

Q11 Why is there a need for dark matter to be abundant; what is the best description of our current understanding of the nature of the dark matter? Pencil across *one* cell in row 11. NB: Not all of the statements in the key are necessarily true.

KEY for Q11

- A Dark matter probably promoted the formation of galaxies; it probably consists largely of cold hydrogen atoms. ~~X~~
  - B Dark matter probably promoted the formation of galaxies; it probably consists largely of energetic (hot) neutrinos of non-zero mass. ~~X~~
  - C Dark matter seems necessary to explain the filamentary and sheet-like distribution of galaxies in space; it probably consists almost entirely of energetic (hot) neutrinos of non-zero mass, with negligible proportions of other contributions. ~~X~~
  - D Dark matter seems necessary to explain the filamentary and sheet-like distribution of galaxies in space; it probably consists almost entirely of cold, non-baryonic particles, with negligible proportions of other contributions. ~~X~~
  - E Dark matter seems necessary to explain the filamentary and sheet-like distribution of galaxies in space; it almost certainly consists of a mixture of cold, non-baryonic particles, and energetic (hot) neutrinos of non-zero mass. ~~X~~
  - F Dark matter seems necessary to explain the filamentary and sheet-like distribution of galaxies in space; some mix of cold non-baryonic particles and energetic (hot) neutrinos of non-zero mass is a possibility. ✓
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Q12 All the galaxies in a certain supercluster that have had their redshifts measured have smaller redshifts than expected from Hubble's Law applied to galaxies at the supercluster's distance. What is the most appropriate interpretation of this observation? Pencil across *one* cell in row 12. NB: Not all of the statements in the key are necessarily true.

KEY for Q12

- A The galaxies in the supercluster are orbiting around the centre of the supercluster. ~~X~~
- B The galaxies in the supercluster are expanding outwards from the centre of the supercluster. ~~X~~
- C There is a mass concentration between us and the supercluster. ✓
- D There is a mass concentration beyond the supercluster. ~~X~~
- E The supercluster is moving in accord with the Hubble flow. ~~X~~
- F The supercluster has an excess of quasars. ~~X~~