**1. Suppose a router receives an IP packet containing 600 data bytes and has to forward the packet to a network with a maximum transmission unit of 200 bytes. Assume that the IP header is 20 bytes long. What are fragment offset values for divided packets?**

A) 22, 44, 66, 88 B) 0, 22, 44

C) 0, 22, 44, 66 D) 22, 44, 66

Answer:(C)
Explanation:

Given, MTU size of the destination network = 200 bytes, IP header length = 20

Maximum amount of data that can be sent in one fragment = 200 – 20 = 180 bytes.
The amount of data sent in a fragment must be a multiple of 8.
So, the maximum data sent that can be in one fragment = 176 bytes.
Thus, 4 fragments are created-
1st fragment contains 176 bytes of data.
2nd fragment contains 176 bytes of data.
3rd fragment contains 176 bytes of data.
4th fragment contains 72 bytes of data
Fragment offset value for 1st fragment = 0
Fragment offset value for 2nd fragment = 176 / 8 = 22
Fragment offset value for 3rd fragment = (176+176) / 8 = 44
Fragment offset value for 4th fragment = (176 + 176 + 176) / 8 = 66
Thus, Option (C) is correct.

**2. In Ipv4, reassembly of the fragments is done at____?**

A) Destination host only B) Intermediate routers only

C) Source host only D) Source and destination host

Answer:(A)
Explanation:

Fragmentation is done at intermediate routers(if any) and reassembly only at the destination host.

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**3. Host X sends a message to host Y, which has two intermediate networks in between them. A TCP message consisting of 2100 bytes is passed to IP for delivery across two hosts. The first network has an MTU of 1200 bytes, and the second network has an MTU of 400 bytes, excluding network overhead. Assume that the IP overhead per packet is 20 bytes. What is the fragmentation offset for the Last fragment that reaches the destination?**

A) 250 B) 350 C) 450 D) 550

Answer:(A)
Explanation:

File size = 2100; when it goes to the network layer, 20 bytes are added, becoming 2120B.
This is for understanding as we can solve it without considering IP overhead because fragmentation is done on data, not headers.
At sender S: 2100 B to intermediate router P(1200 bytes without header) to intermediate router Q(400 B w/o header) to destination D.
S to P: fragment 1: 1200 B fragment 2: 900 B to P
P to Q: for 1200 B fragment
F1 : 400(data length in bytes) offset : 0
F2: 400 offset: 400/8=50
F3: 400 offset: 100
for 900 B fragment
F4: 400 offset: 150
F5: 400 offset: 200
F6: 100 offset: 250 last fragment
In other way, 250 x 8 = 2000 bytes ahead of this last fragment (from 0 to 1999), and the sequence number of the last fragment is 2000.
So 250 is the last fragment offset.

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**3. Consider the following statements about the functionality of an IP-based router. Which is/are True? [MSQ]**

A) A router does not modify the IP packets during forwarding.

B) It is not necessary for a router to implement any routing protocol.

C) A router should reassemble IP fragments if the MTU of the outgoing link is larger than the size of the incoming IP packet.

D) Fragmentation is done at intermediate routers.

Answer:(B,D)
Explanation:

A. False. A router modifies the IP packets during forwarding because TTL (Time to Live) changes.
B. True. A router does not need to implement any routing protocol. It can just forward packets in all directions without doing any routing.
C. False. The router does not assemble the packets. Assembling is done only in the destination system.
D.True. Fragmentation is done at intermediate routers.

**4. An IP router with a Maximum Transmission Unit (MTU) of 1500 bytes has received an IP packet of size 4404 bytes with an IP header of length 20 bytes. The values of the relevant fields in the header of the third IP fragment generated by the router for this packet are**

A) MF bit: 0, Datagram Length: 1444; Offset: 370

B) MF bit: 1, Datagram Length: 1424; Offset: 185

C) MF bit: 1, Datagram Length: 1500; Offset: 370

D) MF bit: 0, Datagram Length: 1424; Offset: 2960

Answer:(A)
Explanation:
Number of packet fragments = ⌈ (total size of packet)/(MTU) ⌉
So, the Datagram with data 4404 bytes fragmented into 3 fragments.

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| Packet-1: | Packet-2: | Packet-3: |
|---|---|---|
| 1480 \| 20<br>MF: 1<br>Length: 1500<br>Offset $= \frac{0}{8} = 0$ | 1480 \| 20<br>MF: 1<br>Length: 1500<br>Offset $= \frac{1480}{8} = 185$ | 1444 \| 20<br>MF: 0<br>Length: 1444<br>Offset $= \frac{1480+1480}{8} = \frac{2960}{8} = 370$ |

**5. The intermediate routers between the source and destination need the following information in the IP header_____?[MSQ]**

A) Version B) Protocol

C) Identification Number D) Source IP Address

Answer:(A,B,C,D)
Explanation:

The version field indicates the version of IP used. This information is required to process the packet appropriately based on its version.

The protocol field indicates the next level of protocol. The router requires this information to accept or discard the packet if its buffer is full. Based on the priority, the router takes its decision.

The identification number field identifies the fragments of the same datagram. This information is required while reassembling the datagram fragments.

The source IP Address field indicates the IP Address of the source. The router requires this information to send an ICMP packet to the source. ICMP packet informs the source that its packet has been discarded.

Thus, All these fields are required in the IP Header.

**6. An IP datagram of size 1000 bytes arrives at a router. The router has to forward this packet on a link whose MTU (maximum transmission unit) is 100 bytes. Assume that the**

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**size of the IP header is 20 bytes. The number of fragments that the IP datagram will be divided into for transmission is _____.**

A) 13

B) 14

C) 15

D) 16

Answer:(A)
Explanation:

Size of Datagram (L) = 1000 bytes
MTU = 100 bytes
Size of IP header = 20 bytes
Size of Data that can be transmitted in one fragment (payload)
= 100 – 20 = 80 bytes
Size of Data to be transmitted = Size of Datagram – size of header
= 1000 – 20 = 980 bytes
No. of fragments required = ⌈ 980/80⌉ = 13

**7: Which of the following fields in the IPv4 datagram is unrelated to fragmentation?**

A) Flags B) Offset C) TOS D) Identifier

Answer:(C)
Explanation:

Fragment offset, Flags (like MF), and Identification (Identifier) are related to fragmentation.

Only TOS is not related to fragmentation.

**8. The TTL field has a value of 10. How many routers (max) can process this datagram?**

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A) 10 B) 11 C) 12 D) 13

Answer:(A)
Explanation:

TTL value == No.of Routers

TTL stands for Time to Live. This field specifies the life of the IP packet based on the number of hops it makes (Number of routers it goes through). TTL field is decremented by one each time the datagram is processed by a router. When the value is 0, the packet is automatically destroyed.

**9. What should be the flag value to indicate the last fragment?**

A) 0 B) 1 C) -1 D) 2

Answer:(A)
Explanation:

The Flag field in the IP header is used to control and identify the fragments. It contains three bits: reserved, don't fragment and more fragments. If the bit of more fragments is 0, the fragment is the last.

**10. Which field helps to check the rearrangement of the fragments?**

A) Offset B) TTL C) Identifier D) Flag

Answer:(A)
Explanation:

The Fragment Offset field specifies where the fragment fits in the original datagram. The offset of the first fragment will always be 0. The size of the field (13 bits) is 3 bits shorter than the size of the total length field (16 bits).

**11. Consider two hosts, P and Q, connected through a router R. The maximum transfer unit (MTU) value of the link between P and R is 1500 bytes, and between R and Q is 820**

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**bytes. A TCP segment of size 1400 bytes was transferred from P to Q through R, with an IP identification value of 0×1234. Assume that the IP header size is 20 bytes. Further, the packet can be fragmented, i.e., the Don't Fragment (DF) flag in the IP header is not set by P. Which of the following statements is/are correct? [MSQ]**

A) TCP destination port can be determined by analysing only the second fragment.

B) If the second fragment is lost, P must resend the whole TCP segment.

C) Two fragments are created at R, and the IP datagram size of the second fragment is 620 bytes.

D) If the second fragment is lost, R will resend the fragment with the IP identification value 0×1234.

Answer:(B,C)
Explanation:

TCP Segment Size = 1400,
Packet size = segment size + IP Header Size = 1400+ 20 = 1420
At R Packet will be Fragmented MTU = 800 + 20 (Header)
Hence Packet's Data (1400) will be divided in two packets = (800 + 600)
First Fragment = (800 + 20)
Second Fragment = ( 600 + 20 )

A- FLASE: The TCP destination port can be determined by analyzing only the second fragment. This option is incorrect, as the Destination Port Number can be identified by looking at any packet or Fragment. Not just only from the Second Fragment.

B-TRUE: If the second fragment is lost, P must resend the whole TCP segment. This is correct. If any of the Fragments is lost, then the entire packet/TCP segment has to be retransmitted; this is one of the drawbacks of fragmentation.

C- TRUE: Two fragments are created at R, and the IP datagram size of the second fragment is 620 bytes.
D - FALSE: If the second fragment is lost, R will resend the fragment with the IP identification value 0 × 1234. This option is false. If any of the Fragments is lost, then the entire packet/TCP segment has to be retransmitted.

**12. Fragmentation and Reassembly happen at ____ layer?**

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A) Network Layer B) Transport Layer

C) Data link Layer D) Presentation Layer

Answer:(A)
Explanation:

Fragmentation and Reassembly happen at the Network layer.
Segmentation happens at the Transport layer.
Framing Happens at Data Link Layer

**13. In an IPv4 datagram, the M bit is 0, the value of HLEN is 10, the total length is 400, and the fragment offset value is 300. The position of the datagram and the sequence numbers of the first and the last bytes of the payload, respectively, are_____?**

A) Last fragment, 2400 and 2789

B) First fragment, 2400 and 2759

C) Last fragment, 2400 and 2759

D) Middle fragment, 300 and 689

Answer:(C)
Explanation:

M = 0 - There is no fragment after this, i.e., the Last fragment.
HLEN = 10, So header length is 4×10=40, as 4 is the constant scale factor.
Total Length = 400 (40 Byte Header + 360 Byte Payload)
Fragment Offset = 300, which means 300×8 Byte = 2400 bytes before this last fragment.
So, the position of the datagram is the last fragment.
The sequence number of First Byte of Payload = 2400 (as 0 to 2399 Sequence no are used)
The sequence number of Last Byte of Payload = 2400+360-1=2759

**14. Which of the following statements is/are TRUE fragmentation?[MSQ]**

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A) By using the identification number, we can determine which fragment belongs to which packet

B) By using the offset, we can determine the sequence of the fragments of that particular packet

C) By using the identification number, we can determine the sequence of the fragments of that particular packet

D) By using the offset, we can determine which fragment belongs to which packet

Answer:(A,B)
Explanation:

A - TRUE, by using the identification number, we can determine which fragment belongs to which packet

B- TRUE: by using the offset, we can determine the sequence of the fragments of that particular packet.

**15. If a datagram of size 4000 bytes from the transport layer arrives at the network layer, it has to be forwarded through a link with a maximum capacity of 800 bytes. Then, calculate the number of fragments needed if the header size is 20 bytes. Also, calculate the data size of the last fragment.**

A) 5 fragments, 100 bytes B) 6 fragments, 100 bytes

C) 5 fragments, 200 bytes D) 6 fragments, 200 bytes

Answer:(B)
Explanation:

Data to be transferred = 4000 - 20 = 3980 bytes.
Capacity of link data = 800 bytes
= 800 - 20 = 720 bytes (not divisible by 8) => 776 bytes

Total no. of fragments = 3980 / 776 = 6

Last fragment contains = 3980 - 5 x 776 = 100

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