G: $S \to AS \mid \epsilon$
$A \to aA \mid b$

1. (a) LL(1)

$X \to \alpha$ : Look at First($\alpha$ Follow($X$))

1) $S \to AS$ First$(AS) = \{a, b\}$

2) $S \to \epsilon$ First$(\epsilon$ Follow$(S)) = \{\perp\}$

3) $A \to aA$ First$(aA) = \{a\}$

4) $A \to b$ First$(b) = \{b\}$

No conflict so LL(1)

| | a | b | ⊥ |
|---|---|---|---|
| S | $S \to AS$ | $S \to AS$ | $S \to \epsilon$ |
| A | $A \to aA$ | $A \to b$ | |

1. (b) LR(0)

S0
$S \to .AS$
$S \to .\epsilon$
$A \to .aA$
$A \to .b$

$S \to .\epsilon$ is same as $S \to \epsilon .$ which is a reduce configuration. This is a shift-reduce conflict so not LR(0).

1. (c) SLR(1)

S0:
$S \to .AS$
$S \to .\epsilon$
$A \to .aA$
$A \to .b$

| | |
|---|---|
| A | S1 |
| a | S2 |
| b | S3 |
| ⊥ | Reduce $[S \to \epsilon]$ |

Follow$(S) = \{\perp\}$

S1:
$A \to A.S$
$S \to .AS$
$S \to .\epsilon$
$A \to .aA$
$A \to .b$

| | |
|---|---|
| S | S4 |
| A | S1 |
| a | S2 |
| b | S3 |
| ⊥ | Reduce $[S \to \epsilon]$ |

Follow$(S) = \{\perp\}$

S2
$A \to a.A$
$A \to .aA$
$A \to .b$

| | |
|---|---|
| A | S5 |
| a | S2 |
| b | S3 |

S3 $A \to b.$ Reduce $A \to b$

S4 $A \to AS.$ Reduce $A \to AS$

S5 $A \to aA.$ Reduce $A \to aA$

So grammar is SLR(1).

1. (d) LR(1)

S0
$[S \to .AS, \perp]$
$[S \to .\epsilon, \perp]$
$[A \to .aA, \perp/a/b]$
$[A \to .b, \perp/a/b]$

| | |
|---|---|
| A | S1 |
| a | S2 |
| b | S3 |
| ⊥ | Reduce $S \to \epsilon$ |

S1
$[S \to A.S, \perp]$
$[S \to .AS, \perp]$
$[S \to .\epsilon, \perp]$
$[A \to .aA, \perp/a/b]$
$[A \to .b, \perp/a/b]$

| | |
|---|---|
| S | S4 |
| A | S1 |
| a | S2 |
| b | S3 |
| ⊥ | Reduce $S \to \epsilon$ |

S2
$[A \to a.A, \perp/a/b]$
$[A \to .aA, \perp/a/b]$
$[A \to .b, \perp/a/b]$

| | |
|---|---|
| A | S5 |
| a | S2 |
| b | S3 |

S3 $[A \to b., \perp/a/b]$ Reduce $A \to b$

S4 $[S \to AS., \perp]$ Reduce $A \to AS$

S5 $[A \to aA., \perp/a/b]$ Reduce $A \to aA$

No conflicts so LR(1).

1. (e) LALR(1)

All states with the same base configuration (there are none of them) can be merged, so LALR(1).

2. $S \to AS \mid \epsilon$ generates $AAA\ldots = A^*$

$A \to aA \mid b$ generates $aaaab = a^*b$

So Language is: $(a^*b)^*$