MARKING SCHEME

MATHEMATICS Compulsory Part · Paper 1

Topic practice: Permutations and Combinations · 2027

This marking scheme has been prepared for markers' reference. It is not a set of model answers. Award method marks where the working is sound. Accept equivalent methods unless the question specifies otherwise.

Question	Solution	Marks	Remarks
SECTION A(1) (16 marks)			
1.	**12** By the multiplication rule, the number of ways is $4 \times 3 = 12$.	3	
2.	**120** The number of arrangements is $5! = 5 \times 4 \times 3 \times 2 \times 1 = 120$.	3	
3.	**56** The number of ways is $\binom{8}{3} = \frac{8!}{3!5!} = \frac{8 \times 7 \times 6}{3 \times 2 \times 1} = 56$.	4	
4.	**(a) 358800 (b) 55200** (a) The number of passwords is $P(26, 4) = 26 \times 25 \times 24 \times 23 = 358800$. (b) If the password contains A, choose the position of A (4 ways), then choose the remaining 3 letters from the other 25 letters and arrange them: $P(25, 3) = 25 \times 24 \times 23 = 13800$. Thus the number is $4 \times 13800 = 55200$.	6	
SECTION A(2) (24 marks)			
5.	**(a) 3060 (b) 1260 (c) 3050** (a) Total number of committees is $\binom{18}{4} = 3060$. (b) Choose 2 boys from 10 and 2 girls from 8: $\binom{10}{2} \times \binom{8}{2} = 45 \times 28 = 1260$. (c) The number of committees with at least 1 boy is the total minus the number with no boys (all girls): $\binom{18}{4} - \binom{8}{4} = 3060 - 70 = 2990$. Alternatively, sum over the number of boys: $\binom{10}{1}\binom{8}{3} + \binom{10}{2}\binom{8}{2} + \binom{10}{3}\binom{8}{1} + \binom{10}{4}\binom{8}{0} = 560 + 1260 + 960 + 210 = 2990$.	7	

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Question	Solution	Marks	Remarks
6.	**(a) 120 (b) 48 (c) 72** (a) The number of arrangements is $5! = 120$. (b) Treat the two mathematics books as a single block. Then we arrange 4 items (the block and the other 3 books): 4! ways. Within the block, the two mathematics books can be arranged in 2! ways. So the number is $4! \times 2! = 24 \times 2 = 48$. (c) The number of arrangements with the mathematics books separated is the total minus the number with them together: $120 - 48 = 72$.	8	
7.	**(a) 252 (b) 115 (c) 186** (a) Total number of teams is $\binom{10}{5} = 252$. (b) Teams with at least 2 girls: sum over the number of girls $k = 2, 3, 4$: $\binom{4}{2}\binom{6}{3} + \binom{4}{3}\binom{6}{2} + \binom{4}{4}\binom{6}{1} = 6 \times 20 + 4 \times 15 + 1 \times 6 = 120 + 60 + 6 = 186$. Alternatively, total minus teams with 0 or 1 girl: $252 - (\binom{4}{0}\binom{6}{5} + \binom{4}{1}\binom{6}{4}) = 252 - (6 + 60) = 186$. (c) More boys than girls means at least 3 boys. Sum over the number of boys $k = 3, 4, 5$: $\binom{6}{3}\binom{4}{2} + \binom{6}{4}\binom{4}{1} + \binom{6}{5}\binom{4}{0} = 20 \times 6 + 15 \times 4 + 6 \times 1 = 120 + 60 + 6 = 186$.	9	
SECTION B (10 marks)			
8.	**(a) 720 (b) 144 (c) 144** (a) The number of arrangements is $6! = 720$. (b) Treat the 3 mathematics books as a single block. Then we arrange 4 items (the block and the 3 science books): 4! ways. Within the block, the 3 mathematics books can be arranged in 3! ways. So the number is $4! \times 3! = 24 \times 6 = 144$. (c) First arrange the 3 science books in a row: $3! = 6$ ways. This creates 4 gaps (including the ends) where the mathematics books can be placed. To ensure no two mathematics books are adjacent, we must choose 3 of these 4 gaps and place the 3 distinct mathematics books in them: $\binom{4}{3} \times 3! = 4 \times 6 = 24$ ways. Thus the total number of arrangements is $6 \times 24 = 144$.	10	

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