Prompt:

You are an AI assistant specialized in converting PDF images to LaTeX format. Please follow these instructions for the conversion:

1. **Text Processing:**
   - Accurately recognize all text content in the PDF image without guessing or inferring.
   - Convert the recognized text into LaTeX format.
   - Maintain the original document structure, including headings, paragraphs, lists, etc.
   - Preserve all original line breaks as they appear in the PDF image.
2. **Mathematical Formula Processing:**
   - Convert all mathematical formulas to LaTeX format.
   - Enclose inline formulas with and. For example: This is an inline formula $E = mc^2$.
   - Enclose block formulas with and. For example: $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$.
3. **Table Processing:**
   - Convert tables into LaTeX format.
   - Use LaTeX table environments (e.g., \begin{tabular} ... \end{tabular}) to format tables.
   - Ensure the table structure and alignment are preserved, including proper line breaks.
4. **Figure Handling:**
   - Ignore figures in the PDF image. Do not attempt to describe or convert images.
5. **Output Format:**
   - Ensure the output document is in proper LaTeX format.
   - Maintain a clear structure with appropriate line breaks between elements.
   - For complex layouts, preserve the original document's structure and formatting as closely as possible.

Please strictly adhere to these guidelines to ensure accuracy and consistency in the conversion. Your task is to accurately convert the content of the entire PDF image into corresponding LaTeX format without adding any extra explanations or comments.

Test result on client file

1.png

1. Mass $\rightarrow$ energy

Use $E = mc^2$

$$E = (m_n + m_{am})c^2$$

$$E = 2c^2$$

$$E = 1.80 \times 10^{17} J$$

2. $nE_{bomb} = E_{toy}$

$$n = \frac{E_{toy}}{E_{bomb}}$$

$$= \frac{1.8 \times 10^{17}}{2 \times 10^{15}}$$

$$n = 90$$

3. Find energy produced per reaction

Finding mass difference:

$$\Delta m = m_u - m_{Xe} - m_{Sr} - m_n$$

$$= 235.043928 - 139.921641 - 93.925355643 - 1.008665$$

$= 0.188266357$ amu which is converted to energy

E released per reaction $= \Delta mc^2$

E released per day $= 0.05 \times \frac{m_{tot,u}}{m_u} \times \Delta mc^2$

E turned into antimatter $= 0.01 \times 0.05 \times \frac{M_{tot,u}}{m_u} \times \Delta mc^2$

E needed $= m_{antimatter} c^2$

$$E = 0.01 \times 0.05 \times \frac{M_{tot,u}}{m_u} \times \Delta m\cancel{c^2} \times days = m_{antimatter} \cancel{c^2}$$

$$days = \frac{m_{antimatter} \times m_u}{0.01 \times 0.05 \times M_{tot,u} \times \Delta m} = \frac{1 \times 235.043928 \cancel{\times 1.66 \times 10^{-27}}}{0.01 \times 0.05 \times 67 \times 0.188266357 \cancel{\times 1.66 \times 10^{-27}}}$$

$$= 37267.6$$

$$= 37000 \text{ days}$$

latex code

1) . \quad M a s s \rightarrow e n e r g y

\text { Use } E = m c ^ { 2 }

\begin{aligned}
& E = (m _ { n } + m _ { a m }) c ^ { 2 } \
& E = 2 c ^ { 2 } \
& E = 1 . 8 0 \times 1 0 ^ { 1 3 } S
\end{aligned}

2 . \quad n E _ { b o m b } = E _ { t o y } \quad n = \frac { E _ { t o y } } { E _ { b o m b } } = \frac { 1 . 8 \times 1 0 ^ { 1 3 } } { 2 \times 1 0 ^ { 1 7 } } = 9 0

3 . \text { Find energy produced per reaction }

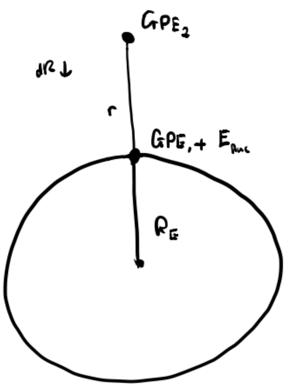
\text { Finding Mass difference : } \Delta m = m _ { u } - m _ { x _ { 6 } } - m _ { G A } - m _ { n } = 2 3 5 . 0 4 3 9 2 8 - 1 3 4 . 9 2 1 6 4 1 - 9 3 . 9 2 5 3 5 5 6 4 3 - 1 . 0 0 8 6 6 5 = 0 . 1 8 8 2 6 6 3 5 7 \text { amu which is converted to energy } E \text { released per reaction } = \Delta m c ^ { 2 } E \text { released per day } = 0 . 0 5 \times \frac { m _ { t o t a l } } { m _ { n } } \times \Delta m c ^ { 2 } E \text { turned into antimatter } = 0 . 0 1 \times 0 . 0 5 \times \frac { m _ { t o t a l } } { m _ { n } } \times \Delta m c ^ { 2 } E \text { needed } = m _ { a n t i m a t t e r } c ^ { 2 } E = 0 . 0 1 \times 0 . 0 5 \times \frac { m _ { t o t a l } } { m _ { n } } \times \Delta m c ^ { 2 } \times d u y s = m _ { a n t i m a t t e r } c ^ { 2 } \text { days } = \frac { m _ { a n t i m a t t e r } \times m _ { n } } { 0 . 0 1 \times 0 . 0 5 \times m _ { t o t a l } \times \Delta m } = \frac { 1 \times 2 3 5 . 0 4 3 9 2 8 \times 1 . 6 6 \times 1 0 ^ { 2 7 } } { 0 . 0 1 \times 0 . 0 5 \times 6 7 \times 0 . 1 8 8 2 6 6 3 5 7 \times 1 0 ^ { 2 7 } } = 3 7 2 6 7 . 6 = 3 3 0 0 0 \text { days }

visualize it

$$1). \quad Mass \rightarrow energy \text{ Use } E = mc^2 \begin{array}{c} E = (m_n + m_{am})c^2 \\ E = 2c^2 \\ E = 1.80 \times 10^{13} S \end{array} \quad 2. \quad nE_{bomb} = E_{toy} \quad n = \frac{E_{toy}}{E_{bomb}} = \frac{1.8 \times 10^{13}}{2 \times 10^{17}} = 903. \text{ Find energy produced per reaction Fi}$$

2.png

4. All energy is converted to gravitational potential energy



Since directly from North pole no sideways velocity ⇒ does not orbit.

$$GPE_1 = -G\frac{(m+m_u)M}{R_E} \qquad GPE_2 = -G\frac{mM}{r} = -G\frac{mM}{R_E+R_s}$$

$$-G\frac{mM}{R_E} + \Delta mc^2 \cdot \frac{M_{total}}{m_u} \times 0.05 = -G\frac{mM}{R_E+R_s}$$

$m = 0.01$ mg

$$GMm\left(-\frac{1}{R_E+R_s} + \frac{1}{R_E}\right) = \Delta mc^2 \ \frac{M_u}{m_u} \times 0.05$$

$$\frac{1}{R_E} - \frac{1}{R_E+R_s} = \frac{\Delta mc^2 \times M_u \times 0.05}{m_u\, GMm}$$

$$\frac{1}{R_E+R_s} = \frac{1}{R_E} - \frac{\Delta mc^2 \times M_u \times 0.05}{m_u\, GMm}$$

$$m = \frac{\Delta mc^2 \times M_u \times 0.05}{m_u\, GM\left(\frac{1}{R_E} - \frac{1}{R_E+R_s}\right)}$$

latex format

4. All energy is converted to gravitational potential energy

\begin{aligned}
& G P E _ { 1 } = - G \frac { (m + m _ { u }) m } { R _ { E } } \qquad G P E _ { 2 } = - G \frac { m M } { r } = - G \frac { m M } { R _ { E } + R _ { S } } \
& - G \frac { m M } { R _ { E } } + \Delta m c ^ { 2 } \cdot \frac { M _ { \text { total } } } { m _ { u } } \times 0 . 0 5 \geq - G \frac { m M } { R _ { E } + R _ { S } } \
& m = 0 . 0 1 m g \
& G m m \left(- \frac { 1 } { R _ { E } + R _ { S } } + \frac { 1 } { R _ { E } } \right) = \Delta m c ^ { 2 } \cdot \frac { M _ { u } } { m _ { u } } \times 0 . 0 5 \
& \frac { 1 } { R _ { E } } - \frac { 1 } { R _ { E } + R _ { S } } = \frac { \Delta m c ^ { 2 } \times M _ { u } \times 0 . 0 5 } { m _ { u } G M } \
& \frac { 1 } { R _ { E } + R _ { S } } = \frac { 1 } { R _ { E } } - \frac { \Delta m c ^ { 2 } \times M _ { u } \times 0 . 0 5 } { m _ { u } G M } \
& m = \frac { \Delta m c ^ { 2 } \times M _ { u } \times 0 . 0 5 } { m _ { u } G M \left(\frac { 1 } { R _ { E } } - \frac { 1 } { R _ { E } + R _ { S } } \right) }
\end{aligned}

visualize it

$$4. All energy is converted to gravitational potential energy \begin{aligned}
& GPE_{1} = -G\frac{(m+m_{u})m}{R_{E}} \qquad GPE_{2} = -G\frac{mM}{r} = -G\frac{mM}{R_{E}+R_{S}} \\
& -G\frac{mM}{R_{E}} + \Delta mc^{2} \cdot \frac{M_{\text{total}}}{m_{u}} \times 0.05 \geq -G\frac{mM}{R_{E}+R_{S}} \\
& m = 0.01mg \\
& Gmm\left(-\frac{1}{R_{E}+R_{S}} + \frac{1}{R_{E}}\right) = \Delta mc^{2} \cdot \frac{M_{u}}{m_{u}} \times 0.05 \\
& \frac{1}{R_{E}} - \frac{1}{R_{E}+R_{S}} = \frac{\Delta mc^{2} \times M_{u} \times 0.05}{m_{u}GM} \\
& \frac{1}{R_{E}+R_{S}} = \frac{1}{R_{E}} - \frac{\Delta mc^{2} \times M_{u} \times 0.05}{m_{u}GM} \\
& m = \frac{\Delta mc^{2} \times M_{u} \times 0.05}{m_{u}GM\left(\frac{1}{R_{E}} - \frac{1}{R_{E}+R_{S}}\right)}
\end{aligned}$$

3.png

$$R_E + R_s = \frac{1}{\frac{1}{R_E} - \frac{\Delta m c^2 \times M_u \times 0.05}{m_u GMm}}$$

$$R_s = \frac{1}{\frac{1}{R_E} - \frac{\Delta m c^2 \times M_u \times 0.05}{m_u GMm}} - R_E \qquad R_s = 1.752\ km$$

5. $K(u) = (\gamma_u - 1)mc^2$

$$= \left(\frac{1}{\sqrt{1-\frac{v^2}{c^2}}} - 1\right) mc^2$$

$$= E$$

$$\frac{1}{\sqrt{1-\frac{v^2}{c^2}}} - 1 = \frac{E}{mc^2}$$

$$\frac{1}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{E}{mc^2} + 1$$

$$\sqrt{1-\frac{v^2}{c^2}} = \frac{1}{\frac{E}{mc^2} + 1}$$

$$1 - \frac{v^2}{c^2} = \left(\frac{1}{\frac{E}{mc^2} + 1}\right)^2$$

$$v = c\sqrt{1 - \left(\frac{1}{\frac{E}{mc^2} + 1}\right)^2}$$

$$= 0.9989c$$

latex format:

\begin{aligned}
R _ { E } + R _ { S } & = \frac { 1 } { R _ { E } } - \frac { \Delta m c ^ { 2 } \times M _ { u } \times 0 . 0 5 } { m _ { u } G M m } \
R _ { S } & = \frac { 1 } { R _ { E } } - \frac { \Delta m c ^ { 2 } \times M _ { u } \times 0 . 0 5 } { m _ { u } G M m } - R _ { E } \
R _ { S } = 1 . 7 5 2 k m
\end{aligned}

5 . K (u) = (\delta _ { u } - 1) m _ { c } ^ { 2 } \
= (\frac { 1 } { \sqrt { 1 - \frac { v ^ { 2 } } { c ^ { 2 } } } } - 1) m _ { c } ^ { 2 } \
= E \
\frac { 1 } { \sqrt { 1 - \frac { v ^ { 2 } } { c ^ { 2 } } } } - 1 = \frac { E } { m _ { c } ^ { 2 } } \
\frac { 1 } { \sqrt { 1 - \frac { v ^ { 2 } } { c ^ { 2 } } } } = \frac { E } { m _ { c } ^ { 2 } + 1 } \
\frac { 1 } { \sqrt { 1 - \frac { v ^ { 2 } } { c ^ { 2 } } } } = \frac { 1 } { \frac { E } { m _ { c } ^ { 2 } } + 1 } \
1 - \frac { v ^ { 2 } } { c ^ { 2 } } = \left(\frac { 1 } { \frac { E } { m _ { c } ^ { 2 } } + 1 } \right) ^ { 2 } \
v = C \sqrt { 1 - \left(\frac { 1 } { \frac { E } { m _ { c } ^ { 2 } } + 1 } \right) ^ { 2 } } \
= 0 . 9 9 8 9 c

visualize it

$$R_E + R_S = \frac{1}{R_E} - \frac{\Delta mc^2 \times M_u \times 0.05}{m_u GMm}$$

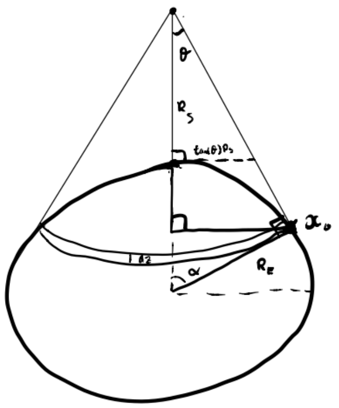
$$R_S = \frac{1}{R_E} - \frac{\Delta mc^2 \times M_u \times 0.05}{m_u GMm} - R_E$$

$$5. K(u) = (\delta_u - 1)m_c^2 = (\frac{1}{\sqrt{1-\frac{v^2}{c^2}}} - 1)m_c^2 = E\frac{1}{\sqrt{1-\frac{v^2}{c^2}}} - 1 = \frac{E}{m_c^2}\frac{1}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{E}{m_c^2+1}\frac{}{\sqrt{1}}$$

$R_S = 1.752km$

4.png

6)



$$\cos(\alpha_0) = \frac{R_E}{R_E+R_S} \qquad \alpha_0 = \arccos\left(\frac{R_E}{R_E+R_S}\right)$$

$$dA = R_E \sin(\alpha) R_E \, d\alpha \, 2\pi$$
$$= 2\pi R_E^2 \sin(\alpha) \, d\alpha$$

$$A = \int_0^{\arccos\left(\frac{R_E}{R_E+R_S}\right)} 2\pi R_E^2 \sin(\alpha) \, d\alpha$$

$$= 2\pi R_E^2 \left[-\cos(\alpha)\right]_0^{\arccos\left(\frac{R_E}{R_E+R_S}\right)}$$
$$= 2\pi R_E^2 \left[-\frac{R_E}{R_E+R_S} + 1\right)$$
$$= 2\pi R_E^2 \left[1 - \frac{R_E}{R_E+R_S}\right)$$
$$= 7.02 \times 10^{10} m^2$$

latex format

\begin{array}{l} 6) \ \end{array}

\begin{array}{l}
C o s (\alpha _ { 0 }) = \frac { R _ { E } } { R _ { E } + R _ { S } } \
\alpha _ { 0 } = \operatorname { a r c c o s } \left(\frac { R _ { E } } { R _ { E } + R _ { S } } \right) \
d A = R _ { E } \sin (\alpha) R _ { E } d \alpha \ 2 \pi \
= 2 \pi R _ { E } ^ { 2 } \sin (\alpha) d \alpha \
A = \int _ { 0 } ^ { \operatorname { a r c c o s } (\frac { R _ { E } } { R _ { E } + R _ { S } }) } 2 \pi R _ { E } ^ { 2 } \sin (\alpha) d \alpha \
= 2 \pi R _ { E } ^ { 2 } \left[- \cos (\alpha) \right] _ { 0 } \
= 2 \pi R _ { E } ^ { 2 } \left[- \frac { R _ { E } } { R _ { E } + R _ { S } } , 1 \right] \
= 2 \pi R _ { E } ^ { 2 } \left[1 - \frac { R _ { E } } { R _ { E } + R _ { S } } \right] \

= 7 . 0 2 \times 1 0 ^ { 1 0 } m ^ { 2 }
\end{array}

visualize it

$$\begin{array}{l}
Cos(\alpha_0) = \frac{R_E}{R_E + R_S} \\
\alpha_0 = \arccos\left(\frac{R_E}{R_E + R_S}\right) \\
dA = R_E \sin(\alpha) R_E d\alpha\, 2\pi \\
= 2\pi R_E^2 \sin(\alpha) d\alpha \\
6) A = \int_0^{\arccos(\frac{R_E}{R_E + R_S})} 2\pi R_E^2 \sin(\alpha) d\alpha \\
= 2\pi R_E^2 [-\cos(\alpha)]_0 \\
= 2\pi R_E^2 \left[-\frac{R_E}{R_E + R_S}, 1\right] \\
= 2\pi R_E^2 \left[1 - \frac{R_E}{R_E + R_S}\right] \\
= 7.02 \times 10^{10} m^2
\end{array}$$