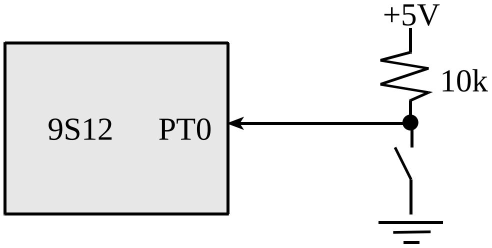
(5) Question 1. $\$1120 = 1*16^3+1*16^2+2*16^1 = 4096+1*256+2*16 = 4096+256+32 = 4384$

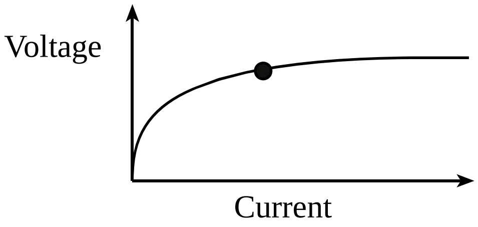
(6) Question 2.
Part a) Call graph
Part b) Precision
Part c) I/O mapped I/O

(6) Question 3. Consider `ldab #100` `subb #-90`
To calculate the overflow (V) bit, convert to signed, and operate. 100- -90 = 190 is incorrect, so V = 1
To calculate the carry (C) bit, convert to unsigned, and operate. 100- 166 = -66 is incorrect, so C = 1

(5) Question 4. 2^{10} is about 10^3, so 2^{20} is about 10^6, which is 6 decimal digits.

(10) Question 5. Interface the switch to PT0 using negative logic



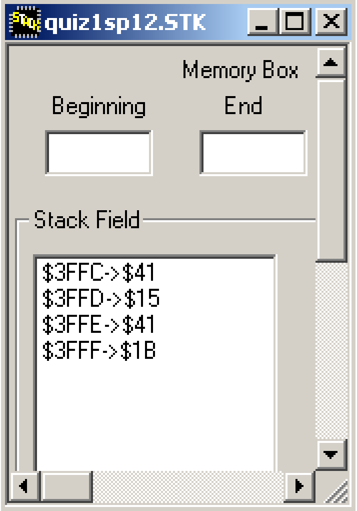


(5) Question 6. Current is exponentially related to voltage

(5) Question 7. `$6000 D001 subb $0001`

R/W	Addr	Data	Changes to A,B,X,Y,S,PC,IR,EAR
R	$6000	$D0	IR=$D0, PC=$6001
R	$6001	$01	EAR=$0001, PC=$6002
R	$0001	$03	B = $45-$03 = $42

(4) Question 8. Subroutine return address is the address of the instruction after the **`bsr`**. Push $411B when **`Test`** called, push $4115 when **`Delay`** called. 16-bit numbers are stored big endian.



```
$3FFC->$41
$3FFD->$15
$3FFE->$41
$3FFF->$1B
```

(4) Question 9. C code to create a variable named `Position` with range 0 to 65535

```
unsigned short Position;
```

(10) Question 10. You only have to push one of them

```
  pshd
  tfr Y,D   ; Y goes to D
  tfr X,Y   ; X goes to Y
  pulx      ; D goes to X
```

It works, but is less efficient to push all three

```
  pshd   ; D on stack
  pshx   ; X,D (X on top)
  pshy   ; Y,X,D (Y on top)
  puld   ; Y goes to D
  puly   ; X goes to Y
  pulx   ; D goes to X
```

(20) Question 11. Two positive logic switches are connected to PT5 and PT2, and one positive logic LED is connected to PT0. Turns on the LED if exactly one of the two switches is on.

```
      org  $4000
main  lds  #$4000    ;optional here because stack not used
      bset DDRT,#$01 ;PT0 output
      bclr DDRT,#$24 ;PT5 and PT2 inputs
loop  ldaa PTT
      anda #$24      ;RegA is 00,04,20 or 24
      cmpa #$20      ;PT5 set, PT2 clear
      beq  On
      cmpa #$04      ;PT2 set, PT5 clear
      beq  On
Off   bclr PTT,#$01  ;LED off
      bra  loop
On    bset PTT,#$01  ;LED on
      bra  loop
      org  $FFFE
      fdb  main      ;reset vector
```

A second possible solution without conditionals, PT0 = PT5^PT2

```
      org  $4000
main  lds  #$4000     ;optional here because stack not used
      ldaa DDRT
      oraa #$01       ;PT0 output
      anda #%11011011 ;PT5 and PT2 inputs
      staa DDRT
loop  ldaa PTT    ;read Bit 5
      lsra
      lsra
      lsra        ;bit2 has PT5 value
      eora PTT    ;bit2 has PT5^PT2
      lsra
      lsra       ;bit0 has PT5^PT2
      anda #1    ;RegA has PT5^PT2
      ldab PTT
      andb #$FE  ;RegB has original PT7-PT1
      aba        ;combine
      staa PTT   ;PT0 = PT5^PT2
      bra  loop
      org  $FFFE
      fdb  main  ;reset vector
```

A third possible solution with fewest instructions

```
      org   $4000
main  lds   #$4000       ;optional here because stack not used
      bset  DDRT,#$01    ;PT0 output
      bclr  DDRT,#$24    ;PT5 and PT2 inputs
loop  brset PTT,#$20,Is5 ;go to is5 if PT5 is high
no5   brset PTT,#$04,On  ;turn on if PT5=low and PT2=high
Off   bclr  PTT,#$01     ;LED off
      bra   loop
is5   brset PTT,#$04,Off ;turn off if PT5=high and PT2=high
On    bset  PTT,#$01     ;LED on
      bra   loop
      org   $FFFE
      fdb   main         ;reset vector
```

(20) Question 12. Write a C program that controls a kidney dialysis pump.

```
void main(void){
  DDRT = 0xFF;  // output power to pump
  DDRP = 0x00;  // input flow rate in ml/min
  while(1){
    if(PTP < 100){ // too slow
      if(PTT < 255){
         PTT++;    // increase power
      }
    }
    if(PTP > 100){ // too fast
      if(PTT > 0){
         PTT--;    // decrease power
      }
    }
  }
}
```

Just for fun, open assemble and run the ***motor.uc*** *example in TExaS.*