Higher Specialist Diploma

Transfusion Science

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. A newly qualified Band 5 Biomedical Scientist comes to you with an anomalous blood grouping result. Describe ten factors that may have contributed to the automated anomalous ABO blood grouping results and provide an explanation of how each factor could have influenced the results.

2. You receive an urgent request for two units of red blood cells from theatres for a patient suffering from a ruptured ectopic pregnancy. The patient's blood grouping results show that they are group A with an inconclusive D type, you have no previous patient history.

   What red cells do you select for this patient and how would you investigate this anomaly further? What post operative considerations are there for this patient?

3. You receive a blood transit box from your local red cell immunohaematology laboratory with two units of red cells for a complex antibody case, a Haematology patient requiring blood 'ASAP'.

   The compatibility labels and crossmatch report have a different date of birth on them from the details you hold. How would you proceed?

4. You have been asked to prepare a presentation for your peers entitled *'Laboratory techniques used to investigate and positively identify clinically significant alloantibodies'.* Describe the techniques and justify why you have chosen them.

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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.

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3. Begin each new answer on a new page.

4. Each question is worth 100 marks.

1. You have been asked to write a standard operating procedure (SOP) to cover both planned and unexpected loss of your Laboratory Information Management System (LIMS), what would you need to include to ensure continued service provision.

2. Critically analyse the benefits of red cell genotyping assays to predict blood group antigens. Provide examples of how this technique benefits patient care.

3. In what scenarios would CMV negative and irradiated blood components be requested and why? How should these requirements be managed and recorded? Describe how you would manage inappropriate requests for these special requirements.

4. Provide an in-depth explanation of the immunological basis of red cell destruction due to incompatible transfusion. Discuss the laboratory investigation and clinical management associated with such an event.

5. Critically appraise the techniques available for estimation of feto-maternal haemorrhage. Discuss the advantages and disadvantages for the techniques you have chosen and how your laboratory would ensure accurate and reproducible results.

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Case Studies

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 six-year-old male of white British ethnicity attends the Emergency Department following two days of fever and fatigue, the parents are also concerned that he has dark urine. They state that he has recently had symptoms of a viral upper respiratory illness for almost two weeks, which they have treated with paracetamol (infant doses) but feel the symptoms have worsened overnight. The child is usually healthy with no history of a blood transfusion. Bloods are taken and he is assessed and weighed. The child weighs 21.3kg and has a temperature of 38.1°C.

Full Blood Count, morphology, and Biochemistry results

Parameter	Result	Reference range (child 6-10 years)
Haemoglobin (Hb)	54	115 - 155 g/L
White blood cells	23.5	4.5 – 14.5 x 10^9/L
Platelet count	210	150 – 400 x 10^9/L
Blood film report:	Anisopoikilocytosis, spherocytes and polychromasia. Agglutination of red cells.	
Total Bilirubin	3.1	0.1 – 1.2 mg/dL
Lactate Dehydrogenase (LDH)	>1800	120 – 300 IU/L

Blood Group and Antibody screen results

Anti-A	Anti-B	Anti-D (1)	Anti-D (2)	A_1 cells	B cells	Control
0	0	4+	4+	4+	4+	0

Cell	Rh	C^w	C	c	D	E	e	M	N	S	s	P1	Lu^a	K	k	Kp^a	Le^a	Le^b	Fy^a	Fy^b	Jk^a	Jk^b	IAT
I	$R_1^wR_1$	+	+	-	+	-	+	+	-	-	+	-	-	-	-	-	-	-	+	-	-	+	0
II	R_2R_2	-	-	+	+	+	-	+	-	-	+	+	-	-	+	-	+	-	+	-	+	-	0
III	rr	-	-	+	-	+	+	+	+	+	-	+	-	+	+	-	-	+	-	+	+	+	0

The patient is transferred to a children's ward, repeat blood group and antibody screen samples are taken and the results are confirmed. One unit of red cells is requested, electronically issued and transfused later that day. He receives 300mls in total. A repeat full blood count is sent to the laboratory following the transfusion and the Haemoglobin has dropped further to 42 g/L. A Direct Antiglobulin Test (DAT) is then requested by the clinician.

Anti-IgG	Polyspecific (AHG)	Anti-C3d	Control
0	1+	3+	0

You perform an IAT and enzyme panel.

Cell	Rh	C^w	C	c	D	E	e	M	N	S	s	P_1	Lu^a	K	k	Kp^a	Le^a	Le^b	Fy^a	Fy^b	Jk^a	Jk^b	IAT	Pap
1	$R_1^wR_1$	+	+	0	+	0	+	+	+	+	0	0	0	0	+	0	0	+	+	0	+	0	0	0
2	R_1R_1	0	+	0	+	0	+	+	0	+	0	3+	0	0	+	0	+	0	+	0	+	0	0	0
3	R_2R_2	0	0	+	+	+	0	+	0	+	+	3+	0	+	+	+	0	+	0	+	+	+	0	0
4	r'r	0	+	+	0	0	+	0	+	0	+	4+	0	0	+	0	0	+	+	0	0	+	0	0
5	r''r	0	0	+	0	+	+	0	+	+	+	0	0	0	+	0	0	0	+	+	0	+	0	0
6	rr	0	0	+	0	0	+	+	+	+	0	4+	0	+	+	0	0	0	0	+	+	0	0	0
7	rr	0	0	+	0	0	+	0	+	0	+	2+	0	0	+	0	0	0	+	+	0	+	0	0
8	rr	0	0	+	0	0	+	+	0	+	+	3+	0	0	+	0	0	+	+	+	0	+	0	0
9	rr	0	0	+	0	0	+	0	+	0	+	0	+	0	+	0	0	+	0	+	0	+	0	0
10	rr	0	0	+	0	0	+	+	+	0	+	3+	0	+	0	+	+	0	+	+	+	0	0	0
Auto	rr	/	0	+	0	0	+	/	/	/	/	/	/	0	/	/	/	/	/	/	/	/	0	

Due to the positive DAT results, you refer the sample to your local red cell immunohaematology (RCI) reference laboratory for further investigations.

a. With all the information provided, discuss the results in detail. What do you think is the most likely cause of the child's anaemia and explain how you came to this conclusion? (25 marks)

b. What further serological testing would help to establish a diagnosis and why? (20 marks)

c. Describe the mechanisms by which this anaemia has been caused. (15 marks)

d. What precautions must be taken when sampling, handling and submitting blood specimens to the laboratory and why? (15 marks)

e. What options are there available for the short-term and long-term clinical management of this patient? (15 marks)

f. What, if any, special requirements should this patient receive, in terms of a blood transfusion and how can you ensure this patient receives the correct blood in future? (10 marks)

UNSEEN CASE STUDIES

2.

A 70 year old male and known Haematology patient has attended the emergency department at 7am on a Saturday, due to severe shortness of breath. His haemoglobin result is 62g/L (normal range 130 – 180g/L). The patient has a transfusion record which shows he received two units of red cells five months ago. His antibody screen was negative at this time. A group and antibody screen sample has been sent to the laboratory with a request for "3 irradiated red cells ASAP".

Blood group and antibody screen results

Anti-A	Anti-B	Anti-D1	Anti-D2	Control	A1 cells	B cells
0	0	4+	4+	0	4+	4+

Antibody Screen

Cell	Rh	C^w	C	c	D	E	e	M	N	S	s	P1	Lu^a	K	k	Kp^a	Le^a	Le^b	Fy^a	Fy^b	Jk^a	Jk^b	IAT
I	$R_1^wR_1$	+	+	-	+	-	+	+	-	-	+	-	-	-	-	-	-	-	+	-	-	+	1+
II	R_2R_2	-	-	+	+	+	-	+	-	-	+	+	-	-	+	-	+	-	+	-	+	-	2+
III	rr	-	-	+	-	-	+	+	+	+	-	+	-	+	+	-	-	+	-	+	+	+	1+

Following these results, you perform an IAT and enzyme antibody panel, Rh/K red cell phenotype and Direct Antiglobulin test (DAT).

Cell	Rh	C^w	C	c	D	E	e	M	N	S	s	P_1	Lu^a	K	k	Kp^a	Le^a	Le^b	Fy^a	Fy^b	Jk^a	Jk^b	IAT	Pap
1	$R_1^wR_1$	+	+	0	+	0	+	+	+	+	0	0	0	0	+	0	0	+	+	0	+	0	2+	1+
2	R_1R_1	0	+	0	+	0	+	+	0	+	0	3+	0	0	+	0	+	0	+	0	+	0	1+	1+
3	R_2R_2	0	0	+	+	+	0	+	0	+	+	3+	0	+	+	+	0	+	0	+	+	+	2+	2+
4	r'r	0	+	+	0	0	+	0	+	0	+	4+	0	0	+	0	0	+	+	0	0	+	1+	1+
5	r''r	0	0	+	0	+	+	0	+	+	+	0	0	0	+	0	0	0	+	+	0	+	2+	2+
6	rr	0	0	+	0	0	+	+	+	+	0	4+	0	+	+	0	0	0	0	+	+	0	1+	1+
7	rr	0	0	+	0	0	+	0	+	0	+	2+	0	0	+	0	0	0	+	+	0	+	1+	1+
8	rr	0	0	+	0	0	+	+	0	+	+	3+	0	0	+	0	0	+	+	+	0	+	2+	2+
9	rr	0	0	+	0	0	+	0	+	0	+	0	+	0	+	0	0	+	0	+	0	+	1+	2+
10	rr	0	0	+	0	0	+	+	+	0	+	3+	0	+	0	+	+	0	+	+	+	0	1+	1+
Auto	rr	/	0	+	0	0	+	/	/	/	/	/	/	0	/	/	/	/	/	/	/	/	0	

Rh and K phenotype

C	c	E	e	K	control
4+	4+	0	4+	0	0

Direct antiglobulin test

Anti-IgG	Anti-IgA	Anti-IgM	Anti-C3c	Anti-C3d	Control
0	0	0	0	0	0

a. Discuss all the results so far, what could be the possible causes for the reactions found? (20 marks)

You consult the patient's clinical electronic record for further information and discover that the patient is receiving the following medications for Multiple Myeloma; lenalidomide, dexamethasone and daratumumab. Based on this information you refer the sample to the local red cell immunohaematology reference laboratory for further investigations and request 3 units of red cells. The patient is admitted, pending his transfusion.

b. What actions should you take with the information you have discovered. Explain your answer? (10 marks)

c. What could be the cause of the patient's pan-reactivity based on their clinical history? Explain your answer in detail. (20 marks)

d. What tests might be performed by the reference laboratory to resolve the positive antibody screen/panel and provide compatible red cells? Explain the mechanisms employed and discuss the possible complications of finding fully matched red cells when employing certain techniques. (20 marks)

Later that evening, the reference laboratory contacts you to say they have completed their investigation and the patient has no underlying clinically significant alloantibodies.

e. Describe the specification of red cells that should be selected for this patient, and how suitability is determined. (10 marks)

f. You have been asked to produce a laboratory policy for 'Managing patients on therapeutic monoclonal antibodies', what will you include? (20 marks)

3.
You receive a full blood count and group and antibody screen sample for an antenatal patient presenting at booking (12 weeks pregnant). You have no transfusion history for the patient in your laboratory computer system.

Full Blood Count Results

Parameter	Result	Reference range (female)
Haemoglobin (Hb)	105 g/L	115 – 165 g/L
White blood count (WBC)	7.2 x 10^9/L	4 - 11 x 10^9/L
Platelet count	187 x 10^9/L	150 – 400 x 10^9/L

Mother Blood Group

Anti-A	Anti-B	Anti-D1	Anti-D2	Control	A1 cells	B cells
0	MF	MF	MF	0	4+	0

Mother Antibody Screen

Cell	Rh	C^w	C	c	D	E	e	M	N	S	s	P_1	Lu^a	K	k	Kp^a	Le^a	Le^b	Fy^a	Fy^b	Jk^a	Jk^b	
I	$R_1^wR_1$	+	+	-	+	-	+	-	+	-	+	-	-	-	-	+	-	-	+	-	-	+	3+
II	R_2R_2	-	-	+	+	+	-	+	-	+	+	+	-	-	+	-	+	-	+	-	+	-	3+
III	rr	-	-	+	-	-	+	+	+	+	-	+	+	+	+	-	-	+	-	+	+	+	3+

You perform an IAT and enzyme antibody panel.

Cell	Rh	C^w	C	c	D	E	e	M	N	S	s	P_1	Lu^a	K	k	Kp^a	Le^a	Le^b	Fy^a	Fy^b	Jk^a	Jk^b	IAT	Pap
1	$R_1^wR_1$	+	+	0	+	0	+	+	+	0	+	0	0	0	+	0	0	+	+	0	+	0	3+	3+
2	R_1R_1	0	+	0	+	0	+	+	0	+	0	3+	0	0	+	0	+	0	+	0	+	0	3+	3+
3	R_2R_2	0	0	+	+	+	0	+	0	+	+	3+	0	+	+	0	0	+	0	+	0	+	3+	3+
4	r'r	0	+	+	0	0	+	0	+	0	+	4+	0	0	+	0	0	+	+	0	+	+	3+	3+
5	r''r	0	0	+	0	+	+	0	+	+	0	0	0	0	+	0	0	0	+	+	0	+	3+	3+
6	rr	0	0	+	0	0	+	+	0	+	0	4+	0	+	+	+	0	0	0	+	+	0	3+	3+
7	rr	0	0	+	0	0	+	0	+	0	+	2+	0	+	+	0	0	0	+	+	+	+	3+	3+
8	rr	0	0	+	0	0	+	0	+	+	+	3+	0	0	+	0	0	+	+	+	0	+	3+	3+
9	rr	0	0	+	0	0	+	+	+	0	+	0	+	+	+	+	0	+	0	+	0	+	3+	3+
10	rr	0	0	+	0	0	+	+	0	0	+	3+	0	0	+	0	+	0	+	+	+	0	3+	3+
Auto																							0	

a. Critically discuss ALL the results provided. At this stage, if blood and blood components are required in an emergency, what would you provide and why? (20 marks)

Upon contacting the antenatal clinic, you find out that the patient is of West African origin and has recently moved into the area. It has also been confirmed that the patient has beta thalassemia major. You have a look on Sp-ICE (the electronic reporting system for test results), and discover an extended phenotype, but there is no antibody history.

Extended red cell phenotype
D+, C-, c+, E-, e+, K-, k+, Fya-, Fyb+, Jka+, Jkb-, M+, N-, S-, s-, Lea-, Leb+

b. Explain the significance of this information and what potential conclusions you have drawn? (10 marks)

c. Describe what further investigations you should undertake at this time and what antenatal care would you advise dependant on the outcome of those investigations? (15 marks)

d. Explain, in detail, the mechanism and consequences of antibody mediated red cell destruction in utero and after birth. (20 marks)

You discuss the patient with the Haematology consultant who confirms that the patient will likely require transfusion support throughout her pregnancy.

e. Detail what red cells you would provide for this patient explaining your rationale and what is the likelihood you have suitable blood in stock? (10 marks)

f. What testing should be performed upon delivery of the baby and discuss why? (10 marks)

g. If the fetus requires transfusion support in-utero or during the postnatal period, what specification of red cells would you provide and explain why? (10 marks)

h. Discuss the probability that the baby will also be diagnosed with thalassemia major? Explain your reasoning. (5 marks)