Recall that the radius of the earth is $6.4 \times 10^6$ m. Then, if an object 10 km above the earth's surface feels a gravitational force, $F_G = mg_{10k}$, the same object, when 20 km above earth's surface, will feel, most nearly, a gravitational force, $F_G =$

a) $2mg_{10k}$

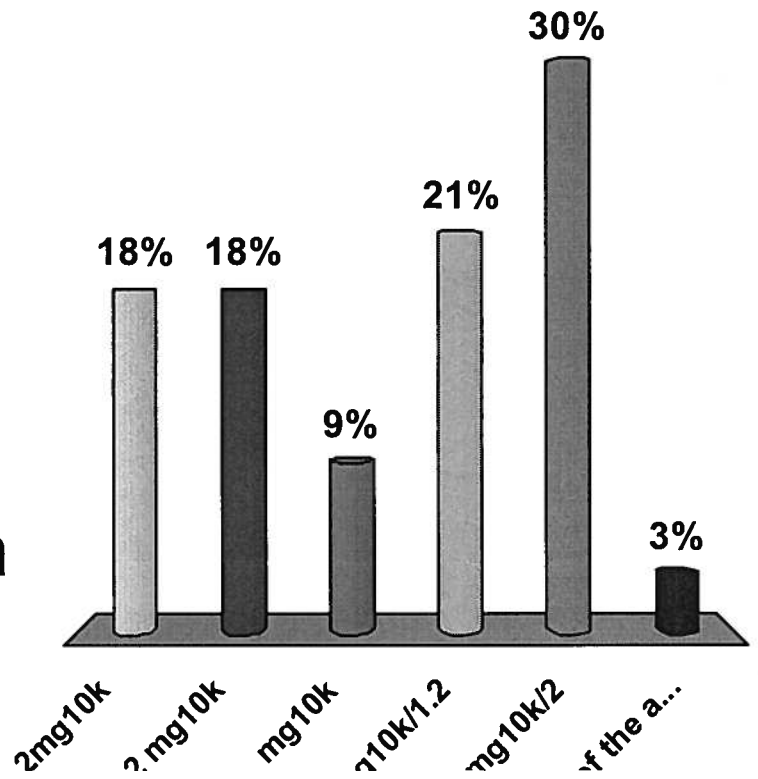
b) $1.2\ mg_{10k}$

✓c) $mg_{10k}$

d) $mg_{10k}/1.2$

e) $mg_{10k}/2$

f) None of the above is within 10% of the correct force.



# The correct answer, most nearly, is c) $F_G = mg_{10k}$; as follows.

- The exact Gravitational force on mass, m, at height, h, above the earth's surface (or at distance, $R_E$+h, from the center of the earth) is $F_G = GmM_E/(R_E+h)^2$ .
- Since $R_E = 6.4 \times 10^6$ m = $6.4 \times 10^3$ km, we compute that
- $(R_E+h) = (6.4 +0.01)x10^3$ km at h=10 km, and $(R_E+h) = (6.4 +0.02)x10^3$ km at h=20 km differ by less than (1/6)%.
- Therefore, the force at 20 km differs by much less than 1% from the force at 10 km.
- Thus, most nearly, the two forces are the same: Answer c) is correct.