1. True or False. BGP provides an indication of reachability which ensures that the optimal route is advertised. Explain your answer.

Solution: FALSE. A BGP path indicates reachability only. BGP makes no attempt to advertise routing optimality.

2. If I want to use a method beside use of local preferences to ensure that our traffic does not go through ASs that are not trusted or that are unfriendly, I would (indicate the best answer):
   (a) secure my BGP routers to ensure no traffic is transmitted.
   (b) buy all the ASs between the source and destination so I know I could trust them.
   (c) ignore any advertised routes that contain those dangerous ASs.
   (d) use MD5-hash on the link state packets I transmitted.

Solution: (c)

3. Two types of attacks were discussed in Chapter 18: 1) route hijacking and 2) the routed wide area MITM attack. What is the difference in how BGP is exploited in each attack?

Solution: BGP Route (or prefix) hijacking involves advertising a more specific network prefix, which contains the target’s IP address. This will result in redirecting traffic to the attacker’s BGP router. A routed wide area MITM attack takes it a step further by forwarding the traffic on to the intended destination.

4. What information is required to secure Internet routing?

Solution: Authenticated route attributes from every AS.

5. What makes securing Internet routing so difficult today and in the future?

Solution: BGP does not provide security. It provides no mechanism to authenticate the allocation or origin of a network prefix and ASN. Technical solutions are available to secure BGP routing, but each suffers from drawbacks.

6. What prefix and AS path should router R50 announce to hijack the Midtrest webserver?

Solution: 30.31.48.0/20, with AS-path 50
7. Consider the network diagram and BGP route announcement from router 50 of AS50 below. AS10 is a multihomed AS. Assuming no local preferences are set, for every AS, draw the path that each AS would select to reach 30.31.51.10 beginning with the AS router and ending with the Midtrest webserver.

![Network Diagram]

Solution:

```
1.2.3.0/24
R10
AS 10

1.1.1.0/30
R20
AS 20

2.2.2.0/30
R30
AS 30

3.3.3.0/30
R40
AS 40

5.5.5.0/30
R50
AS 50

www.midtrest.com
30.31.51.10

7.7.7.0/30
R70
AS 70

10.10.10.0/30

Note: AS70 and AS50 will ignore the announcement because their AS numbers are in the announcement. Also, AS50-70-40 provides the static route to the target, so that midtrest.com IP traffic will arrive at the correct destination. AS20 must use the path AS20-30-50-70-40 because AS10 is multi-homed.
```

8. The Internet Routing Registries (IRRs) house important information about the IP prefixes, ASNs, routing policy, network topology, and human points of contact of registered ASes.

Access the website www.irr.net in either Firefox or Chrome on your Windows computer.
Click on the link for an overview of the IRR and answer the following questions:

a) What do IRRs provide?
Solution: IRRs provide a database of IP prefixes, ASNs, routing policies, network topology, and human points of contact for registered Autonomous Systems.

b) Why use a routing registry?

Solution: To authenticate the validity of BGP route announcements, and aid in filtering rouge/malicious announcements.

c) Do people trust the information in the IRR? When is this a problem?

Solution: Generally, yes, but the data in IRR repositories can become inaccurate over time. It can be a problem if an AS changes ownership, goes out of business, and the IRR data is not refreshed. In addition, since registration is voluntary, not all ASes are included in the repository.

9. One of the most effective solutions against false route injection into the Internet routing system is the use of Resource Public Key Infrastructure (RPKI). Just within the last few years, all Regional Internet Registries (RIRs) began offering RPKI. Access the website www.arin.net/resources/rpki/index.html and watch the video “Resource Certification Explained” to learn more about how RPKI works and answer the following questions:

a) In RPKI, what is used to verify that an IP address has been allocated to a specific entity?

Solution: Resource certificates

b) In RPKI, what is used to verify that an AS may originate a specific network prefix?

Solution: Route origin authorizations

c) What is one thing RPKI does not provide assurance of?

Solution: Route attributes within BGP announcements

10. What must AS network operators do with the data from RPKI to secure internet routing?

Solution: They must use RPKI data to construct their BGP filters.