

A. Due Problems 3.26, 3.27, 3.31 and 3.37 in your text.

B. Carbon-14 dating is a way of determining the age of certain archeological artifacts of a biological origin up to about 50,000 years old.

- (a) Explain why there is an ~ 50,000 yr limit on the dating of carbon-based archeological artifacts.

A child mummy is found high in the Andes. Analysis of its remains shows that the C-14 has decayed to 35% of living tissue.

- (b) When did the child die?

**C. Radio-dating authenticates Biblical tunnel**

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Biblical accounts of the construction of an ancient underground tunnel below Jerusalem have been verified by dating the material lining its walls.

The books of Kings and Chronicles report that the Siloam tunnel was built by King Hezekiah, ruler of Judea 2700 years ago. Its aim was to provide a secret source of drinking water should the city face a siege by Assyrian assailants. Even today, the tunnel delivers water from the Gihon Spring to the Siloam Pool, 500 metres away.

Some scholars have questioned the biblical account, suggesting that the tunnel, which is up to 30 metres below ground, was built 500 or so years later. But a team led by Amos Frumkin of the Hebrew University of Jerusalem has now settled the argument by radio-dating the tunnel's lining. Frumkin says the tunnel is the first biblical structure dating from the Iron Age to be authenticated.

Frumkin and his colleagues found plant material in the plaster lining the tunnel, and stalactites that began to grow from the ceiling shortly after its completion. They then used radio-isotope dating to establish how old they were. For the plants, carbon dating was used, measuring the

carbon-14 isotope and its decay product carbon-12. For the stalactites, isotopes of the elements uranium and thorium were measured.

"They're two complementary methods," says Frumkin. Taken together they indicate that the tunnel originated about 700 BC, as stated in the Bible. "It verifies the biblical account, and that King Hezekiah was responsible."

(a). What is the nuclear reaction describing uranium 235 decay?

(b) U-235 has a half life of  $7.1 \times 10^8$  years. What is the radioisotope ratio measured in the stalactites in the cave?