作业务必自己抄一遍后再拍照上传，用文档图片上传后果自负。作业尽早提交，老师会尽快批改的，得分也会高一些。如果拖到期末补交普遍得分不高，附上源文档方便查看，如有数据看不清请对照源文档。

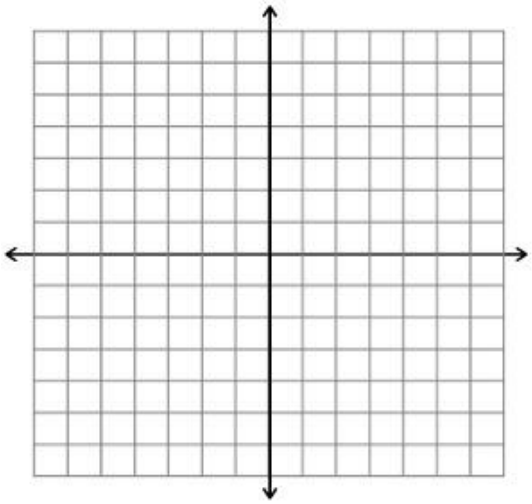
University Physics A(1) 2019

Worksheet #1

Name: Student number:

Problems

(1) [1.X.79] Imagine that you have a basketball and a tennis ball at different locations. The center of the basketball is at $\langle 3, -5, 0 \rangle$ m, and the center of the tennis ball is at $\langle -3, -1, 0 \rangle$ m (relative to some origin). On the graph below, do the following:



(a) Draw dots at the locations of the center of the basketball and the center of the tennis ball.

(b) Draw the position vector the basketball, which is an arrow whose tail is at the origin and whose tip is at the location of the basketball. Label this position vector $\vec{B}$.

(c) Draw the position vector of the tennis ball. Label it $\vec{T}$.

(d) Draw the relative position vector for the tennis ball relative to the basketball. The tail of this vector is at the center of the basketball, and the tip of the vector is at the center of the tennis ball. Label this relative position vector $\vec{r}$.

(e) Complete the following equations:

$\vec{B} = \langle \quad , \quad , \quad \rangle$ m

$\vec{T} = \langle \quad , \quad , \quad \rangle$ m

(f) Complete the following equation by reading the coordinates of $\vec{r}$ from the graph: $\vec{r} = \langle \quad , \quad , \quad \rangle$ m

(g) Calculate: $\vec{T} - \vec{B} = \langle \quad , \quad , \quad \rangle$ m

(h) Is it true that $\vec{r} = \vec{T} - \vec{B}$?

(i) Calculate the magnitudes of the vectors $\vec{B}$, $\vec{T}$, and $\vec{r}$.

(j) Calculate the difference of the magnitudes $\left|\vec{T}\right|-\left|\vec{B}\right|$.

(k) Does $\left|\vec{T}\right|-\left|\vec{B}\right|=\left|\vec{T}-\vec{B}\right|$?

(2) [1.P.89] A spacecraft (宇宙飞船) traveling at a velocity of $\langle -20,-90,40\rangle$ m/s is observed to be at a location $\langle 200,300,-500\rangle$ m relative to an origin located on a nearby asteroid (小行星). After some time, the spacecraft has moved to location $\langle -200,-1500,300\rangle$ m.

(a) How much time did it take for the spacecraft to travel between these locations?

(b) How far did the spacecraft travel?

(c) What is the speed of the spacecraft（速度大小）?

(d) What is the unit vector in the direction of the spacecraft's velocity（速度的单位方向矢量）?

(3) [1.P.98] At 6 seconds after 3:00, a butterfly (蝴蝶) is observed leaving a flower whose location is $\langle 6,-3,10\rangle$ m relative to an origin on top of a nearby tree. The butterfly flies until 10 seconds after 3:00, when it lands on a different flower located at $\langle 6,-3.8,11.2\rangle$ m.

(a) What was the location of the butterfly at a time 8.5 seconds after 3:00?

(b) What assumption (假设) did you have to make in calculating this location?

(4) [1.P.117] The figure below shows a portion of the trajectory (弹道) of a ball traveling through the air. Arrows indicate its momentum at several locations. At these locations, the ball's momentum is:

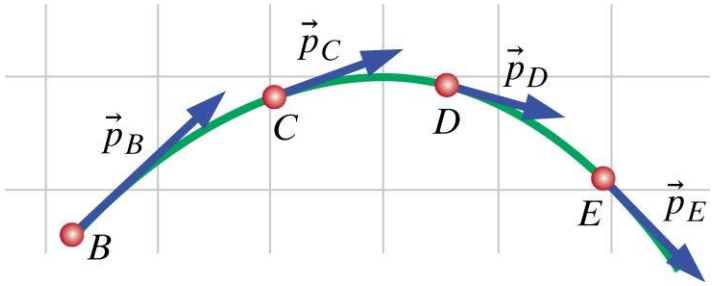
$\vec{p}_B = \langle 3.03, 2.83, 0 \rangle$ kg m/s

$\vec{p}_C = \langle 2.55, 0.97, 0 \rangle$ kg m/s

$\vec{p}_D = \langle 2.24, -0.57, 0 \rangle$ kg m/s

$\vec{p}_E = \langle 1.97, -1.93, 0 \rangle$ kg m/s

$\vec{p}_F = \langle 1.68, -3.04, 0 \rangle$ kg m/s



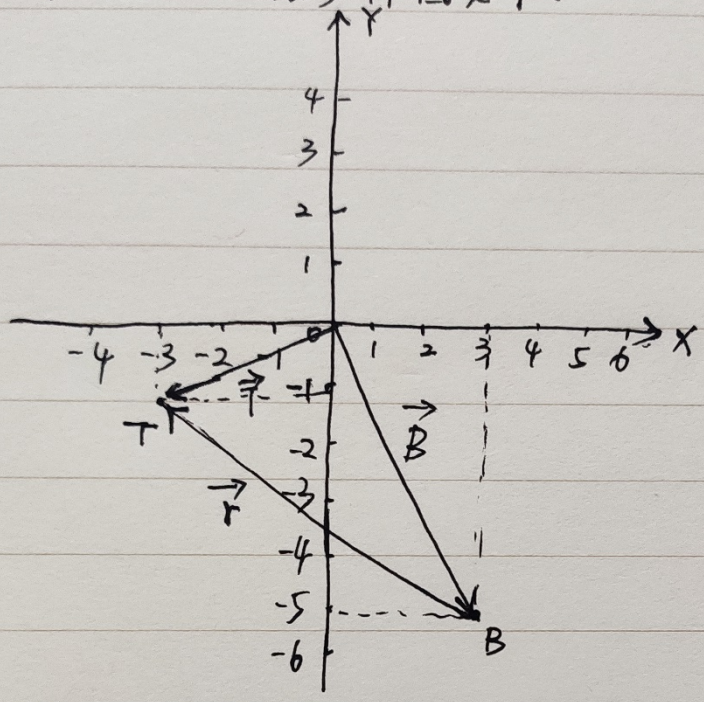
(a) Calculate the *change* in the ball's momentum between each pair of adjacent locations (B to C, C to D, etc.).

(b)On the diagram (在图上), draw arrows representing each $\Delta\vec{p}$ you calculated in part (a).

(c) Between which two locations（相邻两点） is the magnitude of the change in momentum greatest?

2020. 第一周作业

(1) (a)(b)(c)(d) 作图如下：



(e) $\vec{B}=(3,-5,0)$ $\vec{T}=(-3,-1,0)$

(f) $\vec{r}=(-6,4,0)$

(g) $\vec{T}-\vec{B}=(-3,-1,0)-(3,-5,0)=(-6,4,0)$

(h) 由(f)(g)知：$\vec{r}=\vec{T}-\vec{B}$

(i) $|\vec{B}|=\sqrt{3^2+(-5)^2+0^2}=\sqrt{34}\approx 5.83m$

$|\vec{T}|=\sqrt{(-3)^2+(-1)^2+0^2}=\sqrt{10}\approx 3.16m$

$|\vec{r}|=\sqrt{(-6)^2+4^2+0^2}=2\sqrt{13}\approx 7.21m$

(j) $|\vec{T}|-|\vec{B}|=3.16-5.83=-2.67m$

(k) $|\vec{T}-\vec{B}|=|\vec{r}|=7.21m\neq -2.67m$

所以 $|\vec{T}|-|\vec{B}|\neq|\vec{T}-\vec{B}|$

·TRANSCENDENCY·

(2)(a) 假设作匀速运动，则 $t=\frac{\Delta\vec{r}_x}{\vec{v}_x}=\frac{\Delta\vec{r}_y}{\vec{v}_y}=\frac{\Delta\vec{r}_z}{\vec{v}_z}$

$\therefore t=\frac{\Delta\vec{r}_x}{\vec{v}_x}=\frac{-200-200}{-20}s=20s$

(b) $\Delta\vec{r}=(-200,-1500,300)-(200,300,-500)$

$=(-400,-1800,800)m$

$|\Delta\vec{r}|=\sqrt{(-400)^2+(-1800)^2+800^2}m=2010m$

(c) $|\vec{v}|=\sqrt{(-20)^2+(-90)^2+40^2}m/s=100.5m/s$

(d) $\hat{v}=\frac{\vec{v}}{|\vec{v}|}=\frac{(-20,-90,40)}{100.5}m/s=(-0.20,-0.90,0.40)m/s$

(3)(a) $\vec{v}=\frac{\Delta\vec{r}}{\Delta t}=\frac{(6,-3.8,11.2)-(6,-3,10)}{10-6}m/s$

$=(0,-0.2,0.3)m/s$

在8.5秒时蝴蝶的位置：$\vec{r}_1=\vec{r}_0+\vec{v}\cdot t$

$=(6,-3,10)+(0,-0.2,0.3)\times 2.5$

$=(6,-3.5,10.75)m$

(b) 假设了蝴蝶在运动时速度保持不变.

·TRANSCENDENCY·

(4)(a) $\Delta\vec{P}_{B\to C}=\vec{P}_C-\vec{P}_B=(2.55,0.97,0)\,kg\cdot m/s-(3.03,2.83,0)\,kg\cdot m/s$

$=(-0.48,-1.86,0)\,kg\cdot m/s$

$\Delta\vec{P}_{C\to D}=\vec{P}_D-\vec{P}_C=(2.24,-0.57,0)\,kg\cdot m/s-(2.55,0.97,0)\,kg\cdot m/s$

$=(-0.31,-1.54,0)\,kg\cdot m/s$

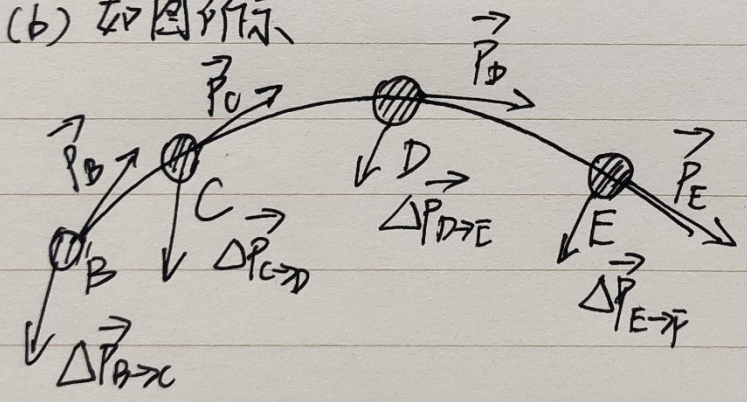
$\Delta\vec{P}_{D\to E}=\vec{P}_E-\vec{P}_D=(1.97,-1.93,0)\,kg\cdot m/s-(2.24,-0.57,0)\,kg\cdot m/s$

$=(-0.27,-1.36,0)\,kg\cdot m/s$

$\Delta\vec{P}_{E\to F}=\vec{P}_F-\vec{P}_E=(1.68,-3.04,0)\,kg\cdot m/s-(-1.97,-1.93,0)\,kg\cdot m/s$

$=(-0.29,-1.11,0)\,kg\cdot m/s$

(b) 如图所示



(c) 由(a)知，在BC之间动能最大.