UNIVERSITY MEDICINE • EXERCISE SHEET

7.2 Antigen recognition: antibodies, receptors and MHC

Name: _____ Class: _____ Date: _____ **Total: 24 marks**

KEY WORDS major histocompatibility complex

Objective

Distinguish the two recognition systems and compute diversity and match probabilities.

1 Key knowledge and worked examples

■ **The chemistries**

Ig/BCR binds free antigen (whole shape); TCR sees peptide + MHC only (I: cytosol → CD8; II: eaten → CD4) ✓.

■ **Worked example: the library**

V(D)J + junctional diversity → 10^6–10^8 specificities; class switch

- affinity maturation 10–100×; sibling full match 1/4 ✓.

2 Practice

2.1 Which Ig class crosses the placenta? [3]

2.2 What does MHC-I display and to which T-cell subset? [3]

2.3 Compute the chance two siblings share both HLA haplotypes. [3]

3 Exam-style questions

3.1 A laboratory reports a new antibody titre 40× baseline at day 14 (fictional serology).

Explain the class-switch and affinity-maturation events behind the rise (germinal centre). Predict the dominant Ig class and its affinity change. State what the same sample at day 4 would likely have shown. [7]

3.2 A kidney transplant candidate has three siblings (fictional).

Compute the probability that at least one sibling is a full 2-haplotype match (each sibling 1/4). Explain why HLA-DR matching matters most for outcome. State what ABO mismatch would cause and when. [8]

Solutions

2.1

- IgG ✓.

2.2

- Cytosolic (self-made) samples to CD8 cells ✓.

2.3

- $1/2 \times 1/2 = 1/4$ ✓.

3.1

- In germinal centres B cells proliferate, switch IgM→IgG (CD40L–CD40 – cytokines) and hypermutate V regions; higher-affinity mutants are selected.
- Dominant IgG at 10–100× affinity ✓.
- Day 4: IgM only (or nothing) – primary-response lag ✓.

3.2

- P(at least one full match of three) $= 1 - (3/4)^3 = 1 - 0.422 = 0.578 \approx 58\ \%$ ✓.
- HLA-DR drives the direct T-cell alloresponse strongest (DR presents the broadest peptide repertoire to CD4 help).
- ABO mismatch → pre-formed anti-A/B antibody → hyperacute rejection, minutes after reperfusion ✓.