KING SAUD UNIVERSITY

Practice problems for midterm-2

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1. Use fast modular exponentiation to compute $123^{1005} \bmod 101$. Show all details.

2. Let a, b, n be integers. Prove that if $a \equiv b \bmod n$ then $a^2 \equiv b^2 \bmod n$.

3. Prove using Induction that for all positive integer *n*, then

$$\sum_{i=1}^{n} (-1)^i i^2 = \frac{(-1)^n n(n+1)}{2}.$$

4. Use Induction to show that,

$$\sum_{i=1}^{n} \frac{1}{i(i+1)} = \frac{n}{n+1}.$$

5. Use Induction to show that if $A_1, A_2, \ldots, A_n$ are sets, then prove the generalized De Morgan's law,

$$\overline{\bigcup_{i=1}^{n} A_i} = \bigcap_{i=1}^{n} \overline{A_i}.$$

6. Find the coefficient of $x^5 y^8$ in the expansion of $(2x - y^2)^9$.

7. How many different distinct words can you make up by re-arranging the letters in MOROCCO.