

NEWTON'S 2ND LAW

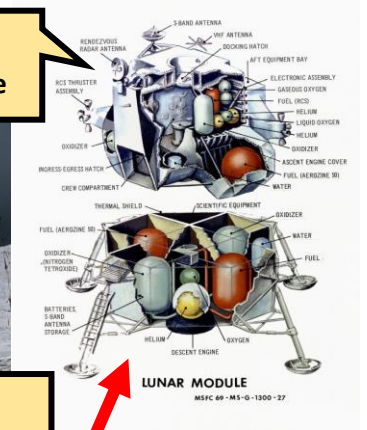
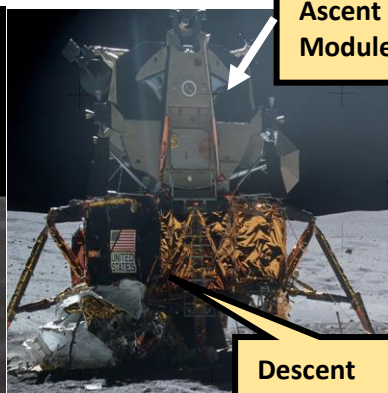
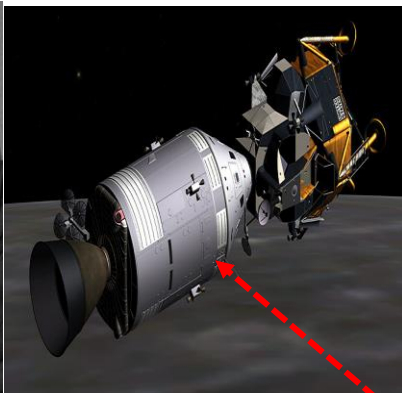
Units 6 & 7 Dr. John P. Cise, Professor of Physics, Austin Com. College,

1212 Rio Grande St., Austin Tx. 78701 ipcise@austincc.edu & New York Times, Sept. 25, 2016 by Sam Roberts

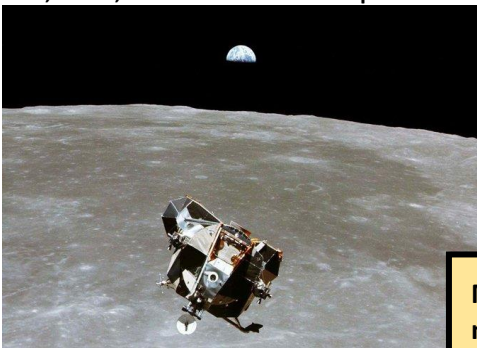
Jack Garman, Whose Judgment Call Saved Moon Landing, Dies at 72



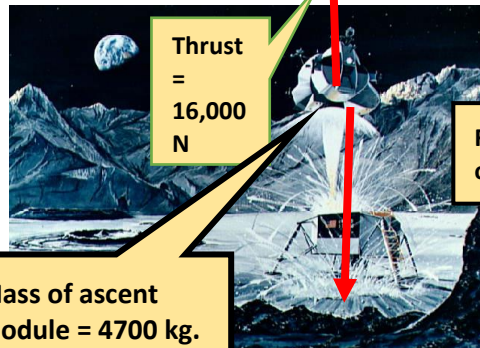
Jack Garman in 1968. He had long career at NASA.



On July 20, 1969, moments after mission control in Houston had given the **Apollo 11 lunar module**, Eagle, the O.K. to begin its descent to the **moon**, a yellow warning light flashed on the cockpit instrument panel. "Program alarm," the commander, **Neil Armstrong**, radioed. "It's a 1202." The alarm appeared to indicate a computer systems overload, raising the specter of a breakdown. With only a few minutes left before touchdown on the moon, Steve Bales, the guidance officer in mission control, had to make a decision: Let the module continue to descend, or abort the mission and send the module rocketing back to the **command ship, Columbia**. By intercom, Mr. Bales quickly consulted Jack Garman, a 24-year-old engineer who was overseeing the software support group from a back-room console. Mr. Garman had painstakingly prepared himself for just this contingency — the possibility of a false alarm. "So I said," he remembered, "on this backup room voice loop that no one can hear, 'As long as it doesn't reoccur, it's fine.'" At 4:18 p.m., with only 30 seconds of fuel remaining for the descent, Mr. Armstrong radioed: "Houston, Tranquillity Base here. **The Eagle has landed.**" Mr. Garman, whose self-assurance and honed judgment effectively saved mankind's first lunar landing, died on Tuesday outside Houston. He was 72. His wife, Susan, said the cause was complications of bone marrow cancer.



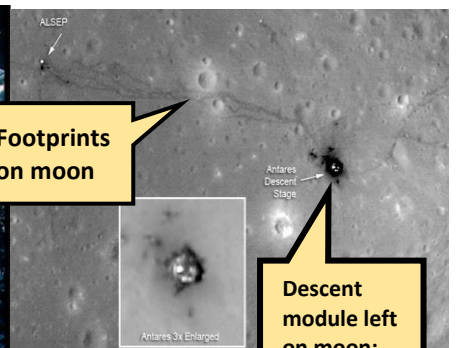
The Apollo 11 Lunar Excursion Module, Photo from the command module in July 1969.



Thrust = 16,000 N

Footprints on moon

Mass of ascent module = 4700 kg.



Descent module left on moon: 1969

INTRODUCTION: Moon gravity is 1.625 m./s.². The lunar excursion module's (LEM) **ascent module** has a mass of 4700 kg.

QUESTIONS: (a) Find **ascent module's** weight on moon?, (b) Find net force (thrust given in graphic) **on ascent module** at launch from lunar surface in 1969?, (c) Find **acceleration of ascent module** from lunar surface?, (d) Find distance traveled from lunar surface 20 seconds after liftoff? , (e) Find **speed of ascent module** 20 seconds after launch from lunar surface? (f) With 16,000 N of thrust off lunar surface, could ascent module blast off earth's surface ?, (g) Explain your answer to (f)

ANSWERS: (a) 7637.5 N , (b) F_{NET} = 8362.5 N., (c) a = 1.78 m./s.² , (d) y = 355.9 ft., (e) v = 35.6 ft./s. (f) _____.