

CENTRIPETAL FORCE PROVIDED BY GRAVITY Units 9 & 8

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Russians Fight to Save Mars Probe After Mishap

By HENRY FOUNTAINNOV. 9, 2011

Russian space engineers scrambled Wednesday to salvage an **ambitious science mission to Mars** after the unmanned spacecraft became stranded in Earth orbit. If they are not successful, the probe, which is loaded with toxic fuel, could re-enter the atmosphere within days or weeks. The spacecraft, a high-stakes effort to bring back soil samples from the Martian moon Phobos — and to return Russia to prominence in planetary exploration after a long dry spell — was launched from Kazakhstan atop a Zenit rocket early Wednesday. Russian officials said that the launching was normal. But then, once the spacecraft was in orbit, two planned firings of its propulsion system, intended to send it on the nearly yearlong journey to Mars, did not occur. “The engines did not fire, not the first or the second time,” said Vladimir Popovkin, director of the Russian space agency Roscosmos. An unnamed person in Russia’s space industry told the Interfax news agency that there had been warnings before the launching that glitches in the probe’s command and control system had not been fully resolved. “The risk of failure because of its abnormal operation was very high. Unfortunately, the worst forecasts have come true,” the person said.

The failure left the 30,000-pound, \$170 million probe, called Phobos-Grunt — “grunt” being the Russian word for ground — stuck in an egg-shaped orbit that at its lowest point is just ((129 miles above the Earth))). The atmosphere, though thin at that altitude, will create enough drag to eventually cause the spacecraft to fall to Earth. When and where that might happen, and how much of the spacecraft might survive a fiery re-entry, is impossible to predict at this point. Roughly two-thirds of the spacecraft’s weight is in fuels, including hydrazine, which is highly corrosive and toxic. The probe also contains a small amount of radioactive cobalt used in one of its instruments, though that presents no danger, a person at the Kazakhstan launching center told the news agency Ria Novosti. Engineers were waiting to re-establish communication with the probe — expected early Thursday morning Moscow time — to send new engine-firing instructions to its computers. But there was no guarantee that the problem was a software one, and the engineers were racing the clock: although the spacecraft has enough power for at least three days and probably longer, the decaying orbit means it could soon reach a point where the engines would not be able to send it away from Earth, said Anatoly Zak, an expert on the Russian space program who tracks the country’s efforts at russianspaceweb.com. NASA said it would help, if asked. “Should Roscosmos need it, we will do our best to provide the services of the space communications and navigation networks, which support NASA’s satellites and spacecraft,” said Michael J. Braukus, a NASA spokesman.

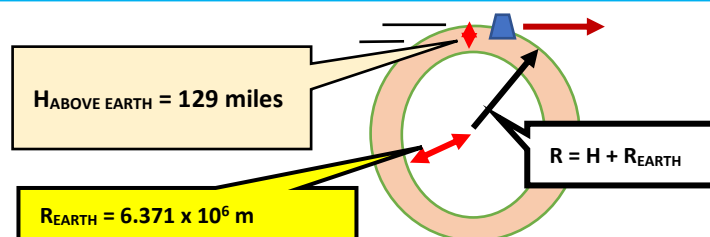


Russian space engineers working recently in Kazakhstan to prepare the unmanned spacecraft.

INTRODUCTION: Centripetal force to keep space craft in orbit is $mv^2/R = g m M_e/R^2$, Thus: $v = (G M_e/R)^{1/2}$

QUESTIONS: (a) Convert 129 miles to meters?, (b) Find speed (in m./s. & mph) spacecraft should have to in orbit at 129 miles up?

HINTS: 1609.34 m./mile, $G = 6.67 \times 10^{-11} \text{ N m}^2/\text{kg}^2$
 $M_{\text{EARTH}} = 5.972 \times 10^{24} \text{ kg}$, 2.377 mph/[m./s.]



ANSWERS: (a) 207,605.38 m., (b) $v = \sim 7,781.1 \text{ m./s.}$ or 17,718 mph

COMMENT: Apparently the speed was too little. Air friction caused the spacecraft to slow down and gravity brought it down

Phobos-Grunt spacecraft is also carrying a 250-pound Chinese satellite that is meant to orbit Mars and study its environment. “It’s interesting that the Chinese were sending along a piggyback payload,” said Scott Pace, director of the Space Policy Institute at George Washington University. “They have to be disappointed” that the mission is in jeopardy, he added.