0. (0 points) `/opt/webwork/webwork2/conf/snippets/ASimpleCombinedHeaderFile.pg`

Alice Quillen **fall22phy141**

Assignment PHY141_WW5 due 10/07/2022 at 09:45am EDT

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1. (1 point) `setPHY141_WW5/pot1.pg`

On potential energy

A particle moves along the x axis under the influence of a position dependent force $F(x)$.
The potential energy function associated with this force is this
$U(x) = 3\,x^2$ - $2\,x$+ 3
At what x value is the potential energy a minimum?
Enter $x =$ ___
At what x value is does the force vanish?
Enter $x =$ ___

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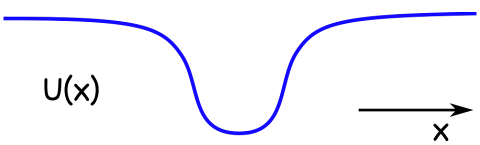
2. (1 point) `setPHY141_WW5/pot2.pg`

On potential energy



A non-relativistic particle moves along the x axis under the influence of a position dependent force $F(x)$.
The potential energy function associated with this force is this
$U(x) = 1 - 5\exp(-5x^2)$
What x value is a fixed point where the particle can remain at rest within the potential well?
Enter $x =$ ___
The particle is now at the bottom of the potential energy well, however it is not at rest.
How much kinetic energy does it need to escape the potential energy well?
Enter $K =$ ___
(Enter numbers accurate to 1 decimal place.)
By "escape the potential well", we mean be able to just barely reach very large positive of negative x with zero kinetic energy. $K \to 0$ as $x \to \infty$.

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3. (1 point) `setPHY141_WW5/PE_force.pg`

On finding the potential energy from a force law

A particle moves along the x axis and has force law
$F(x) = 2x^2 + 2x$.
The force is measured in Newtons and x is measured in meters.
The potential energy has $U = 0$ J at $x = 0$ m.
What is the potential energy at $x = 4$ m?
Enter $U(4\text{ m})$ = _______ J.
Enter a number accurate to at least one decimal places.

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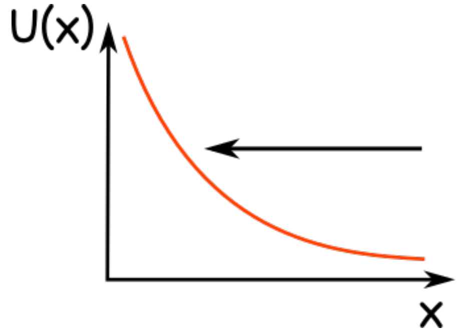
4. (2 points) `setPHY141_WW5/PE_repulse.pg`

On potential energy for a repulsive force



A repulsive force F depends on distance x and has potential energy function
$U(x) = \frac{U_1}{kx} + \frac{U_2}{(kx)^2}$
with coefficients $U_1 = 1$ J and $U_2 = 2$ J. The coefficient $k = 10$ mm.
A non-relativisitic particle is initially at large $x \gg \frac{1}{k}$ and has initial kinetic energy $K_0 = 3$ J and has a negative velocity so that it approaches the origin.
At what x value is the particle's closest approach to the origin?
Enter x = ___ mm.
You will need to solve a quadratic equation.
Enter a number accurate to at least two decimal places.

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5. (1 point) `setPHY141_WW5/deBroglie.pg`

On the deBroglie wavelength

The deBrogelie wavelength $\lambda_{\rm deBroglie} = \frac{h}{p}$ where $h =$ 6.62607015E-34 J s is Planck's constant and p is a particle's momentum.
An experimenter wants to see electron diffraction with a wavelength of about 1 cm. For this problem the non-relativistic limit is valid.
What electron velocity v is needed to do the experiment?
Enter a value for v: _____ m/s
Your answer can be in the form 0.0001 or 1E-4 and it should be accurate to 1 decimal place in exponential notation. You will need to look up the electron mass.

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6. (2 points) `setPHY141_WW5/Pl_length.pg`

On dimensional analysis

Consider the three fundamental physical constants
h: Planck's constant (units J s)
G: The gravitational constant (units kg^{-1}m^{3}s^{-2})
c: The speed of light (units m/s)
Find exponents $\alpha_h, \alpha_G, \alpha_c$ so that
$L_P = h^{\alpha_h} G^{\alpha_G} c^{\alpha_c}$
has units of length.
$\alpha_h =$ ___, $\alpha_G =$ ___, $\alpha_c =$ ___

Find exponents $\beta_h, \beta_G, \beta_c$ so that
$m_P = h^{\beta_h} G^{\beta_G} c^{\beta_c}$
has units of mass.

$\beta_h =$ ___, $\beta_G =$ ___, $\beta_c =$ ___
These quantitites are relevant for theories for the quantization of gravity.