
UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Kedua
Sidang Akademik 2004/2005
*Second Semester Examination
2004/2005 Academic Session*

Mac 2005
March 2005

ESA387/3 Persekitaran Aeroangkasa
Space Environment

Masa : [3 jam]
Hour : [3 hours]

ARAHAN KEPADA CALON
INSTRUCTION TO CANDIDATES:

Sila pastikan bahawa kertas soalan ini mengandungi **DUA BELAS (12)** mukasurat dan **ENAM (6) SOALAN** sebelum anda memulakan peperiksaan.

*Please ensure that this paper contains **TWELVE (12)** printed pages and **SIX (6)** questions before you begin examination.*

Jawab **LIMA (5)** soalan sahaja.
*Answer **FIVE (5)** questions only.*

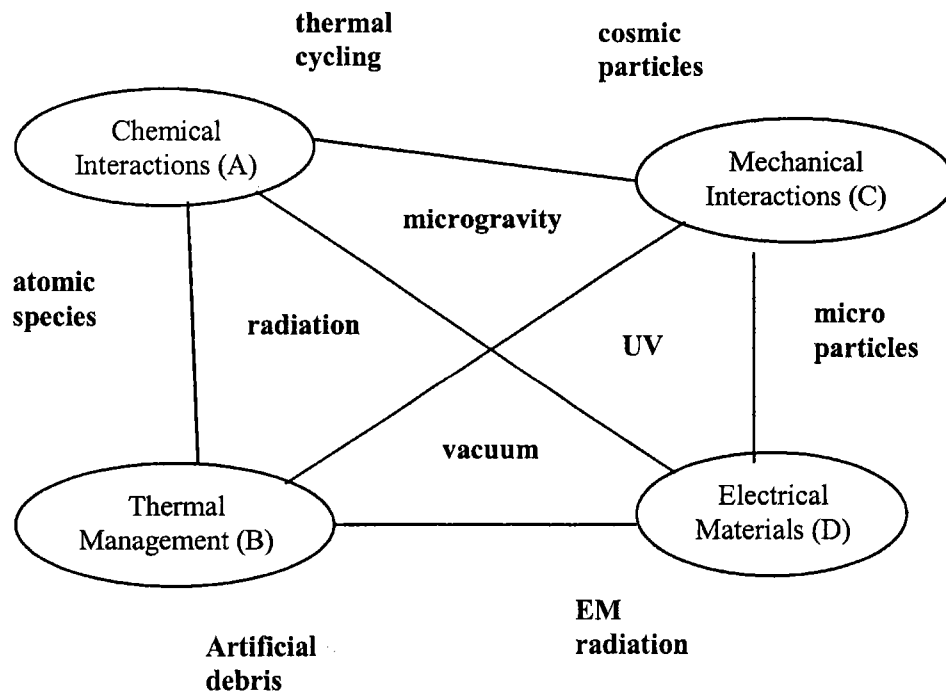
Jawab dalam Bahasa Malaysia.
Answer in Bahasa Malaysia.

Setiap soalan mestilah dimulakan pada mukasurat yang baru.
Each questions must begin from a new page.

JAWAB LIMA SOALAN SAHAJA

1. Perhatikan gambarajah di bawah yang menerangkan sinergi interaksi di antara faktor-faktor persekitaran di angkasa dengan sistem kapal angkasa dan jawab soalan-soalan yang berikutnya:

Observe the diagram below which describe the synergetic interactions between the space environment factors and spacecraft systems and answer the following questions.



- a) Huraikan sinergi tindak balas di antara (A) → (B) → (D) yang disebabkan oleh spesis atomik.

Describe the synergetic interactions between (A) → (B) → (D) due to atomic species.

(40 markah/marks)

- b) Berikan hubungan di antara spesis atomik dan radiasi Ultra Ungu di angkasa terhadap (A).

State the relationship between the atomic species and Ultra Violet rays towards (A).

(20 markah/marks)

- c) Terangkan pengaruh vakum kepada (B) dan huraikan sinergi tindak balas (B)→(C) yang mungkin perlu diambil disebabkan ini.

Explain the effects of vacuum to (B) and describe the synergetic interaction between (B) → (C) that shall have to be taken due to this.

(20 markah/marks)

- d) Berikan kesan mikrograviti terhadap tindak balas (C).

State the effects of microgravity towards (C).

(20 markah/marks)

2. Plasma adalah satu bentuk bahan yang terbanyak, yang meliputi lebih 99% daripada cakrawala. Interaksi kapal angkasa dengan plasma boleh mendatangkan kesan-kesan yang tidak diinginkan terhadap kapal angkasa tersebut.

Plasmas are the most common form of matter, comprising more than 99% of the visible universe. Spacecraft interactions with plasma may invite bad consequences towards the spacecraft.

- a) Huraikan dua daripada kesan-kesan tersebut.

Describe two of the consequences.

(20 markah/marks)

- b) Terangkan perbezaan di antara persekitaran plasma di Orbit Rendah Bumi dan di Orbit Geosegerak.

Explain the difference between the plasma environment in a Low Earth Orbit and a Geosynchronous Orbit.

(20 markah/marks)

- c) Berikan lima ciri-ciri plasma.

State five characteristics of plasma.

(20 markah/marks)

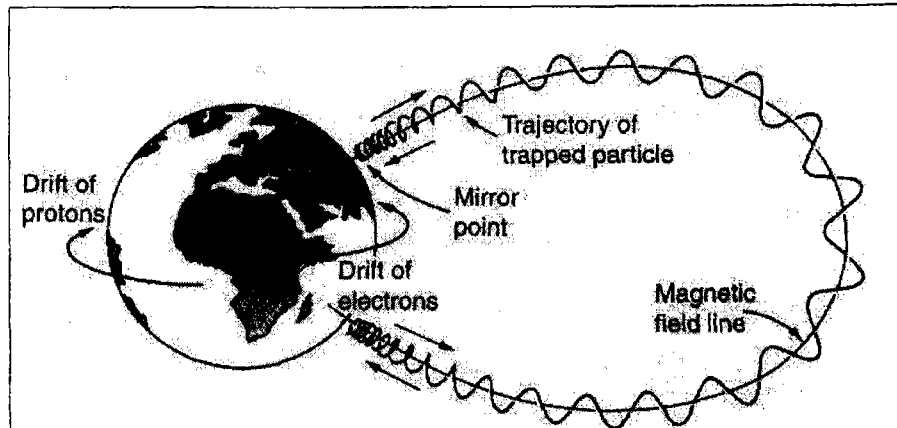
- d) Dalam cakrawala plasma, zarah bercas akan mengalami tiga jenis daya yang bertindak secara keseluruhan ke atasnya dan menentukan pergerakan zarah tersebut. Daya-daya ini ialah, Graviti, Medan Elektrik dan Medan Magnetik. Terangkan secara ringkas peranan dua daripada daya-daya itu terhadap pergerakan zarah dalam plasma.

In plasma universe, charged particle will experience three forces which together determine the motion of the particle. These forces are the Gravity, Electric Field and Magnetic Field. Explain briefly the role of two of the forces towards the motion of the particle in plasma

(20 markah/marks)

- e) Terangkan bagaimana berlakunya proses pencerminan magnetik yang berlaku ke atas zarah-zarah bercas seperti yang digambarkan dalam gambarajah di bawah:

Explain the process of magnetic mirroring which happens to charged particles as depicted in the diagram below:



(20 markah/marks)

3. Orbit sesebuah satelit amat penting dalam menentukan parameter subsistemnya. Bagaimanapun setiap orbit berbeza dari faktor persekitarannya yang perlu diambil kira dalam mereka bentuk sebuah kapal angkasa. Huraikan perbezaan faktor persekitaran yang ada di antara orbit-orbit berikut:

- a) Orbit Rendah Bumi
- b) Orbit Medium Bumi
- c) Orbit Geosegerak
- d) Orbit Segerak-Matahari
- e) Orbit Molniya

Satellite orbit is an important factor in determining satellite subsystems. However, each orbit is different in its environment factors which have to be taken into account in designing a spacecraft. Describe the differences in terms of the environment that each orbit contains:

- a) *Low Earth Orbit*
- b) *Medium Earth Orbit*
- c) *Geosynchronous Orbit*
- d) *Sun-synchronous Orbit*
- e) *Molniya Orbit*

(100 markah/marks)

4. Perhatikan graf di bawah dan jawab soalan berikutnya:

Observe the graph below and answer the following questions:

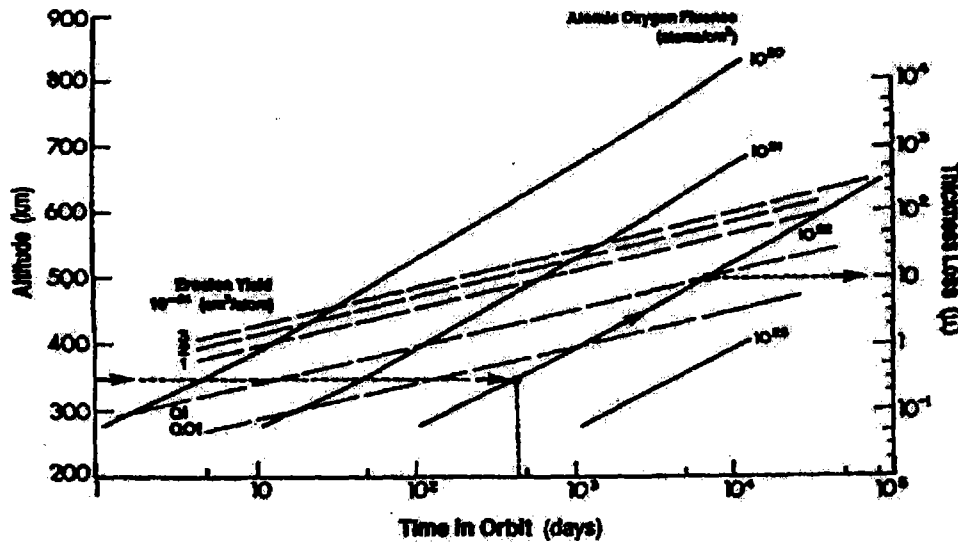


Figure 2.10. Nomogram for Estimating the Material Thickness Lost by Exposure to Atomic Oxygen. (Tennyson, 1993, used with permission)

- (a) Huraikan gambarajah di atas dengan teliti.

Describe the above diagram in detail.

(25 markah/marks)

- (b) Terangkan bagaimanakah fenomena di atas boleh berlaku.

Explain how the above phenomenon happens.

(25 markah/marks)

- (c) Selalunya panel suria sebuah satelit mudah terdedah kepada masalah ini. Mengapa begitu dan apakah yang boleh dilakukan untuk mencegah masalah ini.

Normally, solar panel of a satellite is easily exposed to this problem. Why is that and what can be done to mitigate this problem.

(20 markah/marks)

- (d) Senaraikan risiko-risiko lain yang mungkin dihadapi oleh kapal angkasa akibat daripada perubahan altitud dalam persekitaran berdekatan bumi.

List other risks that may be faced by a spacecraft due to the change in altitude in a near-earth environment.

(30 markah/marks)

5. Gambarajah di bawah menunjukkan graf perbezaan keamatan di antara proton dan elektron melawan altitud.

The figure below indicates the differences of intensity between protons and electrons as a function of altitude.

- a) Huraikan secara umum graf tersebut dan kaitkan jawapan anda dengan keadaan di Sabuk Van Allen.

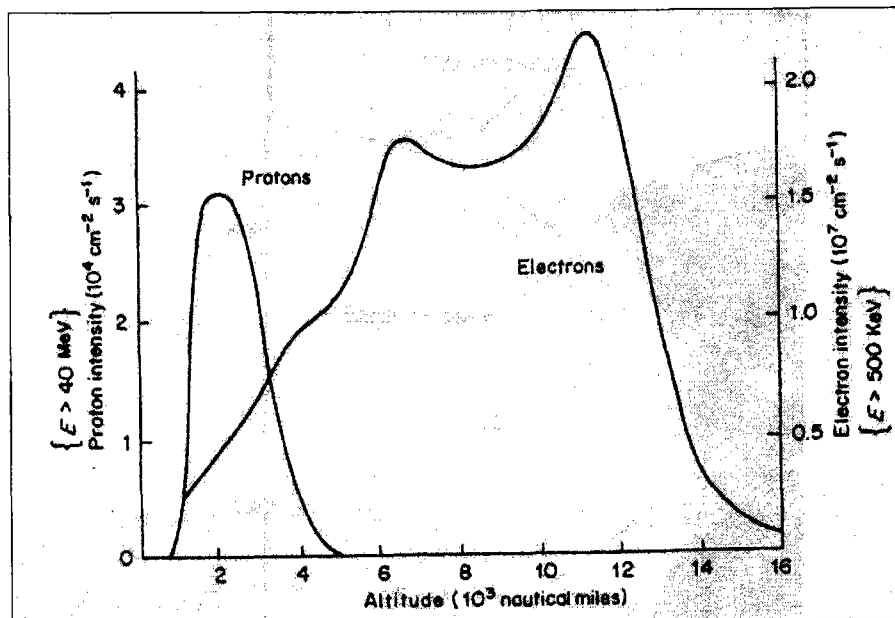
Describe the graph in general terms and relate your answer with the situation in Van Allen Belt.

(20 markah/marks)

- b) Senaraikan perbezaan kesan radiasi di antara zarah-zarah proton dan zarah-zarah elektron ini terhadap kapal angkasa.

List the differences of radiation effects imposed by protons and electrons towards a spacecraft.

(20 markah/marks)



- c) Bincangkan tiga jenis kaedah untuk mengatasi atau mengurangkan kesan radiasi di angkasa bagi kapal angkasa yang beroperasi di Orbit Geosegerak.

Discuss three ways to mitigate the radiation effects on a spacecraft operating in the Geosynchronous orbit.

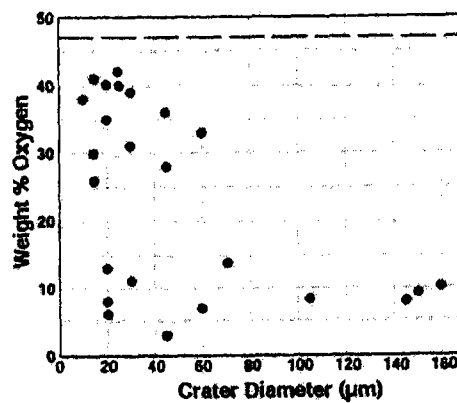
(60 markah/marks)

6. Gambarajah di bawah menunjukkan keputusan kajian saiz diameter lekuk yang disebabkan oleh serpihan aluminium yang menghentam permukaan kapal angkasa berdasarkan peratusan kandungan oksigen dalam Aluminium tersebut.

Figure below shows the results of research on aluminum debris impacting on spacecraft surface versus the percentage of oxygen content.

- a) Terangkan keputusan yang dapat ditakrifkan daripada gambarajah ini.

Explain the results shown on the graph.



(10 markah/marks)

- b) Terangkan tiga tindakan yang boleh diambil bagi mengurangkan risiko terhadap bahaya puing orbit terhadap kapal angkasa sebelum ianya dilancarkan dan bincangkan tentang keberkesanan setiap tindakan tersebut.

Explain three preventive measures that can be taken to mitigate the risks of orbital debris to a spacecraft before it is being launched and discuss the efficiency of each action.

(60 markah/marks)

- c) Graf di bawah menunjukkan perbandingan tenaga kinetik bagi puing objek berdasarkan jisimnya. Bincangkan perbezaan impak yang mengenai kapal angkasa berdasarkan kelajuan puing objek yang berikut:

The graph below shows the relative kinetic energy content of a space debris objects. Discuss the impact differences towards a spacecraft in relation to the velocity of the debris object.

- i) Impak kelajuan-hiper

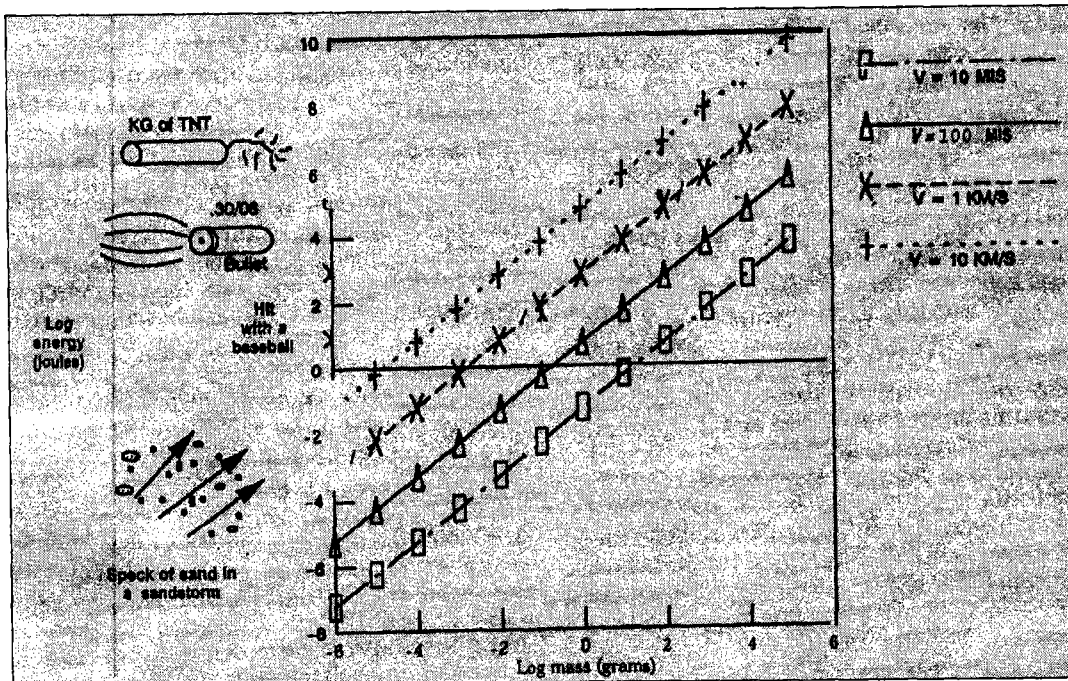
Hyper-velocity impact

- ii) Impak kelajuan rendah

Low velocity impact

- iii) Tindakbalas berantai

Chain reactions



(30 markah/marks)

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