Name____

Physics 120 Quiz #1, January 10, 2020

Please show all work, thoughts and/or reasoning in order to receive partial credit. The quiz is worth 10 points total.

I affirm that I have carried out my academic endeavors with full academic honesty.

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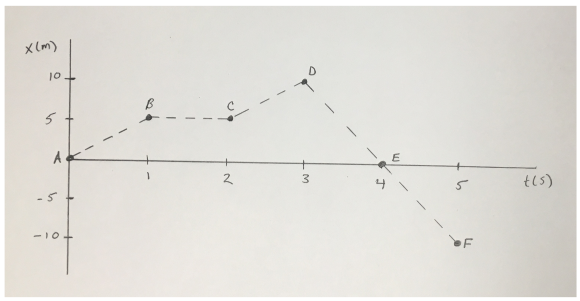
Consider the position versus time graph shown below where an object is undergoing motion in one-dimension. The vertical axis shows the position of the object measured in meters from the origin of the coordinate system while the horizontal axis shows the time in seconds.



a. In words, describe the motion of the object between points B and D.

Between points B and C the object does not change its position while between points C and D the object starts moving in the positive x-direction. The velocity of the object zero between points B and C while it is positive between points C and D. The acceleration of the object is zero between points B and C. Between points C and D as the slope of the position versus time graph for points between C and D is a constant, meaning since the velocity is constant, the acceleration is zero.

b. In words describe the motion of the object between points D and F?

Between points D and F the object is moving in the negative x-direction. The velocity between points D and F is increasing from rest and points in the negative x-direction while the acceleration between points D and F is also negative. Since the slope of the line is constant between points D and F, the acceleration is zero over the interval.

c. What is the average velocity of the object between points A and B?

$$v_{avg,x} = \frac{\Delta x_{AB}}{\Delta t_{AB}} = \frac{5m - 0m}{3s - 2s} = 5\frac{m}{s}$$

d. Suppose that the magnitude of the average velocity between points D and F is determined to be $10\frac{m}{s}$. What is the magnitude of the average velocity between points D and F in furlongs per fortnight, if $1\ furlong = 200m$ and $1\ fortnight = 14\ days$?

$$10\frac{m}{s} \times \frac{1furlong}{200m} \times \frac{3600s}{1hour} \times \frac{24hr}{1day} \times \frac{14\ day}{1forthnight} = 60480\frac{furlongs}{fortnight}$$

Physics 120 Formulas

Motion

$\Delta x = x_f - x_i$
$v_{avg} = \frac{\Delta x}{\Delta t}$
$a_{avg} = \frac{\Delta v}{\Delta t}$

Equations of Motion

displacement: $\begin{cases} x_f = x_i + v_{ix}t + \frac{1}{2}a_x t^2 \\ y_f = y_i + v_{iy}t + \frac{1}{2}a_y t^2 \end{cases}$

velocity: $\begin{cases} v_{fx} = v_{ix} + a_x t \\ v_{fy} = v_{iy} + a_y t \end{cases}$

time-independent: $\begin{cases} v_{fx}^2 = v_{ix}^2 + 2a_x \Delta x \\ v_{fy}^2 = v_{iy}^2 + 2a_y \Delta y \end{cases}$

Uniform Circular Motion

$F_r = ma_r = m\frac{v^2}{r}; \quad a_r = \frac{v^2}{r}$

$v = \frac{2\pi r}{T}$

$F_G = G\frac{m_1 m_2}{r^2}$

Geometry /Algebra

Circles — $C = 2\pi r$, $A = \pi r^2$

Triangles — $A = \frac{1}{2}bh$

Spheres — $A = 4\pi r^2$, $V = \frac{4}{3}\pi r^3$

Quadratic equation: $ax^2 + bx + c = 0$,

whose solutions are given by: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Vectors

magnitude of a vector: $v = |\vec{v}| = \sqrt{v_x^{\ 2} + v_y^{\ 2}}$

direction of a vector: $\phi = \tan^{-1}\left(\frac{v_y}{v_x}\right)$

Useful Constants

$g = 9.8\,{}^{m}\!/\!_{s^2}$ $\quad G = 6.67\times10^{-11}\,{}^{Nm^2}\!/\!_{kg^2}$

$N_A = 6.02\times10^{23}\,{}^{atoms}\!/\!_{mole}$ $\quad k_B = 1.38\times10^{-23}\,{}^{J}\!/\!_{K}$

$\sigma = 5.67\times10^{-8}\,{}^{W}\!/\!_{m^2K^4}$ $\quad v_{sound} = 343\,{}^{m}\!/\!_{s}$

Linear Momentum/Forces

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

$\vec{p}_f = \vec{p}_i + \vec{F}\Delta t$

$\vec{F} = m\vec{a}$

$\vec{F}_s = -k\vec{x}$

$F_f = \mu F_N$

Work/Energy

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

$K_r = \frac{1}{2}I\omega^2$

$U_g = mgh$

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

$W_T = FdCos\theta = \Delta E_T$

$W_R = \tau\theta = \Delta E_R$

$W_{net} = W_R + W_T = \Delta E_R + \Delta E_T$

$\Delta E_R + \Delta E_T + \Delta U_g + \Delta U_S = 0$

$\Delta E_R + \Delta E_T + \Delta U_g + \Delta U_S = -\Delta E_{diss}$

Rotational Motion

$\theta_f = \theta_i + \omega_i t + \frac{1}{2}\alpha t^2$

$\omega_f = \omega_i + \alpha t$

$\omega^2{}_f = \omega^2{}_i + 2\alpha\Delta\theta$

$\tau = I\alpha = rF$

$L = I\omega$

$L_f = L_i + \tau\Delta t$

$\Delta s = r\Delta\theta: \ v = r\omega: \ a_t = r\alpha$

$a_r = r\omega^2$

Simple Harmonic Motion/Waves

$\omega = 2\pi f = \frac{2\pi}{T}$

$T_S = 2\pi\sqrt{\frac{m}{k}}$

$T_P = 2\pi\sqrt{\frac{l}{g}}$

$v = \pm\sqrt{\frac{k}{m}}A\left(1 - \frac{x^2}{A^2}\right)^{\frac{1}{2}}$

$x(t) = A\sin\left(\frac{2\pi t}{T}\right)$

$v(t) = A\sqrt{\frac{k}{m}}\cos\left(\frac{2\pi t}{T}\right)$

$a(t) = -A\frac{k}{m}\sin\left(\frac{2\pi t}{T}\right)$

$v = f\lambda = \sqrt{\frac{F_T}{\mu}}$

$f_n = nf_1 = n\frac{v}{\ldots}$