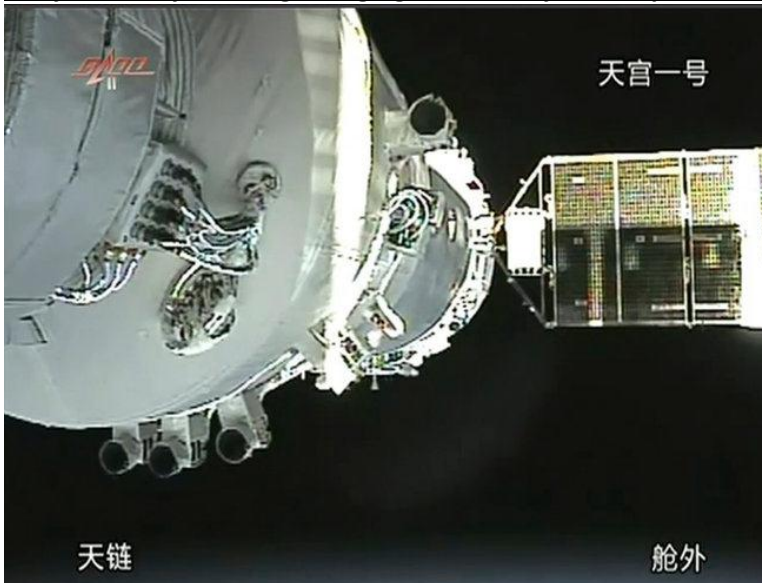


CENTRIPETAL FORCE & GRAVITY Unit 14 & 8 Dr. John P. Cise, Professor

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By Andrew Jacobs . Please send Dr Cise an e-mail on how you used this NYTimes Physics application. Thanks! Dr Cise

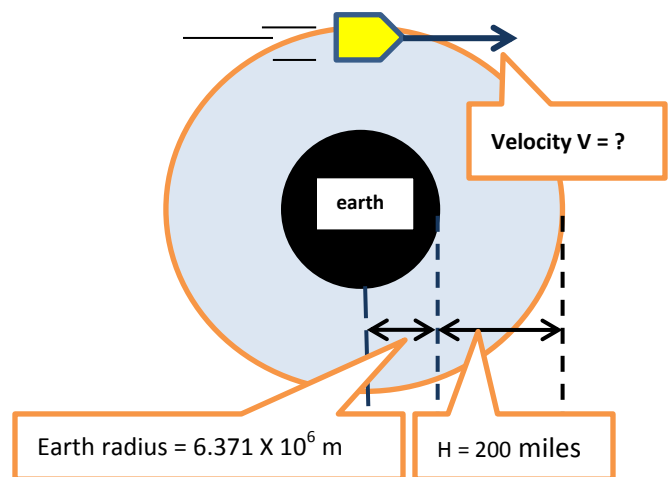
China's Space Program Bolstered by First Docking

BEIJING — With a “kiss” **more than 200 miles above Earth**, a pair of Chinese spacecraft successfully coupled early Thursday morning, bringing the country one step closer to its four-decade quest for manned space exploration.



A still image from a Chinese broadcast on Thursday of the docking of the Shenzhou 8 capsule with the Tiangong 1 module.

INTRODUCTION: Gravity ($F = G[m_{\text{satellite}}M_{\text{earth}}]/R^2$) supplies the needed centripetal force ($m_{\text{satellite}}V^2/R$) to keep the satellite in orbit 200 miles above the earth. Where $R = R_{\text{earth}} + H$. Thus,
$$V^2 = GM_{\text{earth}}/R$$



INTRODUCTION #2: $G =$ gravitational constant = $6.673 \times 10^{-11} \text{ m}^3/\text{kg s}^2$, $M_{\text{earth}} = 5.97 \times 10^{24} \text{ kg}$, $1.61 \times 10^3 \text{ m/mile}$.

QUESTIONS: (a) Convert height of satellite, 200 miles into meters? (b) Find $R = R_{\text{earth}} + H$ in meters? (c) Find velocity V (in m/s) at which the satellite must travel at to stay at orbit 200 miles? (d) Convert answer (c) into mph?

ANSWERS: (a) 322,000 m , (b) $6.693 \times 10^6 \text{ m}$. (c) $\sim 7715 \text{ m/s}$, (d) $\sim 17,258 \text{ mph}$

The docking of the Shenzhou 8 capsule with the Tiangong 1 module was broadcast live on national television. Prime Minister [Wen Jiabao](#) watched from the control center in Beijing, and thousands of citizens expressed their pride through Internet postings in what many referred to as the country's first “space kiss,” remarking how far [China](#) had come since its more impoverished days.

In the coming year, **officials plan to repeat the unmanned exercise with astronauts as part of its mission to reach the moon and to launch its own space station by 2020.** If all goes according to plan, China's floating laboratory would become airborne around the same time the aging International Space Station goes into retirement. American and Russian aerospace engineers perfected space docking in the 1960s, but Wu Ping, a spokeswoman for China's manned space program, said that Chinese scientists had come to this moment largely on their own, having domestically produced hundreds of components and instruments. “This makes China one of the few countries in the world that can independently research and develop docking mechanisms,” Ms. Wu said at a news conference on Thursday, describing the achievement as “a historic breakthrough for our country and a huge technical leap forward.” Some Western scientists, however, said the successful mission provided stark evidence that the 20-year-old sanctions that limit cooperation between American and Chinese aeronautical engineers had failed.