Name____

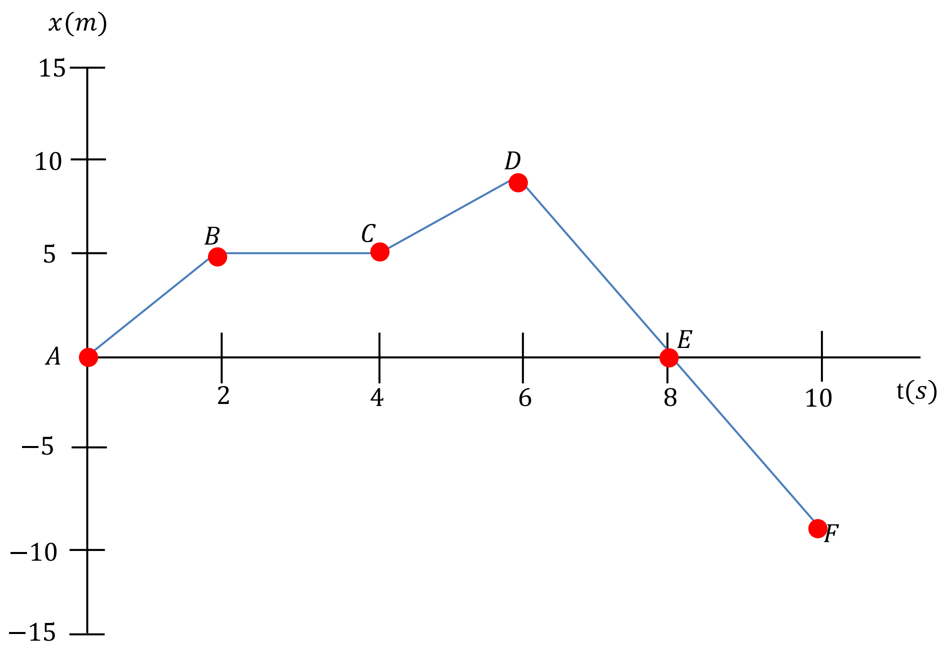
Physics 110 Quiz #1, April 2, 2021

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.

____

1. Consider the following position versus time graph for an object moving in one-dimension. What is the displacement of the object between the points AB, BC, CD, DE, and EF?



$\Delta x_{AB} = x_B - x_A = 5m - 0m = +5m$

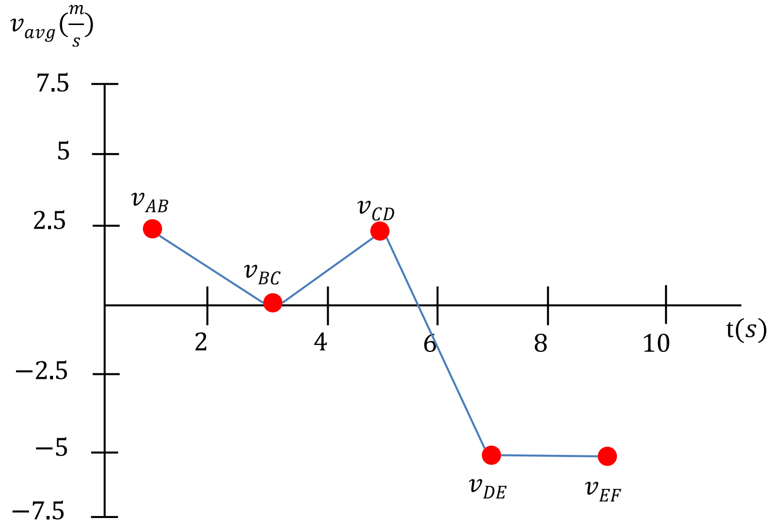
$\Delta x_{BC} = x_C - x_B = 5m - 5m = 0m$

$\Delta x_{CD} = x_D - x_C = 10m - 5m = +5m$

$\Delta x_{DE} = x_D - x_E = 0m - 10m = -10m$

$\Delta x_{EF} = x_F - x_E = -10m - 0m = -10m$

2. On the diagram below, construct the velocity versus time plot.



$v_{AB} = \frac{\Delta v_{AB}}{\Delta t_{AB}} = \frac{5m}{2s} = +2.5\frac{m}{s}$; $v_{BC} = \frac{\Delta v_{BC}}{\Delta t_{BC}} = \frac{0m}{2s} = 0\frac{m}{s}$; $v_{CD} = \frac{\Delta v_{CD}}{\Delta t_{CD}} = \frac{5m}{2s} = +2.5\frac{m}{s}$

$v_{DE} = \frac{\Delta v_{DE}}{\Delta t_{DE}} = \frac{-10m}{2s} = -5\frac{m}{s}$; $v_{EF} = \frac{\Delta v_{EF}}{\Delta t_{EF}} = \frac{-10m}{2s} = -5\frac{m}{s}$

3. What is the average acceleration of the object between points C and E?

$$a_{avg,CE} = \frac{\Delta v_{avg}}{\Delta t} = \frac{v_{DE} - v_{CD}}{t_{DE} - t_{CD}} = \frac{-5\frac{m}{s^2} - 2.5\frac{m}{s^2}}{7s - 5s} = -3.75\frac{m}{s^2}$$

4. What is the average acceleration of the object in part 3 in $\frac{furlongs}{fortnight^2}$, if $1furlong = 201.2m$ and $1fortnight = 14days$?

$$a_{avg,CE} = -3.75\frac{m}{s^2} \times \frac{1furlong}{201.2m} \times \left(\frac{60s}{1min} \times \frac{60min}{1hr} \times \frac{24hr}{1day} \times \frac{14day}{1fortnight}\right)^2$$
$$= -2.7 \times 10^{10}\frac{furlongs}{fortnight^2}$$

Physics 110 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: $\begin{cases} v_{fx}^2 = v_{ix}^2 + 2a_x Dx \\ v_{fy}^2 = v_{iy}^2 + 2a_y Dy \end{cases}$

Uniform Circular Motion

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

$v = \frac{2pr}{T}$

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

Geometry /Algebra

Circles: $C = 2pr$, $A = pr^2$

Triangles: $A = \frac{1}{2}bh$

Spheres: $A = 4pr^2$, $V = \frac{4}{3}pr^3$

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

$g = 9.8\,{}^{m}/_{s^2}$ $G = 6.67 ´ 10^{-11}\,{}^{Nm^2}/_{kg^2}$

$N_A = 6.02 ´ 10^{23}\,{}^{atoms}/_{mole}$ $k_B = 1.38 ´ 10^{-23}\,{}^{J}/_{K}$

$s = 5.67 ´ 10^{-8}\,{}^{W}/_{m^2K^4}$ $v_{sound} = 343\,{}^{m}/_{s}$

Linear Momentum/Forces

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

$\vec{p}_f = \vec{p}_i + \vec{F}\,Dt$

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

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

$F_f = mF_N$

Work/Energy

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

$K_r = \frac{1}{2}Iw^2$

$U_g = mgh$

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

$W_T = FdCosq = DE_T$

$W_R = tq = DE_R$

$W_{net} = W_R + W_T = DE_R + DE_T$

$DE_R + DE_T + DU_g + DU_S = 0$

$DE_R + DE_T + DU_g + DU_S = -DE_{diss}$

Heat

$T_C = \frac{5}{9}[T_F - 32]$

$T_F = \frac{9}{5}T_C + 32$

$L_{new} = L_{old}(1 + aDT)$

$A_{new} = A_{old}(1 + 2aDT)$

$V_{new} = V_{old}(1 + bDT) : b = 3a$

$PV = Nk_BT$

$\frac{3}{2}k_BT = \frac{1}{2}mv^2$

$DQ = mcDT$

$P_C = \frac{DQ}{Dt} = \frac{kA}{L}DT$

$P_R = \frac{DQ}{DT} = esADT^4$

$DU = DQ - DW$

Rotational Motion

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

$\omega_f = \omega_i + \alpha t$

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

$\tau = I\alpha = rF$

$L = I\omega$

$L_f = L_i + \tau\Delta t$

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

$a_r = r\omega^2$

Fluids

$\rho = \frac{M}{V}$

$P = \frac{F}{A}$

$P_d = P_0 + \rho gd$

$F_B = \rho gV$

$A_1v_1 = A_2v_2$

$\rho_1A_1v_1 = \rho_2A_2v_2$

$P_1 + \frac{1}{2}\rho v^2{}_1 + \rho gh_1 = P_2 + \frac{1}{2}\rho v^2{}_2 + \rho gh_2$

Simple Harmonic Motion/Waves

$w = 2pf = \frac{2p}{T}$

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

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

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

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

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

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

$v = fl = \sqrt{\frac{F_T}{m}}$

$f_n = nf_1 = n\frac{v}{2L}$

$I = 2p^2f^2rvA^2$

Sound

$v = fl = (331 + 0.6T)\,\frac{m}{s}$

$b = 10\log\frac{I}{I_0}$; $I_o = 1 ´ 10^{-12}\,\frac{W}{m^2}$

$f_n = nf_1 = n\frac{v}{2L}$; $f_n = nf_1 = n\frac{v}{4L}$