1. 2-out-of-4 Questions

For each question, please mark the *two* correct answers.

(1) WPA2

- □ may use EAP and IEEE 802.1X during the authentication phase.
- □ always encrypts data using RC4 for compatibility with older devices.
- □ does not support pre-shared keys.
- □ derives Pairwise Transient Key (PTK) from Pairwise Master Key (PMK).

(2) DNSSEC provides

- □ protection against DNS amplification.
- □ data confidentiality.
- □ origin authenticity and data integrity of DNS replies.
- □ backwards compatibility with DNS.

(3) DomainKeys Identified Mail (DKIM) provides

- □ multi-factor user authentication.
- □ compatibility with existing e-mail infrastructure.
- □ encryption based on a combination of asymmetric- and symmetric-key cryptography.
- □ detection of forged sender addresses in e-mail.

(4) Pretty Good Privacy (PGP)

- □ authenticates e-mail servers with the help of DNS records.
- □ protects against IP address spoofing.
- □ can use "Web of Trust" for public-key distribution.
- □ provides confidentiality.

(5) Which security measures aim to provide confidentiality for payload data?

- □ WEP
- □ MAC-address filtering
- □ WPA
- □ hidden SSID

(6) Stateless firewalls

- □ apply rules to each incoming/outgoing packet.
- □ can be used to create Demilitarized Zones (DMZ).
- □ cannot inspect headers of higher-level protocols, such as UDP and TCP.
- □ may need to keep track of every active connection.

(7) SSL/TLS

- □ must authenticate both parties before establishing a session.
- □ runs on top of a transport layer protocol (e.g., TCP).
- □ supports Diffie-Hellman based key exchange.
- □ supports Kerberos based key exchange.

(8) Cross-site request forgery (CSRF) vulnerabilities

- □ may be prevented by filtering special HTML characters.
- □ enable attackers to target servers that they cannot directly access.
- □ are typically exploited by injecting malicious client-side scripts.
- □ are typically exploited by tricking a user into requesting a special URL.

(9) What can we use to sandbox code?

- □ virtual machines
- □ executable space protection
- □ IDS
- □ Linux seccomp

(10) Buffer-overflow vulnerabilities

- □ do not affect buffers that are dynamically allocated on the heap.
- □ can be prevented by filtering characters based on a proper whitelist.
- □ may be exploited by attackers to cause denial-of-service.
- □ may be caused by unsafe functions for copying strings.

(11) Which statements are true for typical vulnerabilities?

- □ Attackers may use integer-overflow vulnerabilities to cause buffer overflows.
- □ Attackers may exploit format-string vulnerabilities to gain sensitive information.
- □ Higher-level languages, such as Java and C#, are not susceptible to integer-overflow vulnerabilities.
- □ Only local attackers (e.g., local users) can exploit race-condition vulnerabilities.

(12) Mandatory Access Control (MAC)

- □ cannot be combined with Discretionary Access Control.
- □ can be used to implement multilevel security.
- □ enforces system-wide rules that are set by a central authority.
- □ allows access rights to be propagated at the subjects' discretion.

(13) Which statements are true for input validation?

- □ Short blacklists have a lower impact on usability than short whitelists.
- □ List `ABC...Zabc...z012...9` may be used as a whitelist to prevent cross-site scripting (XSS).
- □ Input that is provided by an authenticated user does not need to be validated.
- □ Shorter whitelists tend to be less secure.

(14) When set on a directory, what do these Unix access-control permission bits mean?

- □ Setgid bit: new files in the directory will inherit the group of the directory.
- □ Write bit: enables modifying the contents of files in the directory.
- □ Execute bit: enables accessing files in the directory.
- □ Sticky bit: prevents users from accessing other users' files in the directory.

(15) SQL injections

- □ cannot be mitigated securely by obscuring table and column names.
- □ are vulnerabilities in client-side scripts (e.g., JavaScript).
- □ may be exploited only by authenticated users.
- □ may be used by an attacker to gain confidential information.

(16) Parasitic malware

- □ cannot exist independently.
- □ ask for payment in exchange for releasing a victim's files or system.
- □ include worms.
- □ include viruses.

(17) Which statements are true for user authentication?

- □ Online password guessing is more challenging for the attacker than offline guessing.
- □ Inherence factors include hardware tokens (e.g., RSA SecureID).
- □ Multi-factor user authentication uses multiple authentication mechanisms.
- □ Salt values must be stored securely to prevent password recovery attacks.

(18) Which statements are true for Intrusion Detection Systems (IDS)?

- □ Signature-based IDS are trained to detect deviations from a known "normal" behavior.
- □ Anomaly-based IDS are trained to detect samples of known attacks.
- □ False-negative error means failure to detect an actual attack.
- □ Network-based IDS may inspect the header and/or payload of a network packet.

2. Matching Questions

For each question, please fill out each __ with the letter of the corresponding text or figure. Note that you have to use each letter exactly once in each question.

(1) Attacks and countermeasures

__ injecting and executing shellcodes

__ eavesdropping wireless networks

__ brute-forcing many passwords

__ DDoS

__ tampering with e-mail

(a) salting

(b) address space layout randomization

(c) PGP

(d) IEEE 802.11i

(e) upstream filtering

3. Open-Ended Questions

For each question, please clearly indicate your final answer.

(1) **Code Vulnerability** What software vulnerabilities can you identify in file `search.php`? Briefly explain where (i.e., on which lines) and how they occur!

File `english.php`:

```
 0:  $text = "Search: ";
```

File `spanish.php`:

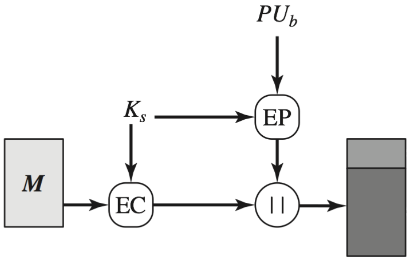
```
 1:  $text = "Buscar: ";
```

File `search.php`:

```
     ...
 2:  $language = $_GET['language']; // english.php or spanish.php
 3:  $search = $_GET['query']; // search keyword
 4:  if ($language == "english.php") {
 5:    include("english.php");
 6:  } else {
 7:    include($language);
 8:  }
 9:  echo($text . $search);
10:  $results = $db->query("SELECT * FROM posts WHERE text = '%" . $search . "%';");
     ... // echo results
```

How would you fix `search.php`? (You do not need to write code, just propose ideas and techniques.)

(2) **Pretty Good Privacy: Symmetric and Asymmetric Keys** The following figure shows how Pretty Good Privacy encrypts a message:



Notation:

- M: message
- K_s: symmetric key
- EC: symmetric-key encryption
- EP: asymmetric-key encryption
- | |: concatenation

How and when is K_s generated?

What is PU_b? How can the recipient decrypt the message?