Problem 3

a) **First Sets:**

S →	ASE | CC | BCS	{ b, f, g, i, j | d, e, g | a, c, k	}
A →	bEC | Da | gB	{ b | f, i, j | g	}
B →	aDE | cD | kAB	{ a | c | k	}
C →	dEa | eS | gB	{ d | e | g	}
D →	iB | jkC | fSk	{ i | j | f	}
E →	CS | Aa | cb	{ d, e, g | b, f, g, i, j | c	}

All of the sets are pairwise disjoint.

b) **Parse Table:**

	a	b	c	d	e	f	g	h	i	j	k
S	BCS	ASE	BCS	CC	CC	ASE	ASE	CC	ASE	ASE	BCS
A	-	bEC	-	-	-	Da	gB	-	Da	Da	-
B	aDE	-	cD	-	-	-	-	-	-	-	kAB
C	-	-	-	dEa	eS	-	-	hf	-	-	-
D	-	-	-	-	-	fSk	-	-	iB	jkC	-
E		Aa	cb	CS	CS	Aa	Aa	CS	Aa	Aa	

c) **Recursive Descent/Leftmost Derivation:**

S →	ASE
→	DaSE
→	fSkaSE
→	fCCkaSE
→	fdEaCkaSE
→	fdAaaCkaSE
→	fdAaaCkaSE
→	fdgBaaCkaSE
→	fdgcDaaCkaSE
→	fdgcj kCaaCkaSE
→	fdgcj khfaa CkaSE
→	fdgcj khfaa dEakaSE
→	fdgcj khfaa dAaakaSE
→	fdgcj khfaa dbECaakaSE
→	fdgcj khfaa dbcbCaakaSE
→	fdgcj khfaa dbcbh faaka SE
→	fdgcj khfaa dbcbh faaka BCSE
→	fdgcj khfaa dbcbh faaka kABCSE
→	fdgcj khfaa dbcbh faaka kABCSE
→	fdgcj khfaa dbcbh faaka kbECBCSE

→ fdgcj khfaa dbcbh faaka kbCSCBCSE
→ fdgcj khfaa dbcbh faaka kbhfSCBCSE
→ fdgcj khfaa dbcbh faaka kbhfBCSCBCSE
→ fdgcj khfaa dbcbh faaka kbhfa DECSCBCSE
→ fdgcj khfaa dbcbh faaka kbhfa iBECSCBCSE
→ fdgcj khfaa dbcbh faaka kbhfa icDECSCBCSE
→ fdgcj khfaa dbcbh faaka kbhfa icjkCECSCBCSE
→ fdgcj khfaa dbcbh faaka kbhfa icjkd EaECSCBCSE
→ fdgcj khfaa dbcbh faaka kbhfa icjkd cbaECSCBCSE
→ fdgcj khfaa dbcbh faaka kbhfa icjkd cbacb CSCBCSE
→ fdgcj khfaa dbcbh faaka kbhfa icjkd cbacb hfSCBCSE
→ fdgcj khfaa dbcbh faaka kbhfa icjkd cbacb hfCCCBCSE
→ fdgcj khfaa dbcbh faaka kbhfa icjkd cbacb hfeSCCBCSE
→ fdgcj khfaa dbcbh faaka kbhfa icjkd cbacb hfeCCCCBCSE
→ fdgcj khfaa dbcbh faaka kbhfa icjkd cbacb hfedEaCCCBCSE
→ fdgcj khfaa dbcbh faaka kbhfa icjkd cbacb hfedc baCCCBCSE
→ fdgcj khfaa dbcbh faaka kbhfa icjkd cbacb hfedc bahfd EaCBCSE
→ fdgcj khfaa dbcbh faaka kbhfa icjkd cbacb hfedc bahfd cbaCBCSE
→ fdgcj khfaa dbcbh faaka kbhfa icjkd cbacb hfedc bahfd cbahf BCSE
→ fdgcj khfaa dbcbh faaka kbhfa icjkd cbacb hfedc bahfd cbahf cDCSE
→ fdgcj khfaa dbcbh faaka kbhfa icjkd cbacb hfedc bahfd cbahf cjkCCSE
→ fdgcj khfaa dbcbh faaka kbhfa icjkd cbacb hfedc bahfd cbahf cjkdEaCSE
→ fdgcj khfaa dbcbh faaka kbhfa icjkd cbacb hfedc bahfd cbahf cjkdc baCSE
→ fdgcj khfaa dbcbh faaka kbhfa icjkd cbacb hfedc bahfd cbahf cjkdc bahfSE
→ fdgcj khfaa dbcbh faaka kbhfa icjkd cbacb hfedc bahfd cbahf cjkdc bahfCCE
→ fdgcj khfaa dbcbh faaka kbhfa icjkd cbacb hfedc bahfd cbahf cjkdc bahfd EaCE
→ fdgcj khfaa dbcbh faaka kbhfa icjkd cbacb hfedc bahfd cbahf cjkdc bahfd cbaCE
→ fdgcj khfaa dbcbh faaka kbhfa icjkd cbacb hfedc bahfd cbahf cjkdc bahfd cbahf E
→ **fdgcj khfaa dbcbh faaka kbhfa icjkd cbacb hfedc bahfd cbahf cjkdc bahfd cbahf cb**

Parse Tree:

```
                                                    S
                        _____|_____
                       /                        |                         \
                      A                          S                          E
                     /                           |                           \
                   D a                  _____B C S_____             c b
                   /              _____/____                   |             \
                  /              /     |     \                  |              \
                f S k           k      A      B                h f            C C
                  |                     |      \                             /   \
                 C C                  b E C    c D                        d E a   h f
                / \                   |   \      \                          |
             d E a  d E a         ____C S  h f   j k C                     c b
               |      |          /     |          \
             A a    A a         h f  __B C S__    d E a
            /      /                 /   |    \      |
          g B    b E C            a D E  h f  C C    c b
            \    |   \             |  \      /   \
           c D  c b  h f          i B  c b  e S   d E a
             \                      |         \     |
            j k C                  c D        C C   c b
              \                     |        /  \
             h f                  j k C    d E a  h f
                                    |        |
                                  d E a     c b
                                    |
                                   c b
```