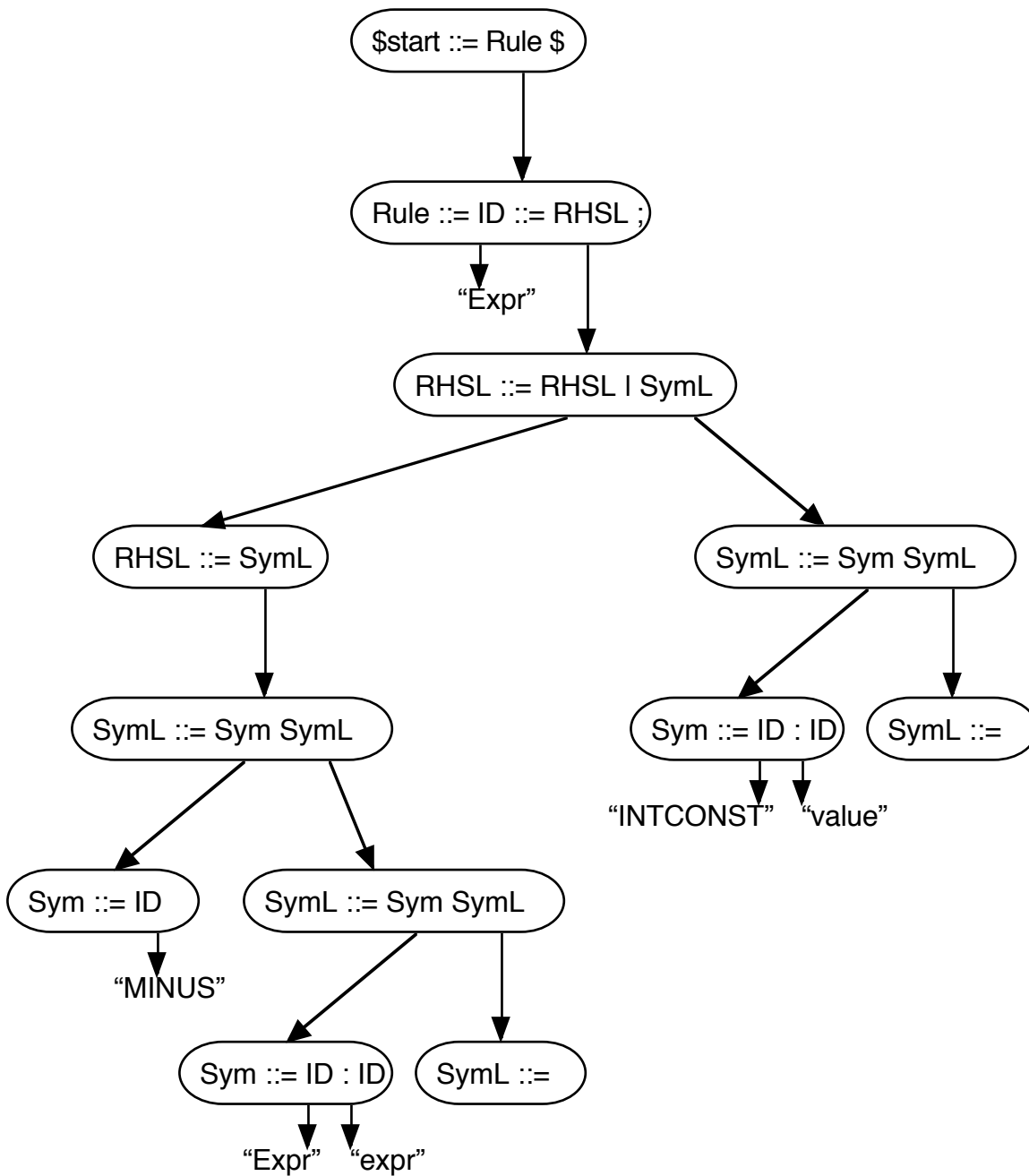


Question 1(a)

Stack							Token	Action	
\$0							ID Expr	Shift 2	
\$0	ID 2						::=	Shift 3	
\$0	ID 2	::= 3					ID MINUS	Shift 7	
\$0	ID 2	::= 3	ID 7				ID Expr	Reduce Sym ::= ID	
\$0	ID 2	::= 3	Sym 6					Shift 7	
\$0	ID 2	::= 3	Sym 6	ID 7			:	Shift 8	
\$0	ID 2	::= 3	Sym 6	ID 7	: 8		ID expr	Shift 9	
\$0	ID 2	::= 3	Sym 6	ID 7	: 8	ID 9		Reduce Sym ::= ID : ID	
\$0	ID 2	::= 3	Sym 6	Sym 6				Reduce SymL ::=	
\$0	ID 2	::= 3	Sym 6	Sym 6	SymL 10			Reduce SymL ::= Sym SymL	
\$0	ID 2	::= 3	Sym 6	SymL 10				Reduce SymL ::= Sym SymL	
\$0	ID 2	::= 3	SymL 5					Reduce RHSL ::= SymL	
\$0	ID 2	::= 3	RHSL 4					Shift 12	
\$0	ID 2	::= 3	RHSL 4	12			ID INTC	Shift 7	
\$0	ID 2	::= 3	RHSL 4	12	ID 7		:	Shift 8	
\$0	ID 2	::= 3	RHSL 4	12	ID 7	: 8	ID value	Shift 9	
\$0	ID 2	::= 3	RHSL 4	12	ID 7	: 8	ID 9	;	Reduce Sym ::= ID : ID
\$0	ID 2	::= 3	RHSL 4	12	Sym 6				Reduce SymL ::=
\$0	ID 2	::= 3	RHSL 4	12	Sym 6	SymL 10			Reduce SymL ::= Sym SymL
\$0	ID 2	::= 3	RHSL 4	12	SymL 13				Reduce RHSL ::= RHSL SymL
\$0	ID 2	::= 3	RHSL 4						Shift 11
\$0	ID 2	::= 3	RHSL 4	; 11				\$	Reduce Rule ::= ID ::= RHSL ;
\$0	Rule1								Shift 14
\$0	Rule1	\$14						\$	Reduce \$start ::= Rule \$
\$0	\$start -1								Accept

Question 1(b)**Question 1(c)**

lalr_state [12]: {

[RHSLList ::= RHSLList OR (*) SymbolList , {SEMICOLON OR }]

[SymbolList ::= (*) , {SEMICOLON OR }]

[SymbolList ::= (*) Symbol SymbolList , {SEMICOLON OR }]

[Symbol ::= (*) IDENT COLON IDENT , {IDENT SEMICOLON OR }]

[Symbol ::= (*) IDENT , {IDENT SEMICOLON OR }]

}

Question 2

```
GlobalDeclStmt ::=
    INTERFACE IDENT:ident
    BEGIN
    InterfaceBodyDeclList:interfaceBody
    END
;

InterfaceBodyDeclList ::=
    InterfaceBodyDeclList:declList InterfaceBodyDecl:decl
|
    /* Empty */
;

InterfaceBodyDecl ::=
    Type:returnType IDENT:ident
    LEFT FormalParamDeclList:formalParams RIGHT
    SEMICOLON
|
    VOID IDENT:ident
    LEFT FormalParamDeclList:formalParams RIGHT
    SEMICOLON
;

FormalParamDeclList ::=
    FormalParamDeclList:declList FormalParamDecl:decl
|
    /* Empty */
;

FormalParamDecl ::=
    Type:type FormalParamList:formalParamList SEMICOLON
|
    VAR Type:type FormalParamList:formalParamList SEMICOLON
;

FormalParamList ::=
    FormalParamList:formalParamList COMMA IDENT:ident
|
    IDENT:ident
;
```

Question 3(a)

```

int max = 0;
for int i = 0;
do
    while i < n;
    if a[ i ] > max
    then
        max = a[ i ];
    end
    i++;
end

```

Question 3(b)

```

public String toString() {
    return "for%+%" + initial + "%-%ndo%+%n" + loopBody + "%-%nend";
}

public void genEnv( Env env ) {
    initEnv = new Env( Env.ENV_LOCAL, env );
    loopEnv = new Env( Env.ENV_LOCAL, initEnv );
    initial.genEnv( initEnv );
    loopBody.genEnv( loopEnv );
}

public void eval( RunEnv runEnv ) throws UserException {
    Multiple initLocals = new Multiple( initEnv.offset().value() );
    RunEnv initRunEnv = new RunEnv( initLocals, runEnv );
    initial.eval( initRunEnv );
    try {
        while ( true ) {
            try {
                Multiple loopLocals
                    = new Multiple( loopEnv.offset().value() );
                RunEnv loopRunEnv = new RunEnv( loopLocals, initRunEnv );
                loopBody.eval( loopRunEnv );
            }
            catch ( ContinueException exception ) {
            }
        }
    }
    catch ( BreakException exception ) {
    }
}

```

Question 3(c)

```

public void eval( RunEnv runEnv ) throws UserException {
    if ( ! cond.eval( runEnv ).boolValue() )
        throw new BreakException();
}

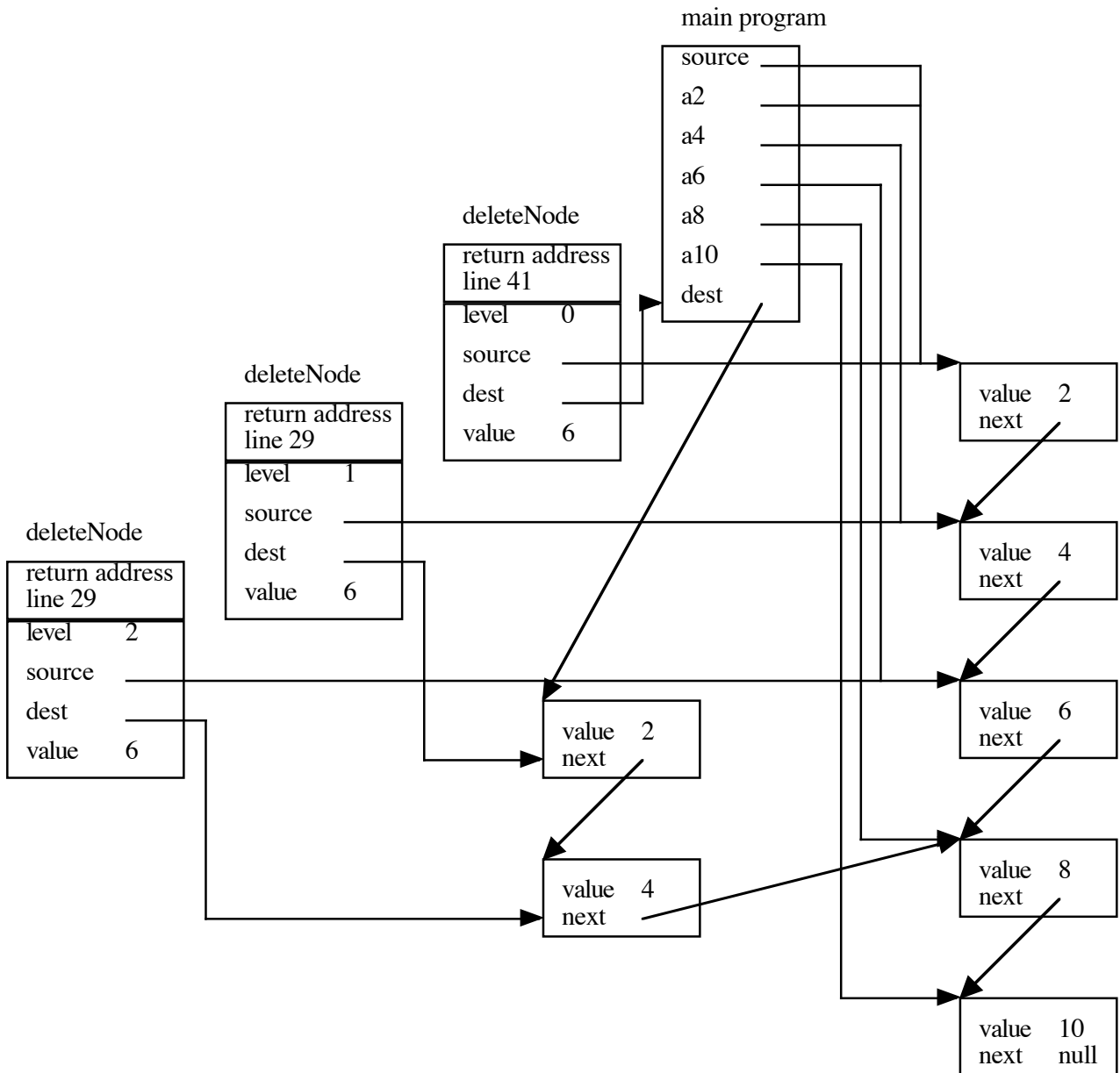
```

Question 4

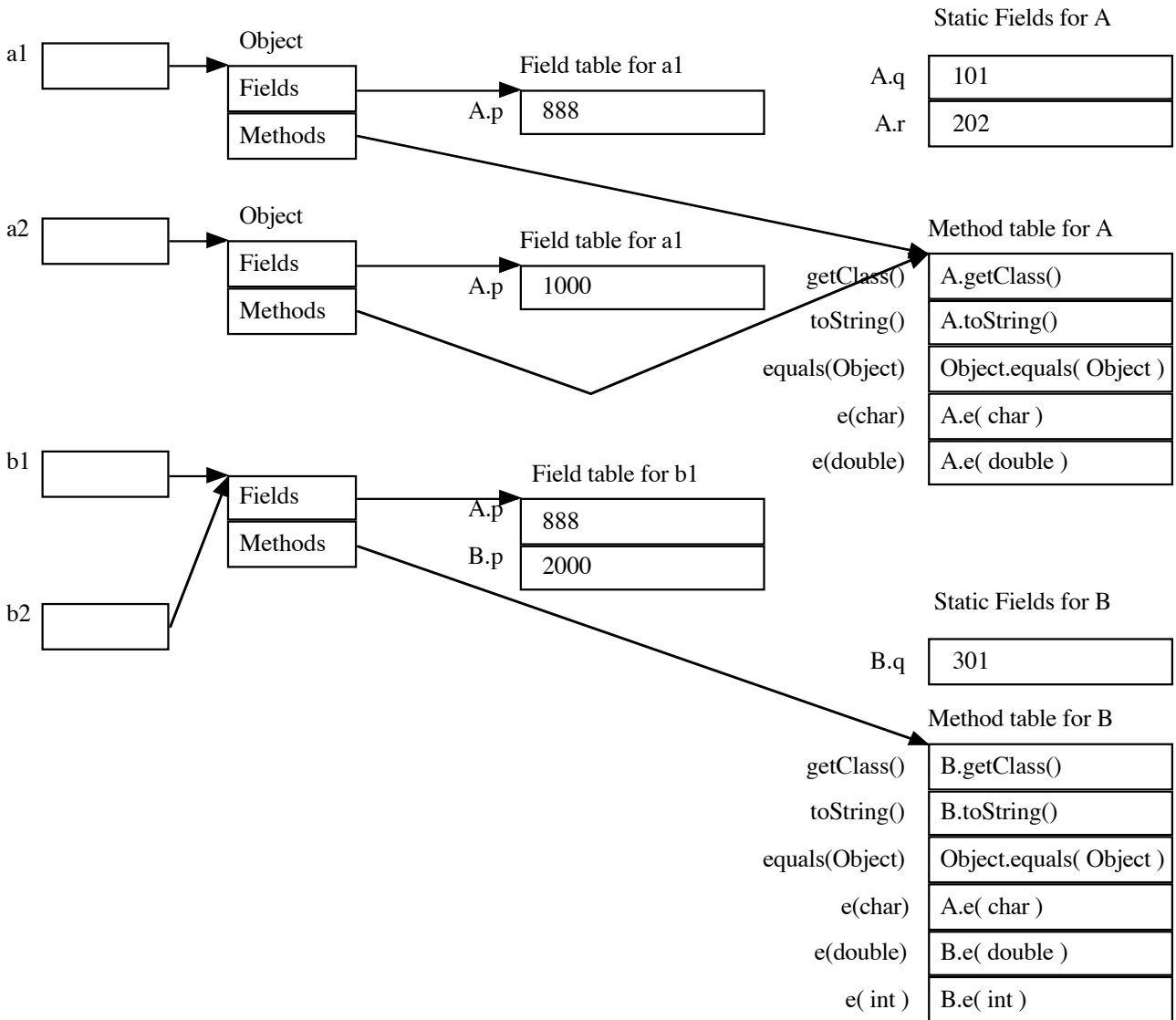
Output

{ 2, 4, 6, 8, 10 }

{ 2, 4, 8, 10 }



Question 5



```
A.q = 101  
A.r = 202  
B.q = 301
```

```
a1.p = 888  
a2.p = 1000  
b1.p = 2000  
b2.p = 888
```

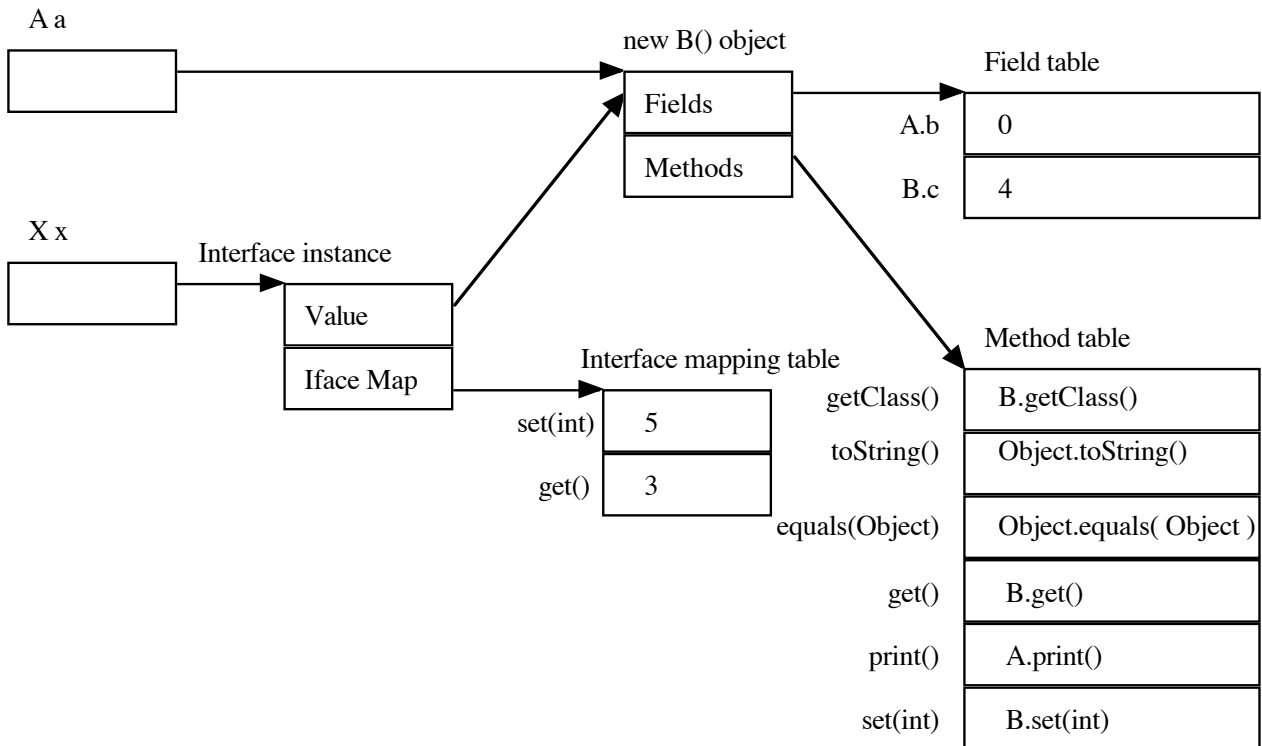
```
a1 = A.toString(): p = 888  
a2 = A.toString(): p = 1000  
b1 = B.toString(): p = 2000  
b2 = B.toString(): p = 2000
```

```
a1.e( 'A' ) = A.e( 'A' )  
b1.e( 'A' ) = A.e( 'A' )  
b2.e( 'A' ) = A.e( 'A' )
```

```
a1.e( 65 ) = A.e( 65.0 )  
b1.e( 65 ) = B.e( 65 )  
b2.e( 65 ) = B.e( 65.0 )
```

```
a1.e( 65.0 ) = A.e( 65.0 )  
b1.e( 65.0 ) = B.e( 65.0 )  
b2.e( 65.0 ) = B.e( 65.0 )
```

Question 6(a)



Question 6(b)

```

{
    lda $sp, -invoc.act1($sp);
    ldiq $t0, 4;
    stq $t0, invoc.act0($sp);
    ldiq $t0, main.static.field.x;
    ldq $t0, 0($t0);
    ldq $nip, IFACE.instanceValue($t0);
    ldq $at, INST.methods($nip);
    ldq $t0, IFACE.interfaceMap($t0);
    ldq $t0, set($t0);
    s8addq $t0, $at, $at;
    ldq $pv, 0($at);
    jsr $ra, ($pv);
    lda $sp, +invoc.act1($sp);
}
    
```