The University Of Sheffield.

Department of Physics And Astronomy.

Autumn Semester 2006-7 2 hours

OUR EVOLVING UNIVERSE
SECTION A

Answer ALL questions in this section. At the end of the examination, tie this paper to your answer book for Sections B and C and hand them in together. Remember to fill in your anonymous number in the space below.

You should not spend more than 45–50 minutes on this section of the examination paper.

Candidate's anonymous number: ……

Desk number: …….. Date: …….

Each question is worth 1 mark.

Multiple choice questions have four possible answers labelled (a) to (d). Circle the letter corresponding to your selected answer. If you change your mind, cross out your original circle and circle your new choice, as in the example below.
A multiple-choice question with more than one choice circled will get no marks.

Example:

A0 This is an example question.

(a) your original choice

(b) another answer

(c) your new choice

(d) another answer

In other (non-multiple-choice) questions, follow the instructions given in the question.

A1 The white star Sirius B is very much less luminous than the Sun. Which of the following statements about Sirius B *must* be true? (Tick *all* that apply.)

(i) Sirius B is not on the main sequence.

(ii) Sirius B is older than the Sun.

(iii) Sirius B is younger than the Sun.

(iv) Sirius B is larger than the Sun.

(v) Sirius B is smaller than the Sun.

(vi) Sirius B is hotter than the Sun.

(vii) Sirius B is cooler than the Sun.

A2 Which of these light sources are likely to produce an *emission line* spectrum? (Tick *all* that apply.)

(i) a tungsten-filament light bulb

(ii) a yellow sodium street lamp

(iii) a mercury vapour street lamp

(iv) hot coal on a fire

(v) molten lava from a volcano

(vi) a neon advertising sign

A3 The colour of a star depends mainly on its

(a) brightness

(b) chemical composition

(c) surface temperature

(d) speed of motion towards or away from us

A4 Viewed through a spectroscope, most stars have

(a) just an emission line spectrum

(b) just a continuous spectrum

(c) a continuous spectrum with superimposed absorption lines

(d) a continuous spectrum with superimposed emission lines

A5 A star which is ten times as massive as the Sun will be

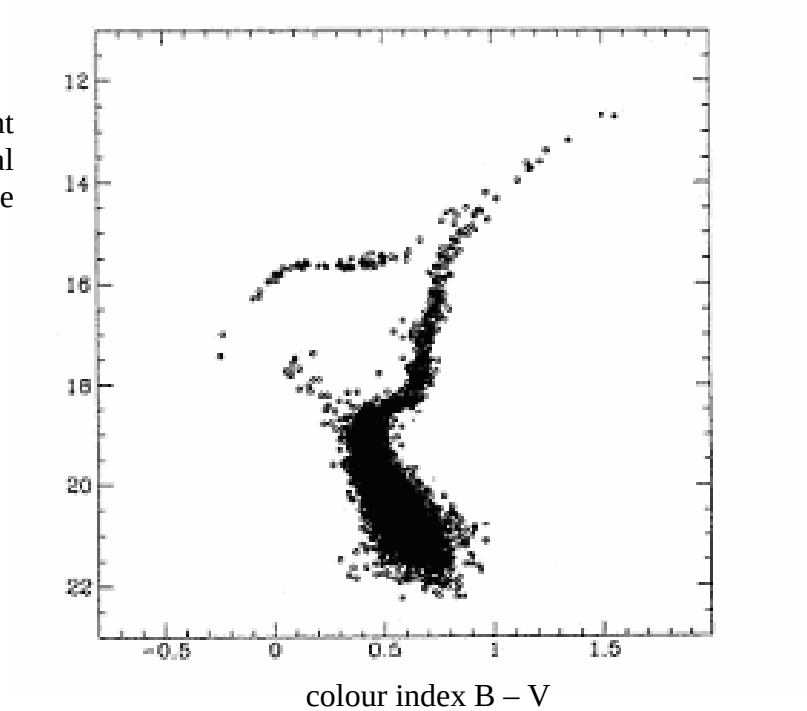
(a) about twice as luminous as the Sun

(b) about ten times as luminous as the Sun

(c) a few hundred times as luminous as the Sun

(d) several thousand times as luminous as the Sun

The picture shows the Hertzsprung-Russell diagram of a stellar cluster.



A6 Circle on the picture the *hottest star* (label it H) and the *coolest star* (label it C).

A7 The cluster whose HR diagram is shown here is

(a) young

(b) old

(c) composed of stars of many different ages

(d) of unknown age: the HR diagram does not give enough information

A8 Which of the following would be typical properties of an **open** cluster such as the Pleiades? (Tick *all* that apply.)

(i) Composed of relatively young stars.

(ii) Composed of very old stars.

(iii) Low to very low heavy element content.

(iv) Moderate to high heavy element content.

(v) Found close to the plane of the Milky Way's disc.

(vi) Found far from the plane of the Milky Way's disc.

A9 A planetary nebula is

(a) the cloud of gas and dust out of which a planetary system will form

(b) the expanding gas cloud formed when a Sun-like star becomes a white dwarf

(c) the expanding gas cloud produced when a massive star explodes

(d) a gas cloud in orbit around a star

A10 Compared to an Sa galaxy, an Sc galaxy has (tick *all* that apply)

(i) a larger, brighter bulge

(ii) a bulge which is barred rather than round

(iii) a smaller, fainter bulge

(iv) more tightly wound spiral arms

(v) less tightly wound spiral arms

(vi) more spiral arms

(vii) fewer spiral arms

A11 Some galaxies are found in dense clusters, while others such as the Milky Way are in small groups. Relative to the dense clusters, the small groups contain

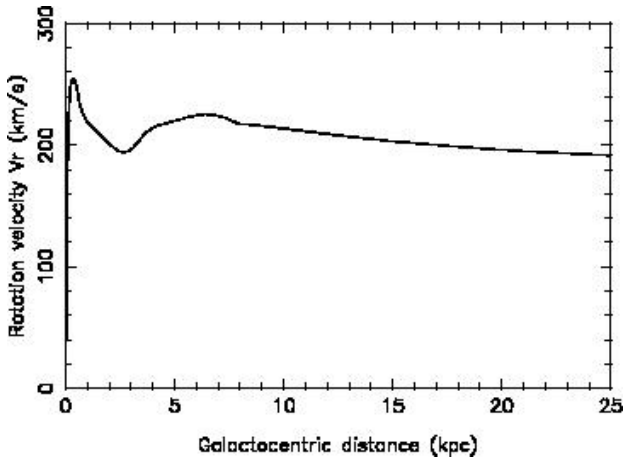
(a) proportionately more elliptical galaxies

(b) about the same fraction of elliptical galaxies

(c) proportionately fewer elliptical galaxies

(d) no elliptical galaxies at all

A12 The rotation curve of the Milky Way, shown on the right, tells us that the orbital speed of stars does not change much as we move out towards the edge of the disc. This suggests that



(a) the mass of the Galaxy is dominated by dark matter

(b) the Galaxy contains a central supermassive black hole

(c) the geometry of the universe is flat

(d) all of the above.

A13 The Steady State model of the universe **fails** to account for

(a) the expansion of the universe

(b) the properties of the cosmic microwave background

(c) the darkness of the night sky

(d) all of the above

A14 If the geometry of the universe is **flat** and there is no cosmological constant, the universe will

(a) eventually recollapse in a Big Crunch

(b) continue to expand at an ever-decreasing rate

(c) continue to expand at a steady rate

(d) continue to expand at an ever-increasing rate

A15 The abundances of the light elements deuterium, helium and lithium tell us

(a) the age of the universe

(b) the value of the Hubble constant

(c) the density of ordinary (baryonic) matter in the universe

(d) the density of all matter in the universe

A16 Arrange the following events in order of their occurrence, earliest first (label them 1 – 4):

(i) primordial nucleosynthesis (the formation of the light elements)

(ii) inflation

(iii) the formation of the first galaxies

(iv) recombination (the birth of the cosmic microwave background)

A17 The spectroscopic (Doppler shift) method of finding planets round other stars is most likely to find

(a) massive planets orbiting close to their stars

(b) massive planets orbiting far from their stars

(c) planets orbiting close to massive stars

(d) planets orbiting far from massive stars

A18 Would you expect to find planets around a 12-billion-year old star?

(a) No, because it would almost certainly have left the main sequence

(b) No, because it is likely to be too low in heavy elements to form a planetary system

(c) Yes, because it would probably be high in heavy elements

(d) Yes, because the likelihood of finding planets should not depend on the age of the star (and we know planetary systems are common)

A19 Spectral lines of ozone (O_3) found in the atmosphere of an extrasolar planet would be good evidence for life because

(a) life is necessary to sustain an oxygen-rich atmosphere

(b) an oxygen-rich atmosphere is necessary to sustain life

(c) ozone is needed to block out lethal ultraviolet radiation

(d) none of the above

A20 The discovery of microbial fossils on Mars would be good news for supporters of SETI (the Search for Extraterrestrial Intelligence) because

(a) it would show that an extraterrestrial civilisation had once visited Mars

(b) it would show that life can exist in harsh environments

(c) it would support the idea that the evolution of life on a suitable planet is "easy"

(d) for no good scientific reason, but it would improve the political climate

END OF SECTION A

Sections B and C of this examination paper are in a separate book.