

Computer Networks 2021 Exercises - Unit 5

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NOTE: Each student's work unit is unique. You must use the work that has been generated for your FAN. If you do not, then you will fail this work unit.

NOTE: You must record your answers in the answer file EXACTLY as required, and commit and make sure your changes have been pushed to the github server, as they will otherwise not be counted.

NOTE: The topic coordinator will periodically run the automatic marking script, which will cause a file called unit5-results.pdf to be updated in your repository. You should check this file to make sure that your answers have been correctly counted. That file will contain the time and date that the marking script was last run, so that you can work out if it has been run since you last changed your answers. You are free to update your answers as often as you wish, until the deadline for the particular work unit.

1 TCP/IP And Related Protocol Packet Formats and Header Fields

For each question, you must record your answer in the unit5-answers.txt file in your git repository. Templates for each answer are provided in unit5-answers.txt for your convenience.

You will find information on the packet header formats in many places, including:

- *https://en.wikipedia.org/wiki/Ethernet_frame#Header*
- *<https://en.wikipedia.org/wiki/IPv4#Header>*
- *https://en.wikipedia.org/wiki/Address_Resolution_Protocol*
- *https://en.wikipedia.org/wiki/Transmission_Control_Protocol#TCP_segment_structure*
- *https://en.wikipedia.org/wiki/User_Datagram_Protocol#UDP_datagram_structure*

Considering the following packet:

```
# 0x0000: 8aee e2b0 ffea a776 1839 d72c 0800 4500 .....v.9,...E.
# 0x0010: 0076 0000 4000 0c06 0000 84f3 0551 272d .v...@.....Q'-
# 0x0020: ccf6 b454 0404 6bbb aeb1 3c31 6d7d 500c ...T..k...<1m}P.
# 0x0030: 20af 0000 0007 5319 6c80 bb80 51ea ba11 .....S.l...Q...
# 0x0040: 6b56 e5a2 ab53 7206 548a 148b 4235 01e3 kV...Sr.T...B5..
# 0x0050: 6b1c 7731 93d2 5eec 2fd0 c640 7f64 2cc9 k.w1..^./..@.d,.
# 0x0060: aa92 2fa5 ffe8 f2c9 48df 8a5e cae5 6c3a ../.....H..^..l:
# 0x0070: 88a4 d2a7 a38e 25ef 5162 14b6 b99a 9905 .....%.Qb.....
# 0x0080: 9347 b236 .....G.6
```

Find the value of the following fields:

Question ID	Field	Type
ab	IP More Fragments	Boolean: Answer Y or N
ac	TCP ACK	Boolean: Answer Y or N
ad	Frame is 802.1q	Boolean: Answer Y or N
ae	IP FLAGS	Integer: Answer with the decimal value of the field.
af	TCP FIN	Boolean: Answer Y or N
ag	TCP source port	Integer: Answer with the decimal value of the field.

Considering the following packet:

```
# 0x0000:  1c1e d813 8f0d 8b20 83be 960a 8848 0000  ....H..
# 0x0010:  4b6c 4500 0055 0000 0000 2211 0000 df9f  K1E..U...."....
# 0x0020:  1408 837b aa3d 1b53 98e6 008f 239d 3608  ...{.=.S....#.6.
# 0x0030:  4153 3e5b 86af 61ca 37ee 989a 5d61 4c6d  AS>[.a.7...]aLm
# 0x0040:  51ab 6173 06fb 3c38 39ee 948e 77e2 cae6  Q.as..<89...w...
# 0x0050:  cd8e fabc 7873 329d 9137 4def 0fa1 0cde  ....xs2..7M.....
# 0x0060:  a466 37ce c14d a4                .f7..M.
```

Find the value of the following fields:

Question ID	Field	Type
ah	ETH source address	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
ai	UDP source port	Integer: Answer with the decimal value of the field.
aj	IP Don't Frag	Boolean: Answer Y or N
ak	IP Protocol of payload	Integer: Answer with the decimal value of the field.
al	IP More Fragments	Boolean: Answer Y or N
am	MPLS TTL	Integer: Answer with the decimal value of the field.

Considering the following packet:

```
# 0x0000:  1d64 87ae 4f90 177f 80ad 1884 8100 4614  .d..0.....F.
# 0x0010:  0800 4500 0060 0000 4000 2c11 0000 14ff  ..E..`...@.,.....
# 0x0020:  88f1 6a35 1663 2a72 5b26 005b 58e5 f536  ..j5.c*r[&.[X..6
# 0x0030:  7469 d20b 6158 937f e743 7f64 ff2f 7ed9  ti...aX...C.d./~.
# 0x0040:  65a6 5e60 0ba9 4873 ee00 daf2 368c 6369  e.^`..Hs....6.ci
# 0x0050:  087a 78e1 7150 0082 434f e626 cad7 7a05  .zx.qP..CO.&...z.
# 0x0060:  9bb5 1798 ba48 98fc ca4e 8ecd 83e9 f127  ....H...N.....'
# 0x0070:  0827                                     .'

```

Find the value of the following fields:

Question ID	Field	Type
an	UDP source port	Integer: Answer with the decimal value of the field.
ao	IP More Fragments	Boolean: Answer Y or N
ap	UDP destination port	Integer: Answer with the decimal value of the field.
aq	IP Don't Frag	Boolean: Answer Y or N
ar	IP ToS	Integer: Answer with the decimal value of the field.
as	IP ECN	Integer: Answer with the decimal value of the field.

Considering the following packet:

```
# 0x0000:  f64c b9ba b058 616a 9810 d512 0800 4500  .L...Xaj.....E.
# 0x0010:  005c 0000 4000 3411 0000 1bdb 72f5 1b61  .\..@.4.....r..a
# 0x0020:  84cb cb31 7957 00bb 6833 a37b 4251 2918  ...1yW...h3.{BQ}.
# 0x0030:  809c 5c10 cbb5 3c7a 58b0 d3d8 e311 fcd7  ..\...<zX.....
# 0x0040:  471f 80b9 6f09 817e de52 512a d18d bc70  G...o...~.RQ*...p
# 0x0050:  d1a6 d451 5d8c a77f ccc2 dc0c c9dc 578e  ...Q].....W.
# 0x0060:  b077 38f1 2b2f 2cb3 81c4                .w8.+/,...
```

Find the value of the following fields:

Question ID	Field	Type
at	ETH source address	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
au	IP FLAGS	Integer: Answer with the decimal value of the field.
av	IP ToS	Integer: Answer with the decimal value of the field.
aw	Frame is 802.1q	Boolean: Answer Y or N
ax	IP destination address	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
ay	IP TTL	Integer: Answer with the decimal value of the field.

Considering the following packet:

```
# 0x0000:  fc3a a121 92b0 1538 6282 aa5f 0800 4500  ...!...8b..._...E.
# 0x0010:  003b 0000 4000 3a11 0000 6379 f6f8 88cd  ...;...@:....cy....
# 0x0020:  cac2 2be4 efe0 00fc bf97 120b 1ee1 4b81  ..+.....K.
# 0x0030:  0203 48ba 047e 1524 12d1 d3ff 0b72 f3e3  ..H...~.$.....r..
# 0x0040:  d718 22f6 ec12 68a5 46                .."...h.F
```

Find the value of the following fields:

Question ID	Field	Type
az	ETH frame type	Four-digit Hex: Answer with the four digit hexadecimal value of the field, e.g., 02AF. Do not put a leading 0x or \$ on the front of the hexadecimal number.
ba	ETH source address	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
bb	Frame is 802.1q	Boolean: Answer Y or N
bc	IP FLAGS	Integer: Answer with the decimal value of the field.
bd	IP ECN	Integer: Answer with the decimal value of the field.
be	IP ToS	Integer: Answer with the decimal value of the field.

Considering the following packet:

```
# 0x0000: 1b0d 563a ede8 74d9 5560 b204 88a8 71f9  ..V:...t.U`....q.
# 0x0010: 0806 0001 0800 0604 0001 f595 7d2a db4d  .........}*M
# 0x0020: c20d 46a2 47b9 6079 2da6 621f 4d33 49fa  ..F.G.`y-.b.M3I.
# 0x0030: e676 ea4f e37e 871f a902 07c5 0f3b 05cb  .v.0.~.....;..
# 0x0040: 0938 3e1b 7772 ed6a f596 93f0 5cd2 1097  .8>.wr.j....\...
# 0x0050: 936c c7c4 d485 18e4 f2cc c044 32cd 8cee  .l.....D2...
# 0x0060: c1cc 2d0d 7c57 d605 3ac1 e0c5 3fa4 cfcf  ..-.|W.....?...
# 0x0070: 9742 acf0 934b 24ae 9af3 b844 0bc0 c0b4  .B...K$....D....
# 0x0080: 50d6 3677 1d15 2574 813c f670 0c8d 23a7  P.6w..%t.<.p..#.
# 0x0090: af60 cce5 b131 f656 e7f8 8357 70ea 7ed9  .`...1.V...Wp.~.
# 0x00a0: b921 51a8 94e9  ....!Q...
```

Find the value of the following fields:

Question ID	Field	Type
bf	Frame is 802.1q	Boolean: Answer Y or N
bg	Frame is MPLS	Boolean: Answer Y or N
bh	ETH destination address	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
bi	ARP target MAC	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
bj	ARP PTYPE	Integer: Answer with the decimal value of the field.
bk	ARP HTYPE	Integer: Answer with the decimal value of the field.

Considering the following packet:

```
# 0x0000: aa15 e120 2075 e2d1 6d95 b78a 0800 4500 .....u..m.....E.
# 0x0010: 003d 0000 4000 2a06 0000 95cb 2937 966a .=..@.*.....)7.j
# 0x0020: 69a3 9bac 26ba 0d43 bf3e 492b feda 50bc i...&...C.>I+..P.
# 0x0030: d8c8 0000 000e 8305 e18b 469d 9cce af23 .....F....#
# 0x0040: 3fbf 879f 9143 3d0f 59f7 51          ?....C=.Y.Q
```

Find the value of the following fields:

Question ID	Field	Type
b1	TCP ACK sequence number	Integer: Answer with the decimal value of the field.
bm	IP Don't Frag	Boolean: Answer Y or N
bn	ETH destination address	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
bo	IP source address	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
bp	Frame is MPLS	Boolean: Answer Y or N
bq	IP TTL	Integer: Answer with the decimal value of the field.

Considering the following packet:

```
# 0x0000: 43fc fad2 9544 a263 6930 ae fa 88a8 22a6 C....D.ci0....".
# 0x0010: 0800 4500 0090 0000 4000 2011 0000 037b ..E.....@.....{
# 0x0020: 5c10 dc65 611f 9bbe 8b36 002d 85e0 a5de \...ea....6.-....
# 0x0030: e402 9791 f292 cbf4 2163 2e16 6e0a b759 .....!c...n..Y
# 0x0040: 227c 819d ff5d 649a e137 b701 48a3 4752 "|...]d..7..H.GR
# 0x0050: 0f05 c6fe 7068 c50b f524 5e15 e73b d785 ....ph...$^...;..
# 0x0060: 7d24 3965 7c2c e3e0 ef13 baf6 9441 8c11 }$9e|,.....A..
# 0x0070: 955e 3965 72a1 ade0 3d23 3d62 bdb3 4c18 .^9er...=#=b..L.
# 0x0080: a70c 829c 3dcf 26f9 7f78 6983 ac2e d830 ....=.&...xi....0
# 0x0090: eb98 b892 6489 a3db 668a 15a5 0c40 960b ....d...f....@..
# 0x00a0: cfb2 ..
```

Find the value of the following fields:

Question ID	Field	Type
br	IP source address	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
bs	IP length	Integer: Answer with the decimal value of the field.
bt	IP More Fragments	Boolean: Answer Y or N
bu	Frame is MPLS	Boolean: Answer Y or N
bv	ETH source address	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
bw	IP FLAGS	Integer: Answer with the decimal value of the field.

Considering the following packet:

```
# 0x0000: f069 45fc 7c4f 31a3 05a2 d321 0806 0001 .iE.|01....!....
# 0x0010: 0800 0604 0001 8394 6975 ecbb 0763 9895 .....iu...c..
# 0x0020: edb7 a1b1 2c89 3b8f 3443 d679 53e5 77da ....,.;.4C.yS.w.
# 0x0030: 3a83 0d00 4dfe 45ff e072 9fd8 7f9d bd91 :...M.E..r.....
# 0x0040: 7676 3c76 5691 724e 18f1 0179 abf4 cd3a vv<vV.rN...y...:
# 0x0050: 360f bb4e 1ed3 6008 f302 1bee 2747 54ff 6..N..`.....'GT.
# 0x0060: 20ab 0407 7881 4d9f 450d ac71 bdbE 7fe8 ....x.M.E..q....
# 0x0070: f1e8 ee16 e05e ed05 dbd4 9927 26a9 fb19 .....^.....'&...
# 0x0080: 3382 bad9 3c3f f3d4 50ee f2d5 cd97 fadb 3...<?...P.....
```

Find the value of the following fields:

Question ID	Field	Type
bx	ARP source IP	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
by	ARP reply	Boolean: Answer Y or N
bz	ARP source MAC	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
ca	ARP target MAC	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
cb	ARP request	Boolean: Answer Y or N
cc	Frame is MPLS	Boolean: Answer Y or N

Considering the following packet:

```
# 0x0000:  5094 0181 12a1 7f14 1988 7e4a 0806 0001  P.....~J....
# 0x0010:  0800 0604 0001 614e 6a61 6cba b135 a516  .....aNja1..5..
# 0x0020:  3d96 31d0 18a9 9ca1 fc38 c6f7 ba0f e5a9  =.1.....8.....
# 0x0030:  6b57 71ea 56fd ffee 9fcc c476 4025 6c51  kWq.V.....v%lQ
# 0x0040:  f1c6 785f 515d 7cd3 78b7 1211 a48e 3780  ..x_Q]|.x.....7.
# 0x0050:  0174 eb67                                .t.g
```

Find the value of the following fields:

Question ID	Field	Type
cd	ARP target IP	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
ce	ARP target MAC	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
cf	Frame is 802.1q	Boolean: Answer Y or N
cg	ARP reply	Boolean: Answer Y or N
ch	ETH frame type	Four-digit Hex: Answer with the four digit hexadecimal value of the field, e.g., 02AF. Do not put a leading 0x or \$ on the front of the hexadecimal number.
ci	Frame is MPLS	Boolean: Answer Y or N

Considering the following packet:

```
# 0x0000: b366 bfaa b0be 42a5 5d39 c748 8100 475a .f....B.]9.H..GZ
# 0x0010: 0806 0001 0800 0604 0001 15ee 23d0 e2b3 .....#...
# 0x0020: e0dc 587a 8ef7 10be ca00 24e9 5a6e 7355 ..Xz.....$.ZnsU
# 0x0030: efe3 8c71 7a70 fd63 c958 8660 45da f090 ...qzp.c.X.`E...
# 0x0040: 7547 6ddd ff32 be70 208c 039a 7e90 c97d uGm..2.p....~...}
# 0x0050: 681b 7417 a7a5 dd68 13ab 70b5 65a9 2398 h.t....h..p.e.#.
# 0x0060: 483b 1f8f 1131 6d86 0e72 d100 28ae 0951 H;...1m..r...(..Q
# 0x0070: 74cf 3a3f 9231 f85e 46c7 91cd 61e8 78b8 t.:?.1.^F...a.x.
# 0x0080: 29 )
```

Find the value of the following fields:

Question ID	Field	Type
cj	ARP target IP	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
ck	ARP source IP	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
cl	ARP request	Boolean: Answer Y or N
cm	Frame is 802.1ad	Boolean: Answer Y or N
cn	Frame is MPLS	Boolean: Answer Y or N
co	ARP HTYPE	Integer: Answer with the decimal value of the field.

Considering the following packet:

```
# 0x0000:  111a 972b 14ef 3ac6 eb5f c85a 0800 4500  ...+..._.Z..E.
# 0x0010:  003f 0000 4000 3211 0000 3ac1 322b 9c46  .?...@.2...:2+.F
# 0x0020:  13b6 ddd3 e0c8 007e 5deb 3840 8559 dca7  .....~].8@.Y..
# 0x0030:  eebe 0fdc 0e6d ddb4 49ce 7d32 21b3 c0e3  ....m..I.}2!...
# 0x0040:  87e9 a85d a325 038d 20df 64de 6a         ...].%....d.j
```

Find the value of the following fields:

Question ID	Field	Type
cp	IP destination address	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
cq	IP TTL	Integer: Answer with the decimal value of the field.
cr	IP More Fragments	Boolean: Answer Y or N
cs	IP DSCP	Integer: Answer with the decimal value of the field.
ct	IP source address	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
cu	ETH destination address	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00

Considering the following packet:

```
# 0x0000:  e07b 124c 511f b178 07bd cfe1 0800 4500  .{.LQ..x.....E.
# 0x0010:  0053 0000 4000 2e11 0000 9d09 8455 8390  .S..@.....U..
# 0x0020:  1ef1 0adf 88ab 00e4 4c10 17a4 d148 a161  ....L....H.a
# 0x0030:  f7a8 9774 86ee 6380 267a 9529 497d c9c4  ...t..c.&z.)I}..
# 0x0040:  2b4d 4fcd 548d 37e4 bfcf 0370 50f8 ca83  +MO.T.7....pP...
# 0x0050:  22a8 1106 c8e8 eafd 3118 6085 517b 745e  ".....1.`.Q{t^
# 0x0060:  f9                                     .
```

Find the value of the following fields:

Question ID	Field	Type
cv	IP length	Integer: Answer with the decimal value of the field.
cw	IP source address	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
cx	UDP source port	Integer: Answer with the decimal value of the field.
cy	Frame is 802.1q	Boolean: Answer Y or N
cz	IP destination address	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
da	UDP destination port	Integer: Answer with the decimal value of the field.

Considering the following packet:

```
# 0x0000: c935 33d7 23a4 8f5a b2ba a692 88a8 166f .53.#...Z.....o
# 0x0010: 0806 0001 0800 0604 0001 87e7 f233 7002 .....3p.
# 0x0020: f034 6a76 f77c b0f5 683d 7b9a 41b7 164d .4jv.|..h={.A..M
# 0x0030: 852d 4324 cfb5 ef0b a0ec 9613 7dda eb2b .-C$......}...+
# 0x0040: 239c 41b7 09df bec3 c769 3dfc ace8 0a61 #.A.....i=....a
# 0x0050: 5e8e 35c3 1502 758d 6fbc 2852 b64e ea6c ^.5...u.o.(R.N.l
# 0x0060: 9361 f945 .a.E
```

Find the value of the following fields:

Question ID	Field	Type
db	ETH destination address	Ethernet MAC Address. Answer in the customary format, retaining leading zeroes, e.g., 02:ca:fe:f0:0d:00
dc	ARP reply	Boolean: Answer Y or N
dd	Frame is MPLS	Boolean: Answer Y or N
de	ARP request	Boolean: Answer Y or N
df	Frame is 802.1ad	Boolean: Answer Y or N
dg	ARP target IP	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21

Considering the following packet:

```
# 0x0000:  b0f1 99ba 41c8 8b15 b576 8158 8847 0001  ....A....v.X.G..
# 0x0010:  1f9a 4500 0047 0000 4000 0411 0000 434d  ..E..G...@.....CM
# 0x0020:  0a34 c617 7a1c 9cec 0fdc 0041 0b48 7b00  .4...z.....A.H{.
# 0x0030:  5df2 be34 be39 150f 9c74 ba4f a2f6 e695  ]..4.9...t.0....
# 0x0040:  e867 5581 40f7 5756 5944 7c79 6289 4229  .gU.®.WVYD|yb.B)
# 0x0050:  3485 1eae 9da1 554c d1                4.....UL.
```

Find the value of the following fields:

Question ID	Field	Type
dh	Frame is MPLS	Boolean: Answer Y or N
di	MPLS TTL	Integer: Answer with the decimal value of the field.
dj	IP destination address	IPv4 address. Answer in dotted quad notation, e.g., 129.96.1.21
dk	IP ECN	Integer: Answer with the decimal value of the field.
dl	UDP destination port	Integer: Answer with the decimal value of the field.
dm	IP ToS	Integer: Answer with the decimal value of the field.

2 Lecture Material Comprehension

The following questions are designed with two purposes in mind:

1. To help you engage with the lecture materials; and

2. To help generate a wide range of questions for the quizzes in this topic.

The second goal is not mandatory for you. However, if you are willing for the answers you provide to the questions in this section to be used in future quizzes in this topic, you are requested to answer the following question as follows *you will not be penalised if you do not give this permission*

Question#	Description
dn	Are you willing to release your following answers in this section from all copyrights, i.e., release them into the public domain, including so that they can be included in quizzes in this topic? <i>you will not be penalised or treated any differently if you do not choose to give this permission</i>

It is important that you answer this question with 'y', if you do decide that you would like to do this (but again, you have no obligation to do so, and you will not be treated differently whether or not you give permission).

The entry in `unit5-answers.txt` would thus look like:

```
# Question 'dn': Do you commit the following answers to the public domain
# and disclaim all copyrights in them?
dn=y
```

For each question, you must record your answer in the `unit5-answers.txt` file in your git repository. For each question, you are required to write a statement that is either true or false about the material in the indicated lecture slide.

For example, if you were asked 'write a **true** statement about the content of Slide 2 of Chapter 1', you would put the statement at the end of the `rz=` line in the file `unit5-answers.txt`. For example, if your statement was 'One of the problems addressed in this chapter is how to build scalable networks', you would write:

Question#	Description
pz	Write a true statement about the content of Slide 2 of Chapter 1

The entry in `unit5-answers.txt` would thus look like:

```
# Question 'pz': Write a true statement about the content of Slide 2 of Chapter 1
pz=One of the problems addressed in this chapter is how to build scalable networks
```

Templates for each answer are provided in `unit5-answers.txt` for your convenience.

If you are asked to write a statement that is false, i.e., untrue, think about statements that someone who has not worked through the material might think would be true. Be creative! Be devious!

Question#	Description
do	Write a false statement about the content of Slide 25 of Chapter 3
dp	Write a true statement about the content of Slide 23 of Chapter 1
dq	Write a false statement about the content of Slide 10 of Chapter 8
dr	Write a true statement about the content of Slide 7 of Chapter 9
ds	Write a true statement about the content of Slide 114 of Chapter 6
dt	Write a true statement about the content of Slide 50 of Chapter 7
du	Write a false statement about the content of Slide 61 of Chapter 8
dv	Write a false statement about the content of Slide 119 of Chapter 2
dw	Write a true statement about the content of Slide 28 of Chapter 7
dx	Write a false statement about the content of Slide 48 of Chapter 7