

**The University of Melbourne
Semester 2 Examination November 2001**

Department: Microbiology and Immunology

Subject Number: 526-205

Subject Title: Microbes, Infection and Immunity

Exam Duration: 3 hours

Reading Time: 15 minutes

This paper has 8 pages

Unauthorised Materials:

Textbooks; lecture notes; lab. notes; prac. manuals; any personal typed, handwritten or photocopied notes are **not permitted**

Instructions to Invigilators:

Please provide two (2) 12 page examination books per student.

Instructions to Students:

- i) This paper contains 10 questions. Each question is worth 18 marks
- ii) Answer every question.
- iii) Answer questions 1 – 5 in one examination book, and questions 6 – 10 in a separate examination book.
- iv) Ensure your student number is on both examination books

Baillieu Library: This paper must **not** be lodged with the Baillieu Library

Question 1:

A chest Xray taken of a patient with pneumococcal pneumonia invariably reveals definite areas of consolidation.

- a) Describe the four stages of lung involvement in pneumococcal pneumonia, explaining how this consolidation is generated. (8 marks).
- b) *S.pneumoniae* can be detected in sputum samples from normal healthy people. Why is this? (2 marks)
- c) In about 25% of patients with pneumococcal pneumonia, *S.pneumoniae* can be detected in the blood. What implications does this have for these patients? (2 marks)
- d) The current vaccine is described as polyvalent. What does this mean? (3 marks)
- e) What type of antibody is known to be helpful in preventing infection with this bacterium? Give reasons for your answer. (3 marks)

Question 2:

Schaechter describes the hepatitis viruses as using either a “hit and run” infectious strategy or a “hide and infiltrate” strategy.

- a) Explain what is meant by this statement and assign each of the hepatitis viruses to one or other of these two categories. (6 marks)
- b) How are the different categories of viruses transmitted? What implications does this have for prevention of disease? (4 marks)
- c) How are patients with infections due to the different categories of viruses treated? Outline any problems encountered. (4 marks)
- d) What is the basis of the damage which results from infection with a hepatitis virus? (4 marks)

Question 3:

- a) CD4 T lymphocytes can be divided into different functional groups. Explain what is meant by the Th1/Th2 paradigm.
What would be the outcome if a Th1 response was not induced in TB infection?
Give reasons for your answer.
(6 marks)
- b) Granuloma formation, as it occurs in the course of an infection with *Mycobacterium tuberculosis*, is described as a “two edged sword”.
What is the mechanism of this response and why is it a “two edged sword”?
(4 marks)
- c) What factors, other than antitubercular drugs, have contributed to the decline in the number of cases of TB in developed countries over the last 50 years?
(4 marks)
- d) The availability of antitubercular drugs appeared to promise the elimination of TB.
What factors have subsequently intervened to make this more difficult to achieve?
(4 marks)

Question 4:

When investigating an outbreak of food poisoning, three factors, time, person and place are considered fundamental to determining the cause of the outbreak.

- a) How can the time of the year be important? Give an example to illustrate your answer.
(2 marks)
- b) How can the person be important? Give an example to illustrate your answer.
(2 marks)
- c) How can the place be important? Give an example to illustrate your answer.
(2 marks)
- d) Describe 2 mechanisms by which the innate immune system of the gut protects us from microorganisms causing food poisoning?
(2 marks)
- e) How does the adaptive immune system in the gut differ from the systemic immune system?
(2 marks)
- f) Describe 2 mechanisms by which the adaptive immune system in the gut protects us from microorganisms causing food poisoning?
(4 marks)
- g) Describe 2 ways in which pathogens evade these mechanisms.
(4 marks)

Question 5:

Sexually transmissible infections (STIs), are caused by a diverse range of microorganisms.

- a) List the main types of microorganisms which cause STIs, giving an example of each type. (4 marks)

- b) Why is it so important that STIs are diagnosed? (4 marks)

- c) Gonorrhoeae is a very common STI. Name two characteristics of the organism which make it a difficult target for the immune system to deal with. (2 marks)

- d) Why is there concern about the dramatic increase over the last 4 years in the number of cases of gonorrhoeae in men who have sex with men? (2 marks)

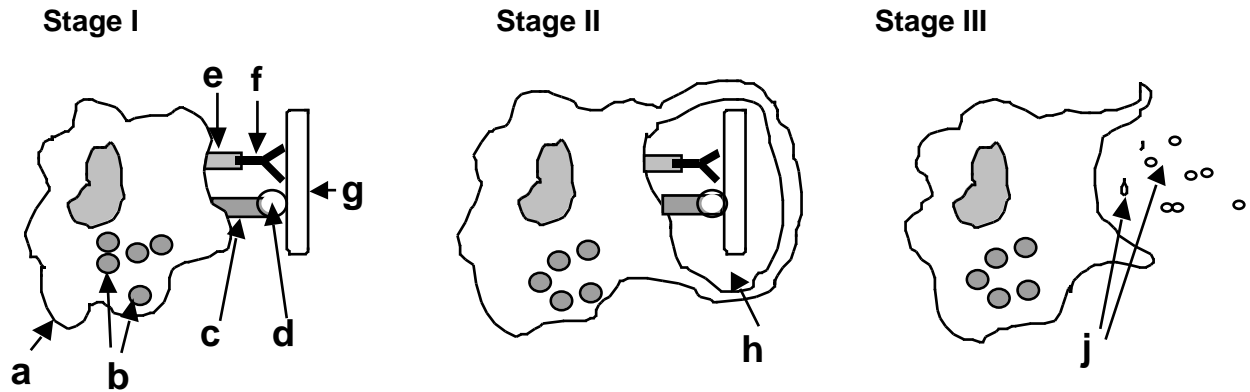
- e). Genital warts are second only to Chlamydial infections as the most common STI. Briefly describe the causative agent of this infection. (1 mark)

- f). List three reasons for the poor immune response generated as a result of this infection. (3 marks)

- g) What is the causative agent of syphilis? How is this disease diagnosed? (2 marks)

Question 6:

- a) The diagram below represents the stages involved in the phagocytosis of a bacterium which has invaded a tissue.



Describe what is happening at each stage of the phagocytic process.

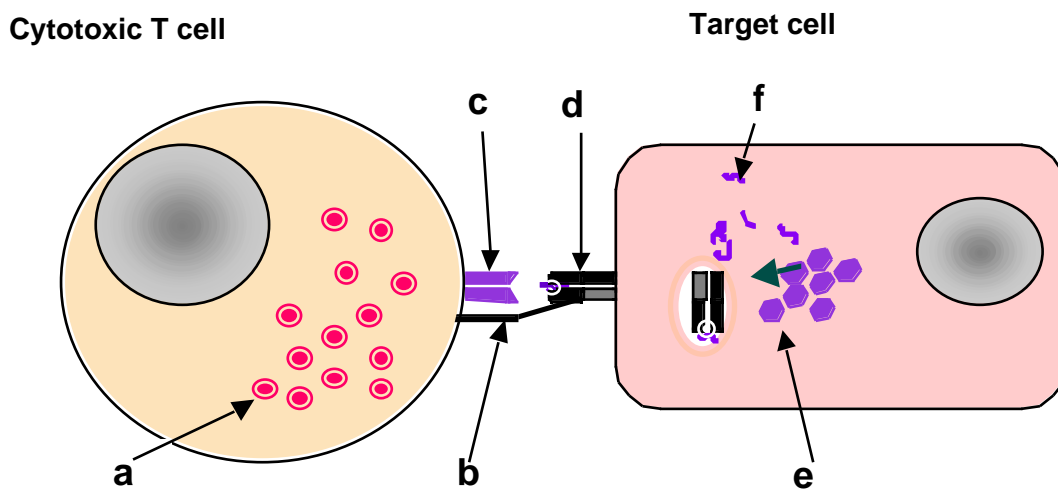
(5 marks)

- b) Label the components indicated by arrows in a), and briefly describe their role in phagocytosis.

(5 marks)

- c) The diagram below represents the interaction of an antigen-activated cytotoxic T cell with its target cell. Label the components a) – f), and describe the interaction between these two cells, and its outcome.

(8 marks)



Question 7

The host immune response against infection by influenza virus uses components of the innate (non-specific) immune response, and the acquired (adaptive, specific) immune response.

- a) Describe the components of the innate defences which operate in influenza infection, and their role. (6 marks)
- b) Describe the acquired (adaptive, specific) immune responses the host makes to influenza virus infection. (4 marks)
- c) The current influenza vaccine is an inactivated vaccine which consists of haemagglutinin and neuraminidase from selected strains of influenza viruses. It has a protection rate of around 70%.

What are the limitations of this vaccine? Explain your answer. (4 marks)

- d) How could you make a more effective vaccine? Briefly explain your answer. (4 marks)

Question 8:

The ability of a microorganism to cause disease involves a series of interactions between the pathogen and the host.

- a) List the interactions (sometimes called “steps in the pathogenic process”) that may occur between the pathogen and the host in order for the pathogen to cause disease. (3 marks)
- b) Describe these interactions, and indicate which are essential in the induction of disease. Illustrate your answer by providing examples from the family “Enterobacteriaceae” (15 marks)

Question 9:

a) Define what is meant by the term “nosocomial infection”. (1 mark)

b) Why do patients contract these infections? (4 marks)

c) The source of microorganisms which cause nosocomial infections is usually either from the hospital environment (eg. instruments, fluids, air), or from people (eg. health care workers, visitors).

List an example of a common bacterium which causes nosocomial infections whose source is people, and an example of a common bacterium which causes nosocomial infections whose source is the hospital environment.

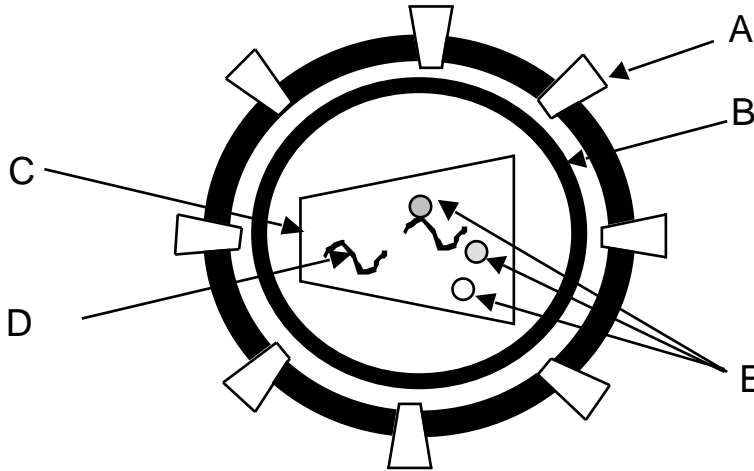
Describe the characteristics of each of the microbes you have chosen which allow them to be important causes of nosocomial infections.

(10 marks)

d) Briefly suggest how nosocomial infections with both these organisms may best be controlled (3 marks)

Question 10:

- a) The diagram below is a very simple sketch of the human immunodeficiency virus (HIV). Describe (in a few words) the function of the components labelled A – E (6 marks)



- b) Briefly describe the replication cycle of HIV in the host, and suggest the stages of the cycle amenable to intervention by anti-viral agents (6 marks)
- c) Patients with HIV suffer significant immune depletion leading to overwhelming infection. Explain how HIV depletes the immune system. Which arm of the immune system is most important in controlling the progress of infection? (6 marks)