



Higher Specialist Diploma

Medical Microbiology

September 2024

Short-Answer Questions

60 minutes

Attempt all Four Questions

Instructions to Candidates

1. Record your candidate number and HSD discipline on the front sheet of the answer booklet.
2. Record your candidate number, the question number and the page number in the spaces provided on the answer sheets.
3. Begin each new answer on a new page.
4. Each question is worth 25 marks.

1. During an annual review of workload statistics it is noted that year on year there has been an increase in demand for the service, and the laboratory is now at the limit of its capacity. Identify ways in which this demand can be managed.
2. After returning from annual leave, you are informed that there have been four incidents raised in the laboratory section that you manage. They all relate to the reporting of incorrect gram stain results from positive blood culture bottles.

Discuss how you would investigate these incidents with reference to potential root causes and corrective actions.

3. A junior member of staff approaches you and mentions that one of the isolates from a blood culture sample has been identified as *Brucella melitensis* from Maldi-tof only. They are unsure how to proceed, how would you advise them? What immediate action needs to be taken?
4. A urine sample has grown an *Enterobacter hormachei*, resistant to ertapenem and sensitive to meropenem with an MIC of 1. The isolate was negative for NDM, KPC, OXA-48, VIM and IMP by in house PCR. These were the only genes associated with carbapenem resistance that were tested for.

With reference to the organism ID discuss the meaning and relevance of these results and how you could confirm the resistance mechanism involved.



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Essay Paper

120 minutes

Attempt 2 out of 5 questions

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1. Record your candidate number and HSD discipline on the front sheet of the answer booklet.
2. Record your candidate number, the question number and the page number in the spaces provided on the answer sheets.
3. Begin each new question on a new page.
4. Each question is worth 100 marks.

1. Compare and contrast molecular identification methods and traditional bacterial culture.
2. Discuss the epidemiology, pathogenesis and laboratory diagnosis of Whooping cough.
3. Discuss the role that the clinical microbiology laboratory has in antimicrobial and diagnostic stewardship and explain the impact on the prevention of antimicrobial resistance.
4. Compare and contrast (with examples) foodborne, waterborne and exotoxin-induced gastrointestinal disease.
5. In January 2024 UKHSA announced the investigation of a newly evolved ribotype (955). This ribotype is closely related to ribotype 027 which is linked to increased mortality, complications and overall more severe disease. Discuss local and national laboratory testing guidelines and patient management (including IPC) for *Clostridium difficile*.



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Case Studies

120 minutes

Attempt all Case Studies

Instructions to Candidates

1. Record your candidate number and HSD discipline on the front sheet of the answer booklet.
2. Record your candidate number, the question number and the page number in the spaces provided on the answer sheets.
3. Begin **each new case study** on a new page.
4. Each question is worth 100 marks.
5. For these case study questions you are strongly advised to answer the questions as they arise during the case study to avoid later information impacting adversely on your answers to the earlier questions by presuming an “outcome”.

SEEN CASE STUDY

1.

A 49-year-old male attended Accident and Emergency with multiple wounds on the extremities of various levels of healing due to a long-standing history of living on the streets. Some of the lesions were cellulosic with some showing well demarcated ulcers. Upon further discussion the patient admits to having a past medical history of intravenous drug user (IVDU). He has never been screened for any blood borne virus (BBV).

- a. Using only the information above, discuss the relevance of the clinical details, what organisms you would expect to grow and the samples you would expect to receive in the microbiology laboratory to aid diagnosis. (25 marks)

On medical review all the patient's microbiology results are negative except for the wound culture. Small pinpoint colonies are observed on the Staph/Strep selective plate incubated in O₂ with no growth seen on the CLED, also incubated in O₂. A gram stain of the colonies has been performed and Gram-Positive Bacilli (GPB) reported.

- b. Explain (with examples) how colonial morphology/growth conditions, gram stain morphology and enzymatic, microbiology 'bench' tests can help to give a presumptive identification? (20 marks)

The Maldi-Tof gives an identification of *Corynebacterium diphtheria* with a good quality score.

- c. Use examples to explain how organisms are categorised by the Advisory Committee on Dangerous Pathogens (ACDP). What category is *C. diphtheria* and what advice would you give for handling the cultures now an ID is available? (20 marks)

The isolate is referred to the reference laboratory for real-time PCR of the toxin gene and an ELEK test.

- d. Critically evaluate the value of each test method in confirming the identification. (20 marks)
- e. Whilst awaiting the results explain how the patient should be managed from a treatment and infection prevention and control (IPC) perspective. (15 marks)

UNSEEN CASE STUDIES

2.

A 50 year old man presented with a two month history of myalgia, weight loss, fever night sweats and headaches. There hasn't been any foreign travel leading up to this illness. He lives in a rural area near cattle farms and keeps small pets including cats and dogs.

- a. Identify any additional medical history that should be taken, and which diagnostic tests would be performed. (15 marks)

The additional patient history has shown that the patient had an earlier aortic valve replacement, he worked as a roofer and in addition to his own pets, he interacts with a number of feral cats and dogs in the nearby rural areas, but there hasn't been any foreign travel outside of the UK for more than ten years.

- b. Identify further tests, a working diagnosis and likely aetiology at this stage? (15 marks)

- c. Based on your answers to question b. outline a treatment plan. (10 marks)

Blood cultures taken during his hospital stay remained negative. A chest X-Ray was clear and Sputum TB samples were smear negative for AFB and cultures are currently negative to date. After two weeks of antibiotics the patient made mild improvement, but quickly deteriorated back down to base line again, suffering fevers, night sweats and headaches. Further blood cultures were taken and were incubated for up to 14 days.

- d. Discuss likely causative organisms at this stage, and which tests can be used to make a diagnosis. (30 marks)

16s PCR was performed on the valve. Following DNA amplification and sequencing it showed homology with *Bartonella henselae*.

- e. Describe the challenges diagnosing *Bartonellosis* and its clinical manifestations. (30 marks)

3.

A 32-year-old male patient presented to his local accident and emergency department complaining of watery diarrhoea, he also complains that he has headaches, and he has lost his appetite. Upon questioning, the patient reported a two-day history of back pain, insomnia, joint weakness, feeling warm/hot and watery diarrhoea.

On examination, the patient was suffering from pyrexia (temperature of 39.3°C), tachycardia with a heart rate of 117 beats per minute, a blood pressure of 110/70 mm/Hg and a respiratory rate of 17 breaths per minute. There was also evidence of slight dehydration with reduced skin turgor.

- a. Based only on the information provided above, what additional information/questions would help with your diagnosis? (5 marks)

Upon request, a travel history was provided by the patient and he explained that he had travelled to Nigeria seven years previously to complete his undergraduate degree. The patient explained that, during this time, he had had one episode of ill health after eating fruit from a street vendor (he could not remember which fruit it was). Twelve hours after eating the food he experienced multiple episodes of water diarrhoea.

Due to these symptoms, he visited the student health clinic and was prescribed ciprofloxacin however, no clinical or laboratory investigations were performed. The patient also explain that he had recently returned (four days previously) from a six-month work-related trip to Papua New Guinea.

On the way to the airport the patient bought a pineapple from a street seller. Knowing this was wrong, he added the pineapple to his suitcase so he could enjoy it when back in the UK. Twelve hours ago, although the fruit was over-ripe, he ate the pineapple and is currently suffering from the symptoms reported above.

- b. Based only on the information provided above, evaluate the past medical history, travel history, the current symptoms, possible infection present and devise an investigative strategy. (25 marks)

Due to the patient's past travel history and the initial symptoms described, a blood sample was collected for Blood Science analysis, and a stool sample and blood cultures were collected for Microbiology analysis.

The results revealed an elevated white blood cell count (White Blood Cell count $21.5 \times 10^9/L$) with the white blood cell differential indicating increased neutrophils. The erythrocyte sediment rate was also increased and the C-reactive protein level was 15 mg/L. The serum creatinine levels were within the normal reference range however, the aspartate

aminotransferase levels were raised, as were the alanine aminotransferase levels. Blood culture results were negative at 24 hours.

- c. Discuss how the stool sample would be analysed within the microbiology laboratory. (15 marks)

The stool sample was initially analysed using Molecular methods with a preliminary result indicating the identification of *Salmonella species*. The sample was also cultured onto XLD, DCA and TCBS media and incubated for 24 hours. No growth was identified on the TCBS media however non-fermenting colonies with a black centre were observed on the XLD agar and non-fermenting colonies were also present on the DCA agar. Agglutination investigations revealed the organism expressed the O antigen 12 and the H antigen D. Agglutination was also observed against the Vi O antigen.

- d. Discuss how *Salmonella species* are identified and why it is important to identify the serotype of the *Salmonella* isolated. What would this laboratory result mean for this patient and how would this organism now be handled in the laboratory. (25 marks)
- e. Rapid identification methods have been used for the identification of *Salmonella*. Discuss the methods that could be considered and the benefits and limitations of these. (20 marks)
- f. Consider the treatment regimen that this patient would benefit from. (10 marks)