UNIVERSITY COLLEGE LONDON

University of London

EXAMINATION FOR INTERNAL STUDENTS

For The Following Qualification:-

Coll Dip

Astronomy DP22: High Energy Astrophysics and Cosmology

COURSE CODE	:	**ASTRDP22**
UNIT VALUE	:	**0.50**
DATE	:	**17-MAY-04**
TIME	:	**18.30**
TIME ALLOWED	:	**2 Hours**

TURN OVER

Answer THREE questions from Section A and
THREE questions from Section B

You are advised to spend no more than 10 minutes on each Section A answer, and about 30 minutes on each Section B answer.

The numbers in square brackets in the right hand margin indicate the provisional allocation of maximum marks per sub–section of a question.

Section A

1. What evidence is there for dark matter in our Galaxy? [4]

   Why is dark matter important and what could it be? [3]

2. What is Hubble's law, and how was it discovered? [4]

   What does it imply is happening to the Universe and why? [3]

3. What are quasars, and how have their numbers changed with cosmic epoch? [5]

   Why might this be the case? [2]

4. How are inverse Compton and synchrotron radiation produced? [5]

   Give an example of an astrophysical source that emits synchrotron radiation, and one that emits through the inverse Compton process. [2]

5. What powers the Crab nebula, and how do we know? [3]

   How and why does the appearance of the Crab differ from other Supernova remnants? [4]

6. What produces the X-ray emission seen in galaxy clusters? How do we know this? [4]

   Where does the energy for this emission come from? [3]

Section B

7. What is *inflation*, and what could have caused it? [5]

   Give three examples of major problems in big-bang cosmology that *inflation* solves. [15]

8. Describe, with the help of a suitable diagram, the different galaxy types in Hubble's classification scheme. What are the key features of the different types? [12]

   In what way is the galaxy population different within clusters to the field galaxy population? In the hierarchical, cold dark matter models for galaxy formation, how do the different galaxies and components of galaxies form? [8]

9. Describe the cosmic distance ladder. [20]

10. Explain what cosmic rays are, how they interact with matter here on Earth, and what an 'air shower' is. [10]

    Give three examples of cosmic ray detectors. Where are cosmic rays of energies below 10^{15} eV thought to come from, and how are they produced? [5]

    What sources or events might be responsible for cosmic rays of $> 10^{15}$ eV? How can we can determine whether or not the most energetic cosmic rays come from distant extragalactic sources? [5]

11. What is a gravitational wave? With the help of a diagram, explain what it does. Why are gravitational waves important to astronomers and physicists, and what sort of astrophysical sources are likely to be strong sources of gravitational radiation? [10]

    Describe the methods, successes, and failures in the quest to detect gravitational radiation so far. [10]

12. Describe the accretion process in a black hole X-ray binary. Include explanations of how and why the material moves between the secondary star and the black hole, how and where the radiation is emitted, and how the properties of the primary and secondary star affect the accretion process. [16]

    How efficient is the accretion process at generating energy compared to nuclear fusion? How efficient would the accretion process be if the primary star was a neutron star or a white dwarf? [4]