NEXT-TIME QUESTION

When at rest on the launching pad, the force of gravity on the space shuttle is quite huge—the weight of the shuttle. When in orbit, some 200 km above Earth's surface, the force of gravity on the shuttle is

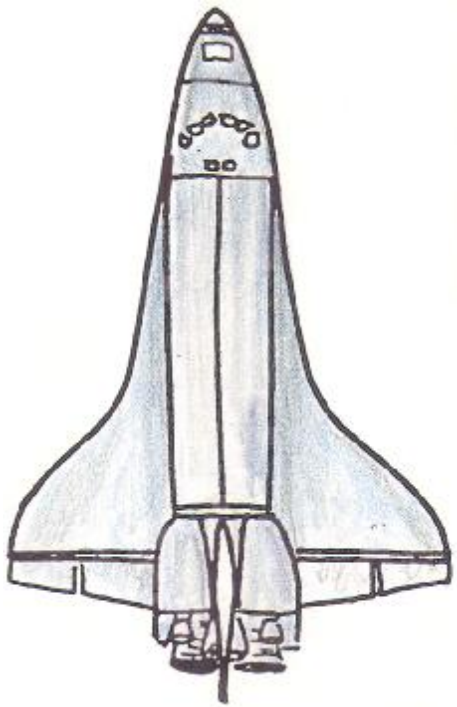
a) nearly as much.

b) about half as much.

c) nearly zero (micro-gravity).

d) zero.

(Neglect changes in the weight of the fuel carried by the shuttle.)



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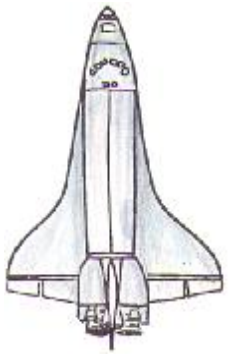
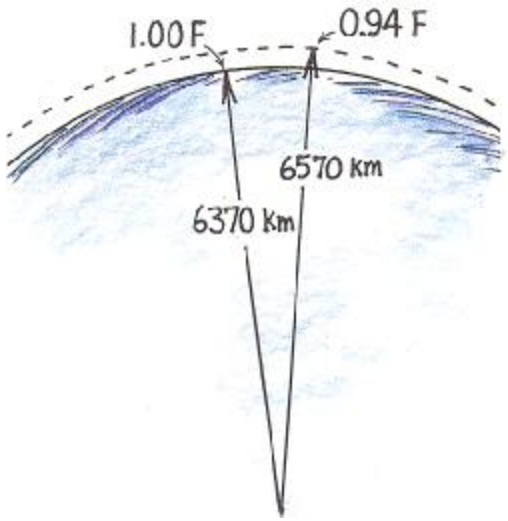


Answer: a, nearly as much

The gravitational force on the shuttle, whether at rest or in orbit, depends on only 3 things: its mass, the mass of Earth, and its distance from Earth's center. The only variable is distance. On the launching pad the shuttle is about 6370 km from Earth's center. When in orbit it is about 6370 + 200 km from Earth's center. In accord with $F = GmM/R^2$, the 200-km difference in distance means a 0.06 fractional difference in force. Discounting the changes in the fuel, the gravitational force on the shuttle in orbit is 94% as much as when on Earth's surface—nearly the same.



This force isn't sensed by astronauts because they're in continual free fall. But it's there!

If it weren't, the craft would fly away from Earth in a straight-line path.

Hewitt Drew it!