



**PROGRAM** : *BIOMEDICAL TECHNOLOGY*

**MODULE** : **Blood Transfusion Technology**

**CODE** : **BTT2111**

**DATE** : **SUPPLEMENTARY EXAMINATION**  
16 JULY 2019

**DURATION** : 180 MINUTES

**WEIGHT** : 50 : 50

**TOTAL MARKS** : 180

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**MODERATOR** : MRS F KLINKERT

**NUMBER OF PAGES** : 17 PAGES

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**INSTRUCTIONS** : QUESTION PAPER MUST BE HANDED IN

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**REQUIREMENTS** : EXAM SCRIPT/S AND 1 MCQ CARD

1. Do section A on the MCQ card.
  2. Do section B and C in the exam script.
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**INSTRUCTIONS TO CANDIDATES:**

1. THIS PAPER CONSISTS OF 3 SECTIONS.
  2. EVERY SECTION MUST BE ANSWERED IN THE EXAMINATION ANSWER SCRIPT/S OR MCQ CARD PROVIDED.
  3. THIS QUESTION PAPER MUST BE RETURNED WITH YOUR EXAMINATION ANSWER SCRIPT.
  4. YOU MAY USE A CALCULATOR.
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**SECTION A: MCQ**

INSTRUCTION: CHOOSE ONLY ONE CORRECT ANSWER AND MARK ON THE MULTIPLE CHOICE (MCQ) ANSWER CARD:

(1 mark per question).

1. Which ONE of these infectious agents is NOT tested for in blood products?
  - a) Hepatitis C antibody
  - b) Hepatitis B
  - c) West Nile virus
  - d) HIV
  - e) Syphilis
  
2. Concerning non-conformances, the following practices must be followed, EXCEPT:
  - a) They must be properly investigated
  - b) A root cause for the problem must be established
  - c) It is not necessary to set a time limit for resolution
  - d) A person must be assigned responsibility for resolution
  - e) Management must ensure that the problem is properly and timeously resolved
  
3. The following are examples of pyrogenic materials (cause pyrogenic transfusion reactions) *except*:
  - a) Dried blood
  - b) Dried protein
  - c) Bacteria
  - d) Products of metabolic growth of bacteria
  - e) Incorrect ABO blood group
  
4. Which ONE of the following transfusions is likely to cause *extravascular* haemolysis?
  - a) Group O blood to group A recipient
  - b) Group B blood to group O recipient
  - c) Group O blood to group AB recipient
  - d) Kell-positive blood to a Kell-negative donor
  - e) All of the above

5. Which ONE of the following is NOT TRUE about the direct antiglobulin test?
- a) It may detect complement on the surface of red cells
  - b) It is positive in haemolytic disease of the newborn because of Rh incompatibility
  - c) It detects agglutination of enzyme-coated red cells
  - d) It is used for cross-matching recipient and donor blood
  - e) It may be positive due to certain drugs that cause *in vivo* coating of red cells with IgG or complement
6. Duffy antigens are receptors for which of the following organisms?
- a) *E. coli*
  - b) *Plasmodium vivax*
  - c) *Trypanosome cruzi*
  - d) *Treponema pallidum*
  - e) *Clostridium perfringens*
7. What occurs in the absence of an H gene?
- a) A, B and H antigens are produced
  - b) A, B and H antigens are NOT produced
  - c) A, B and H antigens are produced but in small quantities
  - d) O antigens are produced
  - e) None of the above
8. What immunoglobulin type causes Cold Autoimmune Haemolytic Anaemia?
- a) IgM
  - b) IgA
  - c) IgG
  - d) IgE
  - e) IgD
9. When the allelic genes are not the same, that person is said to be:
- a) Heterozygous
  - b) Hemizygous
  - c) Recessive
  - d) Dominant
  - e) Homozygous

10. Which of the following statements are FALSE regarding Kidd antibodies?
- a) The Kidd antibodies may be detected by enzyme techniques
  - b) The Kidd antibodies are immune IgG complement activating antibodies
  - c) The Kidd antibodies show marked variability in titre and strength of reaction
  - d) The Kidd antibodies are active at 4°C
  - e) Both antibody specificities are clinically significant
11. When is the primary response produced?
- a) When an antibody invades the body for the first time
  - b) When an antigen invades the body for the first time
  - c) When there has been an exposure of a second dose of the same antigen
  - d) When two antigens invade the body simultaneously
  - e) None of the above
12. Which of the following is TRUE of post transfusion purpura?
- a) PTP is defined as thrombocytopenia arising normally 5-12 days following a transfusion of a red cell/platelet concentrate product.
  - b) It is associated with the presence of antibodies directed against the human platelet antigen systems.
  - c) Platelet specific antibody is most frequently produced by women as a result of immunization via a previous pregnancy.
  - d) All of the above
  - e) None of the above
13. What are the blood grouping phenotype results for the following Rh phenotype: R<sub>1</sub>r?
- a) Positive for anti-D, anti-C, and anti-e
  - b) Positive for anti-D, anti-c, and anti-E
  - c) Positive for anti-c, anti-E, and anti-e
  - d) Positive for anti-D, anti-C, anti-c, and anti-e
  - e) Positive for anti-C, anti-c, anti-E, and anti-e

14. 22% Bovine albumin is added to a blood transfusion test in order to:
- a) Reduce the “charge density” (i.e. the di-electric constant)
  - b) Increase the repulsion between the red cells
  - c) Increase the zeta-potential
  - d) Decreases the cross-linking of IgG molecules
  - e) Causes the antigen sites to become more exposed
15. Rh antibodies are primarily of the \_\_\_\_\_ class.
- a) IgG
  - b) IgM
  - c) IgA
  - d) IgD
  - e) IgE
16. Concerning prevention of HDN, the Rhesugam injection...
- a) Contains a purified gamma D globulin (anti-D)
  - b) Contains a purified gamma E globulin (anti-E)
  - c) Coats the maternal red blood cells
  - d) Lyses the maternal red blood cells
  - e) Is used only when a child is born Rhesus negative
17. Which of the following are examples of anomalous ABO grouping results?
- a) Additional antibodies
  - b) Additional antigens
  - c) Missing antibodies
  - d) Missing antigens
  - e) All of the above
18. In transfusion science, red cells are washed to...
- a) Make them clean
  - b) Avoid haemolysis
  - c) Remove unwanted proteins in the plasma/serum
  - d) Avoid agglutination
  - f) Avoid dilution of the red cells

19. At which temperature should red cells be stored at?
- a)  $22 \pm 2$  °C
  - b)  $4 \pm 2$  °C
  - c) Above 37 °C
  - d) Below -30 °C
  - e) All of the above are incorrect
20. What is the purpose of the reverse grouping test?
- a) To check which antigens are present on the red blood cells
  - b) To check which antibodies are present in the serum
  - c) To check which antigens are present in the serum
  - d) To check which antibodies are present on the red blood cells
  - e) To check agglutinins within the red blood cells
21. Which one of the following statements is TRUE about the Kell blood group system?
- a) Has two main antithetical antigens, the K (Kell) and k (Cellano)
  - b) Anti-K and anti-k are IgG immune antibodies
  - c) React best at 37 degrees Celsius by AHG and enzyme techniques
  - d) Are clinically significant and can activate complement
  - e) All of the above
22. The following is TRUE concerning Rh positive individuals:
- a) They are all homozygous dominant (DD)
  - b) They are either homozygous recessive (dd) or heterozygous (Dd) for this trait.
  - c) They are either homozygous dominant (DD) or heterozygous (Dd) for this trait.
  - d) They are all homozygous recessive (dd)
  - e) None of the above

23. Regarding the technical requirements for quality of results, all reagents must adhere to the following EXCEPT:

- a) Meet minimum requirements.
- b) Be stored correctly.
- c) Manufacturer's directions must be followed.
- d) Every vial of red cells should be inspected for icterus
- e) Records of daily QC should be kept.

Questions 24 - 28. The following statements refer to Compatibility Testing.

The cross-match is a test between the 24\_\_\_\_\_ serum and the 25\_\_\_\_\_ red cells to show that no antibodies are present in the patient's serum that will cause either a frank transfusion reaction (IgM mediated 26\_\_\_\_\_ haemolysis) or premature destruction of the transfused cells 27\_\_\_\_\_ mediated 28\_\_\_\_\_ haemolysis).

- a) extravascular
- b) intravascular
- c) IgG
- d) patient's
- e) donor's

29. *Fill in the missing word:* Antihuman globulin (AHG) is obtained/made by injecting \_\_\_\_\_ with purified human immunoglobulin and complement.

- a) immunized mothers
- b) cows
- c) rabbits
- d) humans
- e) rats

30. Which one of the following phenotypes can be referred to as the "universal recipient"?

- a) AB
- b) A
- c) O
- d) B
- e) Bombay

For the following questions (31-40), choose either True (a on the MCQ card) or False (b on the MCQ card).

31. *True or False:* For the Rh system the D antigen is considered the most immunogenic with most reports of HDN associated with anti-D.
- a) True
  - b) False
32. *True or False:* The dosage effect seen in the Kidd system means individuals with the phenotype Jk(a+b-) have more Jk<sup>a</sup> antigen on the red cell surface than phenotype Jk(a+b+).
- a) True
  - b) False
33. *True or False:* Parents with blood group genotypes OO and AA will have all blood group A children.
- a) True
  - b) False
34. *True or False:* Anti-K is predominantly IgM class, can cause extravascular haemolysis and reacts optimally at 37°C.
- a) True
  - b) False
35. *True or False:* Individuals with the phenotype Fy(a-b-) are protected from *Plasmodium vivax*.
- a) True
  - b) False
36. *True or False:* To produce A or B antigens, the H substance is required as well as precursor substance.
- a) True
  - b) False



37. *True or False:* The Indirect Antiglobulin test is used to detect IgM antibodies in patient plasma using a secondary antibody to bind the Fc regions of the primary antibody.
- a) True  
b) False
38. *True or False:* Red blood cell agglutination occurs in 2 stages: the initial stage is antibody sensitisation, the second stage involves the antibodies crosslinking between each other to form a lattice.
- a) True  
b) False
39. *True or False:* A patient who is blood group B will show positive agglutinations with anti-B and B cells in the forward and reverse group respectively.
- a) True  
b) False
40. *True or False:* Enzyme treated red cell reagents will cause destruction of Rh, Lewis and Kidd antigens.
- a) True  
b) False

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**SECTION A SUBTOTAL: 40**

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**SECTION B: SHORT AND LONG QUESTIONS**

**INSTRUCTION:** ANSWER THE QUESTIONS FOR SECTIONS B AND C IN AN EXAM BOOK (PLEASE MARK EACH SECTION).

**QUESTION 1**

Define the following terms:

- |                       |     |
|-----------------------|-----|
| 1.1. Amorph           | (1) |
| 1.2. Dominant gene    | (1) |
| 1.3. Epitope          | (1) |
| 1.4. Quality Control  | (1) |
| 1.5. Inhibition       | (1) |
| 1.6. Dosage effect    | (2) |
| 1.7. Antibody         | (1) |
| 1.8. Washed red cells | (1) |
| 1.9. Gene             | (1) |

**[10]**

**QUESTION 2**

Describe the secondary immune response in detail.

**[6]**

**QUESTION 3**

The location and number of antigen sites on each red cell can affect antigen-antibody reactivity in a variety of ways. Discuss two (2) of them, and include examples for each.

**[4]**

**QUESTION 4**

Describe intravascular lysis, and give examples of antibodies which are haemolytic *in vivo*.

**[4]**

**QUESTION 5**

Describe the primary stage of red cell agglutination. *Exclude* factors that effect it.

**[3]**

**QUESTION 6**

Show all possible offspring **phenotypes** for the following parents:

GENOTYPES OF PARENTS		POSSIBLE PHENOTYPES OF OFFSPRING
PARENT 1	PARENT 2	
A <sup>2</sup> O	A <sup>2</sup> O	6.1.
A <sup>1</sup> O	A <sup>2</sup> O	6.2.
BO	OO	6.3.
A <sup>1</sup> B	OO	6.4.
A <sup>2</sup> B	BO	6.5.

**[12]****QUESTION 7**

7.1. Describe, in detail, ABO antigen production (biochemistry). Include information on the genes, enzymes and sugars needed to make the various ABO antigens.

(9)

7.2. Name the rare blood group that occurs as a result of the hh genotype, and describe why no A nor B antigens will be made despite that person having A or B genes.

(2)

**[11]****QUESTION 8**

*Additional antibodies* cause anomalous ABO grouping results. Supply two (2) examples of unexpected positive reactions with A and/or B cells.

**[2]****QUESTION 9**

9.1. Please complete the following table on Rh nomenclature (in your scripts):

(6)

Haplotype gene complex	Shorthand nomenclature
CdE	<b>9.1.1</b>
Cde	<b>9.1.2</b>
<b>9.1.3</b>	R
<b>9.1.4</b>	R <sub>z</sub>
cDE	<b>9.1.5</b>
cDe	<b>9.1.6</b>

- 9.2. Describe the C *trans* and *cis* effects in relation to the expression of the D antigen. (4)

**[10]**

**QUESTION 10**

- 10.1. Tabulate the phenotypes and genotypes of the Lutheran blood group system. ( $\frac{1}{2} \times 6 = 3$ )

- 10.2 Why is it possible for a RBC Lewis group to change from Le(a-b+) to Le(a-b-), and when is this most frequently seen? (3)

**[6]**

**QUESTION 11**

Describe, in detail, the pathophysiology of haemolytic disease of the newborn.

**[11]**

**QUESTION 12**

- 12.1. List two (2) of the mechanisms whereby drugs can induce an autoimmune haemolytic anaemia. (2)

- 12.2. Discuss the main characteristics of warm AIHA. (8)

**[10]**

**QUESTION 13**

- 13.1. List three (3) of the mandatory tests carried out on all blood donations. (3)

- 13.2. Briefly describe the following antibody detection methods below:

- 13.2.1. Antiglobulin assay (2)

- 13.2.2. Competitive assay (2)

**[7]**

**QUESTION 14**

- 14.1. List three (3) possible *non-immune* complications of blood transfusion. (3)
- 14.2. Answer the following questions on *Transfusion-Associated Graft-versus-Host Disease* (TA-GvHD).
- 14.2.1. TA-GvHD is defined as... (1)
- 14.2.2. Briefly describe the pathophysiology of how/why this disease occurs. (4)

**[8]**

**QUESTION 15**

- 15.1. Reconstituted frozen red cells are used for transfusion to what type of patient? (3)
- 15.2 Briefly describe *apheresis fresh frozen plasma*. Include how it is collected, and storage. (3)

**[6]**

**QUESTION 16:**

What are the differences between internal and external quality schemes? **[4]**

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**SECTION B SUBTOTAL: 114**

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**SECTION C: APPLICATION QUESTIONS**

**INSTRUCTION:** ANSWER THE QUESTIONS FOR SECTIONS B AND C IN AN EXAM BOOK (PLEASE MARK EACH SECTION).

**QUESTION 1**

Interpret the **ABO and Rh (D)** (e.g. A<sub>2</sub> + or POS) blood groups for the following results. Include subgroups and any abnormalities (such as unusual antibodies) in your answers, if present.

Record the answers in your examination script.

	PATIENTS' CELLS AGAINST				PATIENTS' SERUM AGAINST					RH (D) GROUPING
	ANTI- A <sub>1</sub>	ANTI- A	ANTI- B	ANTI- A,B	A <sub>1</sub> CELLS	A <sub>2</sub> CELLS	B CELLS	O CELLS	AUTO	IgG
<b>A</b>	0	0	0	0	0	0	0	0	0	0
<b>B</b>	0	4	0	4	0	0	4	0	0	0
<b>C</b>	4	4	0	4	0	0	4	0	0	0
<b>D</b>	4	4	4	4	0	0	0	0	0	4
<b>E</b>	0	0	0	0	H	H	H	0	0	4
<b>F</b>	0	0	4	4	4	4	0	0	0	0
<b>G</b>	0	0	0	0	4	4	4	0	0	4
<b>H</b>	0	4	0	4	0	0	4	0	0	4
<b>I</b>	0	4	4	4	4	0	0	0	0	4
<b>J</b>	0	0	0	0	4	4	4	4	0	4

1.1 PATIENT A

1.2 PATIENT B

1.3 PATIENT C

1.4 PATIENT D

1.5 PATIENT E

1.6 PATIENT F

1.7 PATIENT G

1.8 PATIENT H

1.9 PATIENT I

1.10 PATIENT J

**[10]**

**QUESTION 2**

Using the following antigram, identify the antibody(ies) that may be present in the serum from the following 5 patients:

**Record the answers in your examination script.**

No	Rh	OTC	Cw	C	D	E	c	e	M	N	Mg	S	s	P <sub>1</sub>	Lua	Lub	Lea	Leb	K	k	Kpa	Kpb	Wka	Fya	Fyb	Jka	Jkb	Sda	I
1	R <sub>1</sub> W <sub>R</sub> <sub>1</sub>	5304	+	+	+	-	-	+	+	+	-	-	+	++	-	+	-	+	-	+	+	+	-	-	+	+	-	+	
2	R <sub>1</sub> R <sub>1</sub>	3213	-	+	+	-	-	+	+	-	-	+	+	++	+	NT	+	-	-	+	-	+	-	+	+	-	+	+	
3	R <sub>2</sub> R <sub>2</sub>	4095	-	-	+	+	+	-	-	+	-	+	+	+++	-	NT	+	-	-	+	-	+	-	+	+	+	-	±	
4	R <sub>2</sub> R <sub>2</sub>	2395	-	-	+	+	+	-	-	+	-	-	+	+	-	+	-	+	-	+	-	+	-	+	-	+	+	±	
5	r'r	5659	-	+	-	-	+	+	-	+	-	-	+	+	-	+	-	-	-	+	-	+	-	+	+	+	-	±	
6	r''r	5682	-	-	-	+	+	+	+	+	-	+	-	-	+	+	-	+	-	+	-	+	-	+	+	+	+	++	
7	rr	1944	-	-	-	-	+	+	+	-	-	+	+	+	-	+	+	-	+	+	-	+	-	+	+	+	+	+	
8	rr	4326	-	-	-	-	+	+	+	+	-	-	+	+++	-	NT	+	-	-	+	-	+	-	+	-	-	+	++	
9	rr	2827	-	-	-	-	+	+	+	-	-	+	-	+++	-	NT	-	+	+	+	-	+	-	-	+	-	+	+	
10	R <sub>1</sub> R <sub>2</sub>	5045	-	+	+	+	+	+	+	-	-	+	-	+	-	+	+	-	-	+	-	NT	-	+	-	+	-	++	

Specification: single donor group O plasma, reduced blood (haematocrit 60-70%) in CPDA-

	PATIENT P		PATIENT Q	PATIENT R	PATIENT S	PATIENT T	
	ENZ @ 37°C	AHG @ 37°C	AHG @ 37°C	SALINE	AHG @ 37°C	ENZ @ 37°C	AHG @ 37°C
1	0	0	0	0	4	4	4
2	0	4	4	4	4	4	4
3	4	4	4	0	4	4	4
4	4	4	0	0	0	4	4
5	4	4	0	0	4	0	0
6	4	4	4	4	4	0	0
7	4	4	4	0	4	0	0
8	4	4	0	0	0	0	0
9	4	0	4	0	4	0	0
10	4	4	4	0	0	4	4

**2.1. PATIENT P****2.2. PATIENT Q****2.3. PATIENT R****2.4. PATIENT S****2.5. PATIENT T****[6]****QUESTION 3**

A blood bank holds the following units of O blood which have also been typed as follows:

UNIT NO	Rh	M	N	S	s	P <sub>1</sub>	Lu <sup>a</sup>	Lu <sup>b</sup>	Le <sup>a</sup>	Le <sup>b</sup>	K	k	Fy <sup>a</sup>	Fy <sup>b</sup>
101	R <sub>1</sub> R <sub>1</sub>	+	+	-	+	+	-	+	-	-	-	+	+	+
102	R <sub>1</sub> R <sub>2</sub>	+	+	+	+	+	-	+	+	-	-	+	-	-
103	rr	-	+	+	+	+	-	+	-	+	-	+	-	+
104	rr	+	-	-	+	+	+	+	-	+	+	+	+	-
105	R <sub>1</sub> r	-	+	-	+	+	-	+	-	-	-	+	+	-
106	R <sub>1</sub> R <sub>1</sub>	+	-	+	-	+	+	+	-	-	-	+	-	-
107	R <sub>1</sub> R <sub>1</sub>	-	+	+	-	+	-	+	+	-	-	+	-	+
108	R <sub>1</sub> r'	-	+	+	+	+	+	+	+	-	+	+	+	-
109	R <sub>1</sub> r'	-	+	+	+	+	+	-	+	-	-	+	+	-
110	R <sub>1</sub> r	+	-	+	-	+	-	+	-	+	-	+	+	-

The previous patients P; Q; R; S and T each require **2 units** of blood. Which units of blood would you select for cross-matching against each patient, bearing in mind the previous antibody/ies identified? **(WARNING: YOU OBVIOUSLY CANNOT SELECT THE SAME UNIT OF BLOOD MORE THAN ONCE).**

**Record the answers in your examination script.**



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<b>PATIENT</b>	<b>Possibilities</b>	<b>DONOR UNITS SELECTED</b>
<b>3.1 PATIENT P</b>		
<b>3.2 PATIENT Q</b>		
<b>3.3 PATIENT R</b>		
<b>3.4 PATIENT S</b>		
<b>3.5 PATIENT T</b>		

**[10]**

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**SECTION C SUBTOTAL: 26**

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**TOTAL MARKS: 180**

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