Course and assignment number:

Computer Marked Assignment

S281 44

Make sure you know how to use the CMA form: detailed instructions are given in your student handbook (or supplement).
You are strongly advised to attempt every question in this assignment.
If you do not wish to answer a question, pencil across the 'don't know' cell ('?').
If you think that a question is unsound in any way, pencil across the 'unsound' cell ('U') *in addition to* pencilling across either an answer cell or the 'don't know' cell.
Note For each question, you **must** *pencil across* **either** *the required number of answer cells* **or** *the 'don't know' cell.*

Covering: **Block 4**

Cut-off date:
Friday 30 September 1994

PART A

Q1 Which *two* statements in the key resolve Olbers' paradox? Pencil across *two* cells in row 1.

KEY for Q1

A The Universe is 'isotropic' and 'homogenous'.
B Much of the matter in the Universe is in the form of dark matter.
C The Universe is infinite in spatial extent.
D The Universe is finite in age.
E The Universe is 'closed'.
F The Universe is expanding.
G Intergalactic dust absorbs light from distant stars.

Q2 In the early Universe ($t < 100$ s), the ratio of neutrons to protons maintained by reactions (1.21) in Book 4 is given by Equation 1.22. What percentage of baryons were made up of neutrons at a temperature of 6.5×10^9 K. Select from the key the value closest to yours, and pencil across *one* cell in row 2.

KEY for Q2

A 9%
B 10%
C 11%
D 42%
E 50%
F 90%
G 91%
H 95%

Q3 The discovery of the microwave background radiation has been of tremendous significance to modern cosmology. Which *three* statements in the key are *true*? Pencil across *three* cells in row 3.

KEY for Q3

A The black-body spectrum of the background radiation indicates that the Universe is closed.
B The black-body spectrum of the background radiation, together with the expansion of the Universe, is evidence for a *hot* Big Bang.
C The smoothness of the background radiation indicates matter and radiation remain today in thermal equilibrium.
D The degree of smoothness of the background radiation indicates the degree of smoothness of matter when the Universe was about 100 000 years old.
E The intensity fluctuations in the background radiation indicate that there were temperature fluctuations in the Universe during the era of nucleosynthesis.
F The dipole anisotropy of the background radiation indicates that the Earth is moving relative to the expansion of the Universe.
G The dipole anisotropy of the background radiation is evidence for the cosmological principle.

Q4 and Q5 These questions are concerned with the properties of the expansion of the Universe for different cosmological models. $R(t)$ is the scale factor, q is the deceleration parameter, H_0 is the current value of Hubble's constant, and $R(t_0)$ is the present value of the scale factor, i.e. at cosmic time $t = t_0$.

Q4 In a model of the Universe satisfying Hubble's law, in which there is no self-gravity, the expansion is free. Choose *one* item from the key for Q4 and Q5 (on p. 8) which best describes this Universe. Pencil across *one* cell in row 4.

Q5 Suppose that the Universe is described by the Einstein–de Sitter model. Choose *one* item from the key for Q4 and Q5 (on p. 8) which best describes this Universe. Pencil across *one* cell in row 5.