Homework-4

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1 Introduction

We have 5 problems and try to solve those.

2 Analysis of Problems

2.1 Problem 1

Consider the prime p = 9929 and the primitive element 2.

2.1.1 Show the steps of the Diffie-Hellman between Alice and Bob for a = 1983 and b = 2014.

Table 1: Add caption

Alice	(p, q) = (9929, 2)	Bob
a=1983		b=2014
↓		↓
2**1983 (mod 9929) = 8580		2**2014 (mod 9929) = 5387
↓		↓
5387**1983(mod 9929)		8580**2014(mod 9929)
↓		↓
K = 7690		K = 7690

2.1.2 What is the value of the agreed secret key?

Result: 7690

2.2 Problem 2

Consider the RSA public and private key pairs: (e, n) = (17, 902801) and (d, n, p, q, ϕ) = (423953, 902801, 911, 991, 900900).

I have checked to all values(indeed, to practice).

2.2.1 Given M_1 = 500000, compute $C_1 = M_1^e$ (mod n).

Let's compute according to above formula:

$$C_1 = 500000^{17} \pmod{902801} = 487730$$

2.2.2 Given C_2 = 707631, compute $M_2 = C_2^d$ (mod n)

Similarly;

$$M_2 = 707631^{423953} \pmod{902801} = 500001$$

2.3 Problem 3

RSA with three primes would also work: n = pqr, ϕ(n) = (p-1)(q-1)(r-1), gcd(e, ϕ(n)) = 1, and d = e^{-1} (mod ϕ(n))

2.3.1 Setup an example RSA public/private key pair using primes 29, 31, 37, and e = 17.

At first, we compute necessary all values;

$$\text{n} = \text{p.q.r} = 29.31.37 = 33263$$

$$\phi(\text{n}) = (\text{p-1})(\text{q-1})(\text{r-1}) = 28.30.36 = 30240$$

$$\text{d} = e^{-1} \pmod{\phi(\text{n})} = 17^{-1} \pmod{30240} = 10673$$

2.3.2 Encrypt m = 10000 and then decrypt the ciphertext.

$$C_1 = 10000^{17} \pmod{33263} = 29774 \text{ and,}$$

$$M_1 = 29774^{10673} \pmod{33263} = 10000$$

2.3.3 Explain why RSA with three primes algorithm is not preferred.