## Home Work #1

#### Ali BaniAsad 401209244

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### 1 Question 1

#### 1.1 a

$$m{h} = m{r} imes m{v} = egin{bmatrix} i & j & k \\ 0 & 2 & 0 \\ rac{\sqrt{2}}{2} & rac{\sqrt{2}}{2} & 0 \end{bmatrix} = egin{bmatrix} 0 & 0 & -\sqrt{2} \end{bmatrix}$$
 $m{C} = \dot{m{r}} imes m{h} - \mu rac{m{r}}{m}$ 

In Astronomical/Canonical Units:  $\mu = 1$ 

$$\frac{C}{\mu} = e \rightarrow e = \frac{C}{\mu} = \begin{bmatrix} -1 & -1 & 0 \end{bmatrix}$$

$$\boldsymbol{h}.\boldsymbol{e} = \begin{bmatrix} 0 & 0 & -\sqrt{2} \end{bmatrix}. \begin{bmatrix} -1 & -1 & 0 \end{bmatrix} = 0$$

#### 1.2 b, c

$$r = \frac{P}{1 + e\cos(\theta)} \xrightarrow{P = \frac{h^2}{\mu}} r = \frac{h^2}{\mu} \frac{1}{1 + e\cos(\theta)} \to \theta = \arccos\left(\left(\frac{h^2}{\mu r} - 1\right)/e\right)$$

Beacuse r.v > 0,  $\theta$  is in the range  $0 \le \theta \le \pi$ 

$$\rightarrow \theta = \pi/2$$

$$\varepsilon = \frac{v^2}{2} - \frac{\mu}{r} = 0 = \text{constant}$$

#### 1.3 d

In r = 32DU,  $\varepsilon = 0$  and  $\boldsymbol{h} = \text{constant}$ , then v and  $\theta$  calculated as below:

$$\varepsilon = 0 \rightarrow v = \sqrt{\frac{2\mu}{r}} = 0.25 \ DU/TU$$

$$\theta = \arccos\left(\left(\frac{h^2}{\mu r} - 1\right)/e\right) = 2.7862_{rad}$$

Ali BaniAsad 401209244 CONTENTS

## Contents

1	Question 1	1
	1.1 a	1
	1.2 b, c	1
	1.9 d	1

Ali BaniAsad 401209244 LIST OF FIGURES

# List of Figures

Ali BaniAsad 401209244 LIST OF TABLES

## List of Tables