UNIVERSITY COLLEGE LONDON

University of London

EXAMINATION FOR INTERNAL STUDENTS

For The Following Qualifications:-

Coll Dip *UG Dip*

Astronomy DP22: High Energy Astrophysics and Cosmology

COURSE CODE	:	**ASTRDP22**
UNIT VALUE	:	**0.50**
DATE	:	**16-MAY-06**
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]

   What could dark matter be, and why is it important? [3]

2. What is Olbers' paradox? Explain why it was thought to be a paradox, and how it is resolved in modern cosmology. [7]

3. What is the cosmic microwave background, and how was it discovered? [7]

4. X-ray emitting supernova remnants can be split into two classes. What distinguishes them? [2]

   What powers the emission, and what are the radiation mechanisms in the two cases? [5]

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

   Give an example of an astrophysical source that emits inverse Compton radiation, and one that emits cyclotron radiation. [2]

6. What is a gravitational wave, and what does it do? [5]

   Give two examples of sources or phenomena that are likely to be strong emitters of gravitational waves. [2]

Section B

7. Describe the cosmic distance ladder. [20]

8. Summarise, with the aid of a suitable diagram, the history of the Universe from the big bang to the present day. Your answer should include descriptions and timescales for the following:

   - The origin of the cosmic microwave background
   - The formation of stars, galaxies and galaxy clusters
   - Inflation
   - The formation of hadrons, deuterium and helium [20]

9. 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]

   How have quasars evolved with cosmic time? How is this likely to be related to the formation of galaxies? [8]

10. Describe the accretion process in a cataclysmic variable. Include explanations of how and why the material moves between the main sequence star and the white dwarf, how the properties of the white dwarf affect the accretion process, and how the radiation is emitted. [17]

    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 black hole? [3]

11. What is a gamma ray burst, and how were they discovered? [4]

    How are gamma ray bursts and their afterglows thought to be produced? [4]

    Where are they located in the sky, and what does this tell us about their origin? [2]

    What are the two different classes of gamma ray burst? What are the progenitors thought to be, and what is the observational evidence? [10]

12. Explain what cosmic rays are, how they interact with matter here on Earth, and how they were discovered. [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 events or sources might be responsible for cosmic rays of $> 10^{15}$ eV? How can we determine whether or not the most energetic cosmic rays come from distant extragalactic sources? [5]

ASTRDP22/2006 **END OF PAPER**