1}{2} m v^2$

$W_{net} = \Delta K$

$U_{grav} = mgy$

$U_{sp} = \frac{1}{2} k (\Delta s)^2$

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

$\Delta E = W_{nc}$

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

For conservative forces $W = -\Delta U$

$F_{sp} = -k\Delta x$

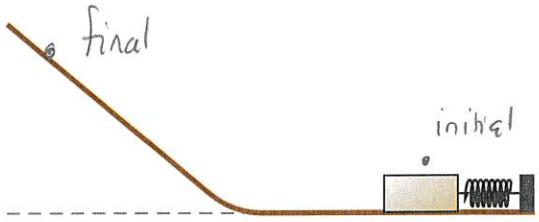
$F_x = -\frac{dU}{dx}$ = − slope graph U vs x

Quiz 1 80% − 80% ≤ 30% − 70%

Use $W = F \Delta r \cos\theta$

319 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. *(131F2024)*



Ans: $\Delta E = W_{nc} \Rightarrow E_f - E_i = W_{nc} \Rightarrow E_f = E_i + W_{nc}$ credit.

$y_f =$ $y_i = 0m$

$v_f = 0 m/s$ $v_i = 0 m/s$

$\Delta s_f = 0m$ $\Delta s_i = 0.25m$

Now

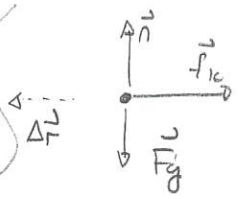
$W_{nc} = W_{friction} + W_{norm}$ (0 ($90°$)

$= f_k \Delta r \cos 180°$ credit

$= \mu_k mg \Delta r \cos 180°$

$= 0.35 \times 8.0kg \times 9.8 m/s^2 \times 0.50m \times -1$

$= -14J$



$\Sigma F_y = ma_y = 0$

$\Rightarrow n = F_g = mg$

$f_k = \mu_k n = \mu_k mg$ credit.

$E_f = E_i + W_{nc}$

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

$\frac{1}{2}mv_f^2 + mgy_f + \frac{1}{2}k(\Delta s_f)^2 = \frac{1}{2}mv_i^2 + mgy_i + \frac{1}{2}k(\Delta s_i)^2 - 14J$

credit credit credit

$mgy_f = \frac{1}{2}k(\Delta s_i)^2 - 14J$

$8.0kg \times 9.8 m/s^2\, y_f = \underbrace{\frac{1}{2}\, 1600 N/m\, (0.25m)^2}_{50J} - 14J = +36J$

$78N\, y_f = 36J$

$\Rightarrow y_f = \frac{36J}{78N} = 0.46m$

Quiz 2 50% – 50% } 10% – 80%

Quiz 3 80% – 100% } 80% – 90%

326 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. *(131F2024)*

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.

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

$F_x = 0 \Rightarrow 2ax + b = 0 \Rightarrow x = -\frac{b}{2a}$

$\Rightarrow x = \frac{-10.0\,\mathrm{J/m}}{2 \times (-4.0\,\mathrm{J/m^2})} = 1.25\,\mathrm{m}$

b) At this location the horizontal component of force is

$F_x = -2\left(-4.0\,\mathrm{J/m^2}\right) 0.0\,\mathrm{m} - 10.0\,\mathrm{J/m} \Rightarrow F_x = -10\,\mathrm{N}$

This points left ⇒ particle moves left

Quiz 4 80% – 90% } 10% – 60%

Ch 11

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

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

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

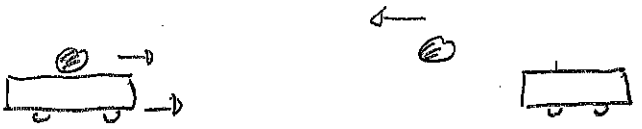
Add vectors

Quiz 5 80% - 95% } 80%

340 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. *(131F2024)*

Inihal Final



$V_{ci} = 10 m/s$ } $= V_i$ $\quad V_{cf} = ?$

$V_{bi} = 10 m/s$ } $\quad V_{bf} = -10.0 m/s$

$$p_{tot\,f} = p_{tot\,i}$$

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

$$m_c V_{cf} + m_b V_{bf} = (m_c + m_b) V_i$$

$$\Rightarrow m_c V_{cf} = (m_c + m_b) V_i - m_b V_{bf}$$

$$\Rightarrow V_{cf} = \frac{(m_c + m_b) V_i - m_b V_{bf}}{m_c}$$

$$= \frac{(0.500 kg)\ 10.0 m/s - 0.100 kg\,(-10.0 m/s)}{0.400 kg}$$

$$= \frac{5.00 kg\,m/s + 1.00 kg\,m/s}{0.400 kg} = 15 m/s$$

(to right).