CHAPTER

4.6

MICROPROCESSOR

---

1. After an arithmetic operation, the flag register of 8085 μP has the following contents

D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
1	0	×	1	×	0	×	1

The contents of accumulator after operation may be

(A) 75 (B) 6C

(C) DB (D) B6

2. In an 8085 microprocessor, the instruction CMP B has been executed while the contents of accumulator is less than that of register B. As a result carry flag and zero flag will be respectively

(A) set, reset (B) reset, set

(C) reset, reset (D) set, set

3. Consider the following 8085 instruction

```
        MVI     A, A9H
        MVI     B, 57H
        ADD     B
        ORA     A
```

The flag status (S, Z, CY) after the instruction ORA A is executed, is

(A) (0, 1, 1) (B) (0, 1, 0)

(C) (1, 0, 0) (D) (1, 0, 1)

4. Consider the following set of 8085 instructions

```
        MVI     A, 8EH
        ADI     73H
        JC      DSPLY
        OUT     PORT1
        HLT
DSPLY : XRA     A
        OUT     PORT1
        HLT
```

The output at PORT1 is

(A) 00 (B) FEH

(C) 01H (D) 11H

5. Consider the following 8085 assembly program

```
        MVI     A, DATA1
        MOV     B, A
        SUI     51H
        JC      DLT
        MOV     A, B
        SUI     82H
        JC      DSPLY
DLT :   XRA     A
        OUT PORT1
        HLT
DSPLY : MOV     A, B
        OUT PORT2
        HLT
```

This program will display

(A) the bytes from 51H to 82H at PORT2

(B) 00H AT PORT1

(C) all byte at PORT1

(D) the bytes from 52H to 81H at PORT 2

6. It is desired to mask is the high order bits ($D_7 - D_4$) of the data bytes in register C. Consider the following set of instruction

(a)

```
        MOV     A, C
        ANI     F0H
        MOV     C, A
        HLT
```

(b)

```
MOV     A, C
MVI     B, F0H
ANA     B
MOV     C, A
HLT
```

(c)

```
MOV     A, C
MVI     B, 0FH
ANA     B
MOV     C, A
HLT
```

(d)

```
MOV     A, C
ANI     0FH
MOV     C, A
HLT
```

The instruction set, which execute the desired operation are

(A) a and b

(B) c and d

(C) only a

(D) only d

7. Consider the following 8085 instruction

```
XRA     A
MVI     B, 4AH
SUI     4FH
ANA     B
HLT
```

The contents of register A and B are respectively

(A) 05, 4A

(B) 4F, 00

(C) B1, 4A

(D) None of the above

8. Consider the following 8085 assembly program :

```
MVI     B, 89H
MOV     A, B
MOV     C, A
MVI     D, 37H
OUT     PORT1
HLT
```

The output at PORT1 is

(A) 89

(B) 37

(C) 00

(D) None of the above

9. Consider the sequence of 8085 instruction given below

```
LXI     H, 9258H
MOV     A, M
CMA
MOV     M, A
```

By this sequence of instruction the contents of memory location

(A) 9258H are moved to the accumulator

(B) 9258H are compared with the contents of the accumulator

(C) 8529H are complemented and stored at location 529H

(D) 5829H are complemented and stored at location 85892H

10. Consider the sequence of 8085 instruction

```
MVI     A, 5EH
ADI     A2H
MOV     C, A
HLT
```

The initial contents of resistor and flag are as follows

A	C	S	Z	CY
××	××	0	0	0

After execution of the instructions the contents of register and flags are

	A	C	S	Z	CY
(A)	10H	10H	0	0	1
(B)	10H	10H	1	0	0
(C)	00H	00H	1	1	0
(D)	00H	00H	0	1	1

11. It is desired to multiply the number 0AH by 0BH and store the result in the accumulator. The numbers are available in register B and C respectively. A part of the 8085 program for this purpose is given below :

```
        MVI     A, 00H
LOOP :  ---------------
        ---------------
        ---------------
        ---------------
        ---------------
        HLT
        END
```

The sequence of instruction to complete the program would be

(A)

```
JNZ     LOOP
ADD     B
DCR     C
```

(B)

```
ADD     B
JNZ     LOOP
DCR     C
```

(C)

```
DCR     C
JNZ     LOOP
ADD     B
```

(D)

```
ADD     B
DCR     C
JNZ     LOOP
```

12. Consider the following assembly language program:

```
        MVI     B, 87H
        MOV     A, B
START : JMP     NEXT
        MVI     B, 00H
        XRA     B
        OUT     PORT1
        HLT
NEXT :  XRA     B
        JP      START1
        OUT     PORT2
        HLT
```

The execution of the above program in an 8085 will result in

(A) an output of 87H at PORT1

(B) an output of 87H at PORT2

(C) infinite looping of the program execution with accumulator data remaining at 00H

(D) infinite looping of the program execution with accumulator data alternating between 00H and 87H.

13. Consider the following 8085 program

```
        MVI     A, DATA1
        ORA     A,
        JM      DSPLY
        OUT     PORT1
        CMA
DSPLY : ADI     01H
        OUT     PORT1
        HLT
```

If DATA1 = A7H, the output at PORT1 is

(A) 47H

(B) 58H

(C) 00

(D) None of the above

Statement for Q.14–15:

Consider the following program of 8085 assembly language:

```
        LXI     H 4A02H
        LDA     4A00H
        MOV     B, A
        LDA     4A01H
        CMP     B
        JZ      FNSH
        JC      GRT
        MOV     M, A
        JMP     FNSH
        MOV     M, B
FNSH :  HLT
```

14. If the contents of memory location 4A00H, 4A01H and 4A02H, are respectively A7H, 98H and 47H, then after the execution of program contents of memory location 4A02H will be respectively

(A) A7H

(B) 98H

(C) 47H

(D) None of the above

15. The memory requirement for this program is

(A) 20 Byte

(B) 21 Byte

(C) 23 Byte

(D) 18 Byte

16. The instruction, that does not clear the accumulator of 8085, is

(A) XRA A

(B) ANI 00H

(C) MVI A, 00H

(D) None of the above

17. The contents of some memory location of an 8085 μP based system are shown

Address Hex.	Contents (Hex.)
3000	02
3001	30
3002	00
3003	30

Fig. P4.6.17

The program is as follows

```
LHLD    3000H
MOV     E, M
INX     H
MOV     D, M
LDAX    D
MOV     L, A
INX     D
LDAX    D
MOV     H, A
```

The contents if HL pair after the execution of the program will be

(A) 0030 H

(B) 3000 H

(C) 3002 H

(D) 0230H

18. Consider the following loop

```
        XRA     A
        LXI     B, 0007H
LOOP :  DCX     B
        JNZ     LOOP
```

This loop will be executed

(A) 1 times

(B) 8 times

(C) 7 times

(D) infinite times

19. Consider the following loop

```
        LXI     H, 000AH
LOOP :  DCX     B
        MOV     A, B
        ORA     C
        JNZ     LOOP
```

This loop will be executed

(A) 1 time (B) 10 times

(C) 11 times (D) infinite times

20. The contents of accumulator after the execution of following instruction will be

```
        MVI     A, A7H
        ORA     A
        RLC
```

(A) CFH (B) 4FH

(C) 4EH (D) CEH

21. The contents of accumulator after the execution of following instructions will be

```
        MVI     A, B7H
        ORA     A
        RAL
```

(A) 6EH (B) 6FH

(C) EEH (D) EFH

22. The contents of the accumulator after the execution of the following program will be

```
        MVI     A, C5H
        ORA     A
        RAL
```

(A) 45H (B) C5H

(C) C4H (D) None of the above

23. Consider the following set of instruction

```
        MVI     A, BYTE1
        RLC
        MOV     B, A
        RLC
        RLC
        ADD     B
```

If BYTE1 = 07H, then content of A, after the execution of program will be

(A) 46H (B) 70H

(C) 38H (D) 68H

24. Consider the following program

```
        MVI     A, BYTE1
        RRC
        RRC
```

If BYTE1 = 32H, the contents of A after the execution of program will be

(A) 08H (B) 8CH

(C) 12H (D) None of the above

25. Consider the following program

```
        MVI     A, DATA
        MVI     B, 64H
        MVI     C, C8H
        CMP     B
        JC      RJCT
        CMP     C
        JNC     RJCT
        OUT     PORT1
        HLT
RJCT :  SUB A
        OUT     PORT1
        HLT
```

If the following sequence of byte is loaded in accumulator,

DATA (H)	58	64	73	B4	C8	FA

then sequence of output will be

(A) 00, 00, 73, B4, 00, FA

(B) 58, 64, 00, 00, C8, FA

(C) 58, 00, 00, 00, C8, FA

(D) 00, 64, 73, B4, 00, FA

26. Consider the following instruction to be executed by a 8085 μp. The input port has an address of 01H and has a data 05H to input:

```
        IN      01H
        ANI     80H
```

After execution of the two instruction the contents of flag register are

(A)	1	0	×	1	×	1	×	0
(B)	0	1	×	0	×	1	×	0
(C)	0	1	×	1	×	1	×	0
(D)	0	1	×	1	×	0	×	0

```
        ORA   A        ;Set flag
        JM    DSPLY    ;If negative jump to
                       ;DSPLY
        OUT   PORT1    ;A → PORT1
DSPLY : CMA            ;Complement A
        ADI   01H      ;A+1 → A
        OUT   PORT1    ;A → PORT1
        HLT
```

This program displays the absolute value of DATA1. If DATA1 is negative, it determine the 2's complements and display at PORT1.

14. (A)

```
        LXI   H, 4A02H ;Store destination address
                       ;in HL pair
        LDA   4A00H    ;Load A with contents of
                       ;memory location A00H
        MOV   B, A     ;A → B
        LDA   4A01H    ;Load A with contents of
                       ;memory location 4A01H
        CMA   B        ;Compare A and B
        JZ    FNSH     ;Jump to FNSH if two
                       ;number are equal
        JC    GRT      ;If CY = 1, (A <B) jump
                       ;to GRT
        MOV   M, A     ;Otherwise A → (4A02H)
        JMP   FNSH
GRT :   MOV   M, B
FNSH :  HLT
```

This program find the larger of the two number stored in location 4A00H and 4A01H and store it in memory location 4A002.

A7H > 98H Thus A7H will be stored at 4A02H.

15. (C) Operand R, M or implied : 1–Byte instruction

Operand 8–bit : 2–Byte instruction

Operand 16–bit : 3–Byte instruction

3–Byte instruction are: LXI, LDA, JZ, JC, JMP

P–Byte instruction are : MOV, CMP, HLT

Hence memory $= 3 \times 6 + 1 \times 5 = 23$ Byte.

16. (D) All instruction clear the accumulator

```
XRA   A      ;A ⊕ A
ANI   00H    ;A AND 00
MVI   A      ;00 → A
```

17. (C)

```
LHLD  3000H  ;(3000A) → HL = 3002H
MOV   E, M   ;(3002H) → E = 00
INX   H      ;HL +1 → HL = 3003H
MOV   D, M   ;M → D=(3003H) = 30H
LDAX  D      ;(DE) → A=(3000H) = 02H
MOV   L, A   ;A → L = 02H
INX   D      ;DE +1 → DE = 3001H
LDAX  D      ;(DE) → A = (3001) = 30H
MOV   H, A   ;A → H = 30H
```

Hence HL pair contain 3002H.

18. (A) The instruction XRA will set the Z flag. LXI and DCX does not alter the flag. Hence this loop will be executed 1 times.

19. (B)

```
        LXI   B, 000AH  ;00 → C, 0AH → B
LOOP :  DCX   B         ; CB – 1 → B,
                        ;flag not affected
        MOV   A, B      ;B → A
        ORA   C         ;A OR C → A, set flag
        JNZ   LOOP
```

Hence this loop will be executed 0AH or ten times.

20. (B)

```
MVI   A, B7H   ;B7H → A
ORA   A        ;Set Flags, CY = 1
RLC            ;Rotate accumulator left
```

The contents of bit D_7 are placed in bit D_0 .

	Accumulator
Before RLC	10100111
After RLC	01001111

21. (A) RAL instruction rotate the accumulator left through carry.

$D_7 \to CY$, $CY \to D_0$, ORA reset the carry.

	Accumulator	CY
Before RAL	10110111	0
After RAL	01101110	1

22. (A) RRC instruction rotate the accumulator right and D_0 is placed in D_7 .

```
MVI   A, C5H   ;C5H → A
ORA   A        ;Reset Carry flag
RAL            ;Rotate A left through
               ;carry, A = 8AH
RRC            ;Rotate A right, A = 45H
```

23. (A) This program multiply BYTE1 by 10. Hence content of A will be 46H.

$07H = 07_{10}$,$7 \times 10 = 70$, $70_{10} = 46H$

24. (B) Contents of Accumulator A = 0011 0010

After First RRC = 0001 1001

After second RRC = 1000 1100

25. (D) This program will display the number between 64H to C8H including 64H. C8H will not be displayed. Thus (D) is correct option.

26. (C) 05H AND 80H =00

After the ANI instruction S, Z and P are modified to reflect the result of operation. CY is reset and AC is set . Thus,

S = 0,   Z = 1,   AC = 1,   P =1,   CY = 0

27. (B)
```
ACI     56H         ;A + 56H + CY → A
```
37H + 56H + 1 =8EH

28. (C) Instruction load the register pairs HL with 01FFH. SHLD instruction store the contents of L in the memory location 2050H and content of H in the memory location 2051H. Contents of HL are not altered.

29. (B) At a time 8085 can drive only a digit. In a second each digit is refreshed 500 times. Thus time given to each digit $= \frac{1}{(5 \times 500)} = 0.4$ ms.

30. (C) The stack pointer register SP point to the upper memory location of stack. When data is pushed on stack, it stores above this memory location.

31. (B) Line 5 push the content of HL register pair on stack. The contents of L will go to 03FFH and contents of H will go to 03FEH. Hence memory location 03FEH contain 22H.

32. (C) Contents of register pair B lie on the top of stack when POP H is executed, HL pair will be loaded with the contents of register pair B.

33. (C) The instruction PUSH B store the contents of BC at stack. The POP PSW instruction copy the contents of BC in to PSW. The contents of register C will be copied into flag register.

$D_0 = 1$ = carry flag, $D_6 = 0$ = zero flag.

Hence zero flag will be reset and carry will be set.

34. (A)
```
        MVI A  DATA1     ;DATA1 → A
        ORA    A         ; Set flag
        JP     DSPLY     ;If A is positive, then
                         ;jump to DSPLY
        XRA    A         ; Clear A
DSPLY   OUT    PORT1     ; A → PORT2
        HLT
```
If DATA1 is positive, it will be displayed at port1 otherwise 00.

****

30. $y(t) = u(t) * h(t)$, where $h(t) = \begin{cases} e^{2t}, & t < 0 \\ e^{-3t}, & t > 0 \end{cases}$

(A) $\frac{1}{2} e^{-2t} u(-t-1) + \frac{5}{6} - \frac{1}{3} e^{-3t} u(-t)$

(B) $\frac{1}{2} e^{2t} u(-t-1) + \frac{5}{6} - \frac{1}{3} e^{-3t} u(-t)$

(C) $\frac{1}{2} e^{2t} + \frac{1}{6} [5 - 3e^{2t} - 2e^{-3t}] u(t)$

(D) $\frac{1}{2} e^{2t} + \frac{1}{6} [5 - 3e^{2t} - 2e^{-3t}] u(-t)$

Statement for Q.31-34:

The impulse response of LTI system is given. Determine the step response.

31. $h(t) = e^{-|t|}$

(A) $2 + e^{t} - e^{-t}$

(B) $e^{t} u(-t+1) + 2 - e^{-t}$

(C) $e^{t} u(-t+1) + [2 - e^{-t}] u(t)$

(D) $e^{t} + [2 - e^{-t} - e^{t}] u(t)$

32. $h(t) = \delta^{(2)}(t)$

(A) 1

(B) $u(t)$

(C) $\delta^{(3)}(t)$

(D) $\delta(t)$

33. $h(t) = u(t) - u(t-4)$

(A) $tu(t) + (1-t) u(t-4)$

(B) $tu(t) + (1-t) u(t-4)$

(C) $1 + t$

(D) $(1+t) u(t)$

34. $h(t) = y(t)$

(A) $u(t)$

(B) t

(C) 1

(D) $tu(t)$

Statement for Q.35-38:

The system described by the differential equations has been specified with initial condition. Determine the output of the system and choose correct option.

35. $\frac{dy(t)}{dx} + 10 y(t) = 2x(t), \; y(0^-) = 1, \; x(t) = u(t)$

(A) $\frac{1}{5}(1 + 4e^{-10t}) u(t)$

(B) $\frac{1}{5}(1 + 4e^{-10t})$

(C) $-\frac{1}{5}(1 + 4e^{-10t}) u(t)$

(D) $-\frac{1}{5}(1 + 4e^{-10t})$

36. $\frac{d^2 y(t)}{dt^2} + 5 \frac{dy(t)}{dt} + 4 y(t) = \frac{dx(t)}{dt}$,

$$y(0^-) = 0, \; \left.\frac{dy(t)}{dt}\right|_{0^-} = 1, \; x(t) = \sin t \, u(t)$$

(A) $\frac{5}{34} \sin t + \frac{3}{34} \cos t + \frac{1}{6} e^{-t} - \frac{13}{61} e^{-4t} \; , \; t \ge 0$

(B) $\frac{5}{34} \sin t + \frac{3}{34} \cos t - \frac{13}{51} e^{-4t} + \frac{1}{6} e^{-t} \; , \; t \ge 0$

(C) $\frac{3}{34} \sin t + \frac{5}{34} \cos t - \frac{13}{51} e^{-4t} + \frac{1}{6} e^{-t} \; , \; t \ge 0$

(D) $\frac{3}{34} \sin t + \frac{5}{34} \cos t + \frac{1}{6} e^{-4t} - \frac{13}{51} e^{-4t} \; , \; t \ge 0$

37. $\frac{d^2 y(t)}{dt^2} + 6 \frac{dy(t)}{dt} + 8 y(t) = 2x(t)$,

$$y(0^-) = -1, \; \left.\frac{dy(t)}{dt}\right|_{0^-} = 1, \; x(t) = e^{-t} u(t)$$

(A) $\frac{2}{3} e^{-t} - \frac{5}{2} e^{-2t} + \frac{5}{6} e^{-4t}, \; t \ge 0$

(B) $\frac{2}{3} + \frac{5}{2} e^{-2t} + \frac{5}{6} e^{-4t} \; , \; t \ge 0$

(C) $4 + 5(3e^{-2t} + e^{-4t}) \; , \; t \ge 0$

(D) $4 - 5(3e^{-2t} + e^{-4t}), \; t \ge 0$

38. $\frac{d^2 y(t)}{dt^2} + y(t) = \frac{3dx(t)}{dt}$,

$$y(0^-) = -1, \; \left.\frac{dy(t)}{dt}\right|_{0^-} = 1, \; x(t) = 2te^{-t} u(t)$$

(A) $\sin t + 4 \cos t - 3te^{-3t} + t, \; t \ge 0$

(B) $4 \sin t - \cos t - 3te^{-t}, \; t \ge 0$

(C) $\sin t - 4 \cos t + 3te^{-3t} + t, \; t \ge 0$

(D) $4 \sin t + \cos t - 3te^{-t}, \; t \ge 0$

39. The raised cosine pulse $x(t)$ is defined as

$$x(t) = \begin{cases} \frac{1}{2}(\cos \omega t + 1), & -\frac{\pi}{\omega} \le t \le \frac{\pi}{\omega} \\ 0, & \text{otherwise} \end{cases}$$

The total energy of $x(t)$ is

(A) $\frac{3\pi}{4\omega}$

(B) $\frac{3\pi}{8\omega}$

(C) $\frac{3\pi}{\omega}$

(D) $\frac{3\pi}{2\omega}$

40. The sinusoidal signal $x(t) = 4 \cos(200t + \pi/6)$ is passed through a square law device defined by the input output relation $y(t) = x^2(t)$. The DC component in the signal is

(A) 3.46

(B) 4

(C) 2.83

(D) 8

41. The impulse response of a system is $h(t) = \delta(t - 0.5)$. If two such systems are cascaded, the impulse response of the overall system will be

(A) $0.5\delta(t - 0.25)$ (B) $\delta(t - 0.25)$

(C) $\delta(t - 1)$ (D) $0.5\delta(t - 1)$

42. Fig. P5.1.40 show the input $x(t)$ to a LTI system and impulse response $h(t)$ of the system.

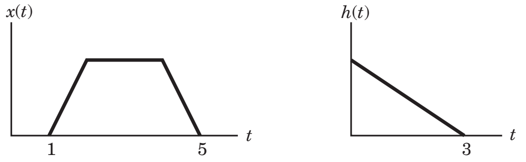


Fig P5.1.42

The output of the system is zero every where except for the

(A) $0 < t < 5$ (B) $0 < t < 8$

(C) $1 < t < 5$ (D) $1 < t < 8$

43. Consider the impulse response of two LTI system

$$S_1 : h_1(t) = e^{-(1-2j)t} u(t)$$

$$S_2 : h_2(t) = e^{-t} \cos 2t \, u(t)$$

The stable system is

(A) S_1 (B) S_2

(C) Both S_1 and S_2 (D) None

44. The non-invertible system is

(A) $y(t) = x(t - 4)$ (B) $y(t) = \int_{-\infty}^{t} x(\tau) d\tau$

(C) $y(t) = \frac{dx(t)}{dt}$ (D) None of the above

45. A continuous-time linear system with input $x(t)$ and output $y(t)$ yields the following input-output pairs:

$$x(t) = e^{j2t} \Leftrightarrow y(t) = e^{j5t}$$

$$x(t) = e^{-j2t} \Leftrightarrow y(t) = e^{-j5t}$$

If $x_1(t) = \cos(2t - 1)$, the corresponding $y_1(t)$ is

(A) $\cos(5t - 1)$ (B) $e^{-j} \cos(5t - 1)$

(C) $\cos 5(t - 1)$ (D) $e^{j} \cos(5t - 1)$

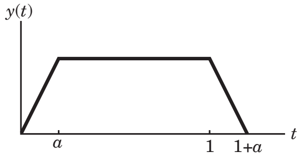
Statement for Q.46–47:

Suppose that

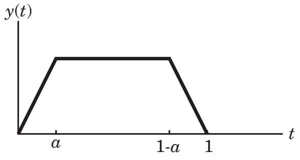
$$x(t) = \begin{cases} 1, & 0 \le t \le 1 \\ 0, & \text{elsewhere} \end{cases} \quad \text{and}$$

$$h(t) = x\left(\frac{t}{a}\right), \text{ where } 0 < a \le 1.$$

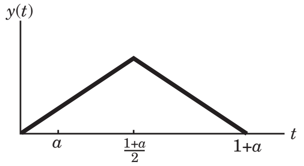
46. The $y(t) = x(t) * h(t)$ is



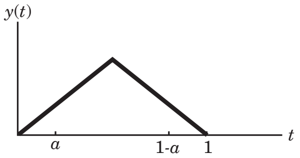
(A)



(B)



(C)



(D)

47. If $dy(t)/dt$ contains only three discontinuities, the value of a is

(A) 1 (B) 2

(C) 3 (D) 0

48. Consider the signal $x(t) = \delta(t + 2) - \delta(t - 2)$.The value of E_∞ for the signal $y(t) = \int_{-\infty}^{t} x(\tau) d\tau$ is

(A) 4 (B) 2

(C) 1 (D) ∞

49. The response of a system S to a complex input $x(t) = e^{j5t}$ is specified as $y(t) = te^{j5t}$. The system

(A) is definitely LTI

(B) is definitely not LTI

(C) may be LTI

(D) information is insufficient

50. The response of a system S to a complex input $x(t) = e^{j8t}$ is specified as $y(t) = \cos 8t$. The system

(A) is definitely LTI

(B) is definitely not LTI

(C) may be LTI

(D) information is insufficient.

51. The auto-correlation of the signal $x(t) = e^{-t} u(t)$ is

(A) $\frac{1}{2} e^{t} u(-t) + \frac{1}{2} e^{-t} u(t)$ (B) $\frac{e^{t}}{2} + \frac{1}{2}(e^{-t} - e^{t}) u(t)$

(C) $\frac{1}{2} e^{-t} u(-t) + \frac{1}{2} e^{-t} u(t)$ (D) $\frac{1}{2} e^{t} u(-t) - \frac{1}{2} e^{-t} u(t)$

****

SOLUTIONS

1. (A) $\frac{2\pi}{T} = 60\pi \quad \Rightarrow \quad T = \frac{\pi}{30}$

2. (C) $T_1 = \frac{2\pi}{5}$ s, $T_2 = \frac{2\pi}{7}$ s, LCM $\left(\frac{2\pi}{5}, \frac{2\pi}{7}\right) = 2\pi$

3. (D) Not periodic because of t.

4. (D) Not periodic because least common multiple is infinite.

5. (C) $y(t)$ is not periodic although $\sin t$ and $6\cos 2\pi t$ are independently periodic. The fundamental frequency can't be determined.

6. (C) This is energy signal because

$$E_\infty = \int_{-\infty}^{\infty} |x(t)| dt < \infty \quad = \int_{-\infty}^{\infty} e^{-4t} u(t) dt \quad = \int_{0}^{\infty} e^{-4t} dt = \frac{1}{4}$$

7. (A) $|x(t)| = 1,\ E_\infty = \int_{-\infty}^{\infty} |x(t)|^2 dt \ = \infty$

So this is a power signal not a energy.

$$P_\infty = \lim_{T \to \infty} \frac{1}{2T} \int_{-T}^{T} |x(t)|^2 dt \ = 1$$

8. (D) $v(t)$ is sum of 3 unit step signal starting from, 1, 2, and 3, all signal ends at 4.

9. (A) The function 1 does not describe the given pulse. It can be shown as follows :

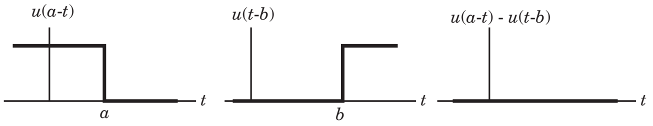


Fig S5.1.3.9

10. (B)

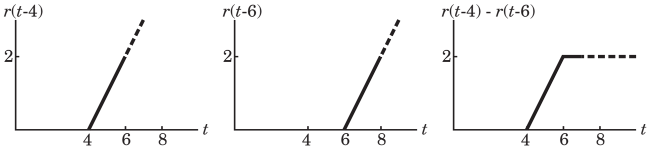


Fig S5.1.10

11. (C)

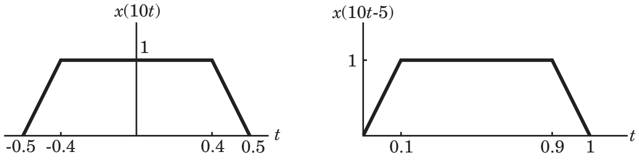


Fig S5.1.11

12. (D) Multiplication by 5 will bring contraction on time scale. It may be checked by $x(5 \times 0.8) = x(4)$.

13. (A) Division by 5 will bring expansion on time scale. It may be checked by $y(t) = x\left(\frac{20}{5}\right) = x(4)$.

14. (C) $y(t) = \begin{cases} 1, & \text{for} \quad -5 < t < -4 \\ -1, & \text{for} \quad 4 < t < 5 \\ 0, & \text{otherwise} \end{cases}$

$$E = \int_{-5}^{-4} (1)^2 dt + \int_{4}^{5} (-1)^2 dt \ = 2$$

15. (D) $E = 2\int_0^5 x^2(t) dt \ = 2\int_0^4 (1)^1 dt \ + 2\int_4^5 (5-t)^2 dt$

$= 8 + \frac{2}{3} = \frac{26}{3}$

16. (B) Let $x_1(t) = v(t)$ then $y_1(t) = u\{v(t)\}$

Let $x_2(t) = kv(t)$ then $y_2(t) = u\{kv(t)\} \neq ky_1(t)$

(Not homogeneous not linear)

$y_1(t) = u\{v(t)\}$,

$y_2(t) = u\{v(t - t_o)\} = y_1(t - t_o)$ (Time invariant)

The response at any time depends only on the excitation at time $t = t_o$ and not on any future value.

(Causal)

17. (C) $y_1(t) = v(t-5) - v(3-t)$

$y_2(t) = kv(t-5) - kv(3-t) = ky_1(t)$ (Homogeneous)

Let $x_1(t) = v(t)$ then $y_1(t) = v(t-5) - v(3-t)$

Let $x_2(t) = 2w(t)$ then $y_2(t) = w(t-5) - w(3-t)$

Let $x_3(t) = x(t) + w(t)$

Then $\quad y_3(t) = v(t-5) + w(t-5) - v(3-t) - w(3-t)$

$= y_1(t) + y_2(t)$ (Additive)

Since it is both homogeneous and additive, it is also linear.

$y_1(t) = v(t-5) - v(3-t)$

$y_2(t) = v(t - t_o - 5) - v(3 - t + t_o) = y_1(t - t_o)$

(Time invariant)

At time, $t=0$, $y(0)=x(-5)-x(3)$. Therefore the response at time, $t=0$ depends on the excitation at a later time $t=3$. (Not causal)

If $x(t)$ is bounded then $x(t-5)$ and $x(3-t)$ are bounded and so is $y(t)$. (Stable)

18. (D) $y_1(t)=v\left(\frac{t}{2}\right)$, $y_2(t)=kv\left(\frac{t}{2}\right)=ky_1(t)$

(Homogeneous)

$x_3=v(t)+w(t)$ then

$y_3(t)=v\left(\frac{t}{2}\right)+w\left(\frac{t}{2}\right)=y_1(y)+y_2(t)$ (Additive)

Since it is both homogeneous and additive, it is also linear

$y_1(t)=v\left(\frac{t}{2}\right)$, $y_2\left(\frac{t}{2}-t_o\right)\neq y(t-t_o)=v\left(\frac{t-t_o}{2}\right)$

(Time variant)

At time $t=-2$, $y(-2)=x(-1)$, therefore, the response at time $t=-2$, depends on the excitation at a later time, $t=-1$. (Not causal)

It $x(t)$ is bounded then $y(t)$ is bounded. (Stable)

19. (C) $y_1(t)=\cos 2\pi t\ v(t)$

$y_2(t)k\cos 2\pi t\ v(t)=ky_1(t)$ (Homogeneous)

$x_3(t)=v(t)+w(t)$

$y_3(t)=\cos 2\pi t\,[v(t)+w(t)]=y_1(t)+y_2(t)$ (Additive)

Since it is both homogeneous and additive. It is also linear.

$y_1(t)=\cos 2\pi t\ v(t)$

$y_2(t)=\cos 2\pi t\,(t-t_o)\neq y(t-t_o)$

$=\cos\,[2\pi(t-t_o)]v(t-t_o)$ (Time Variant)

The response at any time $t=t_o$ depends only on the excitation at that time and not on the excitation at any later time. (Causal)

If $x(t)$ is bounded then $y(t)$ is bounded. (Stable)

20. (C) $y_1(t)=|v(t)|$, $y_2(t)=|kv(t)|=|k|y_1(t)$

If k is negative $|k|y_1(t)\neq ky_1(t)$

(Not Homogeneous Not linear).

$y_1(t)=|v(t)|$, $y_2(t)=|y(t-t_o)|=y_1(t-t_o)$

(Time Invariant)

The response at any time $t=t_o$ depends only on the excitation at that time and not on the excitation at any later time. (Causal)

If $x(t)$ is bounded then $y(t)$ is bounded. (Stable)

21. (C) All option are linear. So it is not required to check linearity.

Let $x_1(t)=v(t)$ then $t\frac{d}{dt}y_1(t)-8y_1(t)=v(t)$

Let $x_2(t)=v(t-t_o)$ then $t\frac{d}{dt}y_2(t)-8y_2(t)=v(t-t_o)$

The first equation can be written as

$$(t-t_o)\frac{d}{dt}y(t-t_o)-8y(t-t_o)=v(t-t_o)$$

This equation is not satisfied if $y_2(t)=y_1(t-t_o)$ therefore

$y_2(t)\neq y_1(t-t_o)$ (Time Variant)

The system can be written as

$$y(t)=\int_{-\infty}^{t}\frac{x(\lambda)}{\lambda}d\lambda+8\int_{-\infty}^{t}\frac{y(\lambda)}{\lambda}d\lambda$$

So the response at any time, $t=t_o$ depends on the excitation at $t\le t_o$, and not on any future values.

(Causal)

The Homogeneous solution to the differential equation is of the form $y(t)=kt^8$. If there is no excitation but the zero excitation, response is not zero. The response will increases without bound as time increases.

(Unstable)

22. (C) $y_1(t)=\int_{-\infty}^{t+3}v(\lambda)d\lambda$

$y_2(t)=\int_{-\infty}^{t+3}kv(\lambda)d\lambda=k\int_{-\infty}^{t+3}v(\lambda)d\lambda=ky_1(t)$ (Homogeneous)

$x_3(t)=v(t)+w(t)$

$y_3(t)=\int_{-\infty}^{t+3}[v(\lambda)+w(\lambda)]d\lambda=\int_{-\infty}^{t+3}v(\lambda)d\lambda+\int_{-\infty}^{t+3}w(\lambda)d\lambda$

$=y_1(t)+y_2(t)$ (Additive)

Since it is Homogeneous and additive, it is also linear.

$y_1(t)=\int_{-\infty}^{t+3}v(\lambda)d\lambda$

$y_2(t)=\int_{-\infty}^{t+3}v(\lambda-t_o)d\lambda=\int_{-\infty}^{t-t_o+3}v(\lambda)d\lambda=y_1(t-t_o)$

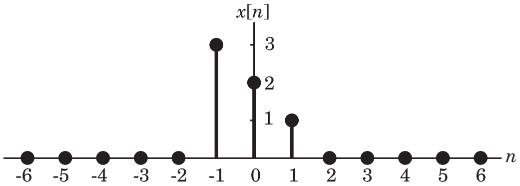
(Time invariant)

The response at any time, $t=t_o$, depends partially on the excitation at time to $t_o<t<(t_o+3)$ which are in future. (Not causal)

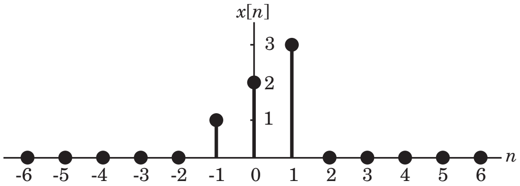
If $x(t)$ is a constant k, then $y(t)=\int_{-\infty}^{t+3}kd\lambda=k\int_{-\infty}^{t+3}d\lambda$ and as $t\to\infty$, $y(t)$ increases without bound. (unstable)

11. $x[n+2]y[n-2]$

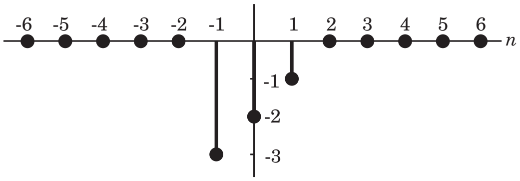
(A)



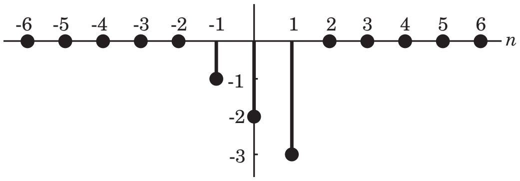
(B)



(C)



(D)



Statement for Q.12–15:

A discrete-time signal is given. Determine the period of signal and choose correct option.

12. $x[n] = \cos\frac{\pi n}{9} + \sin\left(\frac{\pi n}{7} + \frac{1}{2}\right)$

(A) periodic with period $N = 126$

(B) periodic with period $N = 32$

(C) periodic with period $N = 252$

(D) Not periodic

13. $x[n] = \cos\left(\frac{n}{8}\right)\cos\left(\frac{\pi n}{8}\right)$

(A) Periodic with period 16π

(B) periodic with period $16(\pi + 1)$

(C) periodic with period 8

(D) Not periodic

14. $x[n] = \cos\left(\frac{\pi n}{2}\right) - \sin\left(\frac{\pi n}{8}\right) + 3\cos\left(\frac{\pi n}{4} + \frac{\pi}{3}\right)$

(A) periodic with period 16

(B) periodic with period 4

(C) periodic with period 2

(D) Not periodic

15. $x[n] = 2e^{j\left(\frac{n}{6} - \pi\right)}$

(A) periodic with 12π

(B) periodic with 12

(C) periodic with 11π

(D) Not periodic

16. The sinusoidal signal has fundamental period $N = 10$ samples. The smallest angular frequency, for which $x[n]$ is periodic, is

(A) $\frac{1}{10}$ rad/cycle

(B) 10 rad/cycle

(C) 5 rad/cycle

(D) $\frac{\pi}{5}$ rad/cycle

17. Let $x[n], -5 \le n \le 3$ and $h[n], 2 \le n \le 6$ be two finite duration signals. The range of their convolution is

(A) $-7 \le n \le 9$

(B) $-3 \le n \le 9$

(C) $2 \le n \le 3$

(D) $-5 \le n \le 6$

Statement for Q.18–26:

$x[n]$ and $h[n]$ are given in the question. Compute the convolution $y[n] = x[n] * h[n]$ and choose correct option.

18. $x[n] = \{1, 2, 4\}$, $h[n] = \{1, 1, 1, 1, 1\}$

(A) {1, 3, 7, 7, 7, 6, 4}

(B) {1, 3, 3, 7, 7, 6, 4}

(C) {1, 2, 4}

(D) {1, 3, 7}

19. $x[n] = \{1, 2, 3, 4, 5\}$, $h[n] = \{1\}$

(A) {1, 3, 6, 10, 15}

(B) {1, 2, 3, 4, 5}

(C) {1, 4, 9, 16, 20}

(D) {1, 4, 6, 8, 10}

20. $x[n] = \{1, 2, -1\}$, $h[n] = x[n]$

(A) {1, 4, 1}

(B) {1, 4, 2, –4, 1}

(C) {1, 2, –1}

(D) {2, 4, –2}

21. $x[n] = \{\underset{\uparrow}{1}, -2, 3\}, \quad h[n] = \{\underset{\uparrow}{0}, 0, 1, 1, 1, 1\}$

(A) $\{\underset{\uparrow}{1}, -2, 4, 1, 1, 1\}$

(B) $\{\underset{\uparrow}{0}, 0, 3\}$

(C) $\{\underset{\uparrow}{0}, 0, 3, 1, 1, 1, 1\}$

(D) $\{\underset{\uparrow}{0}, 0, 1, -1, 2, 2, 1, 3\}$

22. $x[n] = \{\underset{\uparrow}{0}, 0, 1, 1, 1, 1\}, \quad h[n] = \{1, \underset{\uparrow}{-2}, 3\}$

(A) $\{0, \underset{\uparrow}{0}, 1, -1, 2, 2, 1, 3\}$

(B) $\{\underset{\uparrow}{0}, 0, 1, -1, 2, 2, 1, 3\}$

(C) $\{1, \underset{\uparrow}{-2}, 3, 1, 1, 2, 1, 1\}$

(D) $\{\underset{\uparrow}{1}, -2, 3, 1, 1, 1, 1\}$

23. $x[n] = \{1, 1, \underset{\uparrow}{0}, 1, 1\}, \quad h[n] = \{1, -2, \underset{\uparrow}{-3}, 4\}$

(A) $\{1, -1, -2, \underset{\uparrow}{4}, 1, 1\}$

(B) $\{\underset{\uparrow}{1}, -1, -2, 4, 1, 1\}$

(C) $\{1, -1, \underset{\uparrow}{-5}, 2, 3, -5, 1, 4\}$

(D) $\{1, -1, -5, 2, 3, \underset{\uparrow}{-5}, 1, 4\}$

24. $x[n] = \{1, 2, \underset{\uparrow}{0}, 2, 1\}, \quad h[n] = x[n]$

(A) $\{\underset{\uparrow}{1}, 4, 4, 4, 10, 4, 4, 4, 1\}$

(B) $\{1, 4, 4, 4, \underset{\uparrow}{10}, 4, 4, 4, 1\}$

(C) $\{1, 4, \underset{\uparrow}{4}, 10, 4, 4, 4, 1\}$

(D) $\{1, 4, 4, 10, 4, 4, 4, \underset{\uparrow}{1}\}$

25. $x[n] = \{1, 4, \underset{\uparrow}{-3}, 6, 4\}, \quad h[n] = \{2, \underset{\uparrow}{-4}, 3\}$

(A) $\{2, 4, -19, \underset{\uparrow}{36}, -25, 2, 12\}$

(B) $\{4, -19, \underset{\uparrow}{36}, -25\}$

(C) $\{1, 4, \underset{\uparrow}{-3}, 6, 4\}$

(D) $\{\underset{\uparrow}{1}, 4, -3, 6, 4\}$

26. $x[n] = \begin{cases} 1, & n = -2, 0, 1 \\ 2, & n = -1 \\ 0 & \text{elsewhere} \end{cases}$

$h(n) = \delta[n] - \delta[n-1] + \delta[n-4]$

(A) $\delta[n] - 2\delta[n-1] + 4\delta[n-4] + \delta[n-5]$

(B) $\delta[n+2] + \delta[n+1] - \delta[n] + 2\delta[n-3] + \delta[n-4] + \delta[n-5]$

(C) $\delta[n+2] - \delta[n+1] + \delta[n] + 2\delta[n-3] - \delta[n-4] + 2\delta[n-5]$

(D) $\delta[n] + 2\delta[n-1] + 4\delta[n-5] + \delta[n-5]$

Statement for Q.27–30:

In question $y[n]$ is the convolution of two signal. Choose correct option for $y[n]$.

27. $y[n] = (-1)^n * 2^n u[2n+2]$

(A) $\frac{4}{6}$

(B) $\frac{4}{6} u[-n+2]$

(C) $\frac{8}{3}(-1)^n u[-n+2]$

(D) $\frac{8}{3}(-1)^n$

28. $y[n] = \frac{1}{4^n} u[n] * u[n+2]$

(A) $\left(\frac{1}{3} - \frac{1}{4^n}\right) u[n]$

(B) $\left(\frac{1}{3} - \frac{12}{4^n}\right) u[n+2]$

(C) $\left(\frac{4}{3} - \frac{1}{12}\left(\frac{1}{4}\right)^n\right) u[n+2]$

(D) $\left(\frac{16}{3} - \frac{1}{4^n}\right) u[n+2]$

29. $y[n] = 3^n u[-n+3] * u[n-2]$

(A) $\begin{cases} \frac{3^n}{2}, & n \le 5 \\ \frac{83}{2}, & n \ge 6 \end{cases}$

(B) $\begin{cases} 3^n, & n \le 5 \\ \frac{83}{2}, & n \ge 6 \end{cases}$

(C) $\begin{cases} \frac{3^n}{2}, & n \le 5 \\ \frac{81}{2}, & n \ge 6 \end{cases}$

(D) $\begin{cases} \frac{3^n}{6}, & n \le 5 \\ \frac{81}{2}, & n \ge 6 \end{cases}$

30. $y[n]=u[n+3]*u[n-3]$

(A) $(n+1)u[n]$ (B) $nu[n]$

(C) $(n-1)u[n]$ (D) $u[n]$

31. The convolution of $x[n]=\cos(\frac{\pi}{2}n)\,u[n]$ and $h[n]=u[n-1]$ is $f[n]u[n-1]$. The function $f[n]$ is

(A) $\begin{cases}1, & n=4m+1,\quad 4m+2\\ 0, & n=4m,\quad 4m+3\end{cases}$

(B) $\begin{cases}0, & n=4m+1,\quad 4m+2\\ 1, & n=4m,\quad 4m+3\end{cases}$

(C) $\begin{cases}1, & n=4m+1,\quad 4m+3\\ 0, & n=4m,\quad 4m+2\end{cases}$

(D) $\begin{cases}0, & n=4m+1,\quad 4m+3\\ 1, & n=4m,\quad 4m+2\end{cases}$

Statement for Q.32–38:

Let P be linearity, Q be time invariance, R be causality and S be stability. In question discrete time input $x[n]$ and output $y[n]$ relationship has been given. In the option properties of system has been given. Choose the option which match the properties for system.

32. $y[n]=rect\,(x[n])$

(A) P, Q, R (B) Q, R, S

(C) R, S, P (D) S , P, Q

33. $y[n]=nx[n]$

(A) P, Q, R, S (B) Q, R, S

(C) P, R (D) Q, S

34. $y[n]=\sum_{m=-\infty}^{n+1}u[m]$

(A) P, Q, R, S (B) R, S

(C) P, Q (D) Q, R

35. $y[n]=\sqrt{x[n]}$

(A) Q, R, S (B) R, S, P

(C) S, P, Q (D) P, Q, R

36. $x[n]$ as shown in fig. P5.2.36

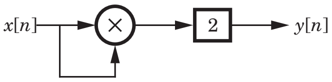


Fig. P5.2.36

(A) P, Q, R, S (B) Q, R, S

(C) P, Q (D) R, S

37. $x[n]$ as shown in fig. P5.2.37

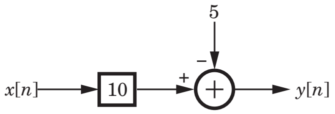


Fig. P5.2.37

(A) P, Q, R, S (B) Q, R, S

(C) P, R, S (D) P, Q, S

38. $x[n]$ as shown in fig. P5.2.38

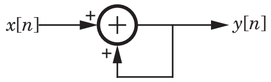


Fig. P5.2.38

(A) P, Q, R, S (B) P, Q, R

(C) P, Q (D) Q, R, S

Statement for Q.39–41:

Two discrete time systems S_1 and S_2 are connected in cascade to form a new system as shown in fig. P5.2.39–41.

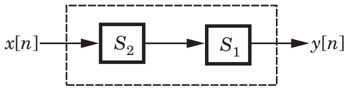


Fig. P5.2.39–41.

39. Consider the following statements

(a) If S_1 and S_2 are linear, the S is linear

(b) If S_1 and S_2 are nonlinear, then S is nonlinear

(c) If S_1 and S_2 are causal, then S is causal

(d) If S_1 and S_2 are time invariant, then S is time invariant

True statements are :

(A) a, b, c (B) b, c, d

(C) a, c, d (D) All

40. Consider the following statements

(a) If S_1 and S_2 are linear and time invariant, then interchanging their order does not change the system.

(b) If S_1 and S_2 are linear and time varying, then interchanging their order does not change the system.

True statement are

(A) Both a and b (B) Only a

(C) Only b (D) None

41. Consider the statement

(a) If S_1 and S_2 are noncausal, the S is non causal

(b) If S_1 and/or S_2 are unstable, the S is unstable.

True statement are :

(A) Both a and b (B) Only a

(C) Only b (D) None

42. The following input output pairs have been observed during the operation of a time invariant system :

$$x_1[n]=\{\underset{\uparrow}{1},\ 0,\ 2\} \xleftrightarrow{S} y_1[n]=\{\underset{\uparrow}{0},\ 1,\ 2\}$$

$$x_2[n]=\{\underset{\uparrow}{0},\ 0,\ 3\} \xleftrightarrow{S} y_2[n]=\{\underset{\uparrow}{0},\ 1,\ 0,\ 2\}$$

$$x_3[n]=\{\underset{\uparrow}{0},\ 0,\ 0,\ 1\} \xleftrightarrow{S} y_3[n]=\{1,\ \underset{\uparrow}{2},\ 1\}$$

The conclusion regarding the linearity of the system is

(A) System is linear

(B) System is not linear

(C) One more observation is required.

(D) Conclusion cannot be drawn from observation.

43. The following input output pair have been observed during the operation of a linear system:

$$x_1[n]=\{-1,\ \underset{\uparrow}{2},\ 1\} \xleftrightarrow{S} y_1[n]=\{\underset{\uparrow}{1},\ 2,\ -1,\ 0,\ 1\}$$

$$x_2[n]=\{1,\ \underset{\uparrow}{-1},\ -1\} \xleftrightarrow{S} y_2[n]=\{-1,\ \underset{\uparrow}{1},\ 0,\ 2\}$$

$$x_3[n]=\{\underset{\uparrow}{0},\ 1,\ 1\} \xleftrightarrow{S} y_3[n]=\{\underset{\uparrow}{1},\ 2,\ 1\}$$

The conclusion regarding the time invariance of the system is

(A) System is time-invariant

(B) System is time variant

(C) One more observation is required

(D) Conclusion cannot be drawn from observation

44. The stable system is

(A) $y[n]=x[n]+1.1y[n-1]$

(B) $y[n]=x[n]-\frac{1}{2}(y[n-1]+y[n-2])$

(C) $y[n]=x[n]-(1.5y[n-1]+0.4y[n-2])$

(D) Above all

45. The system shown in fig. P5.2.45 is

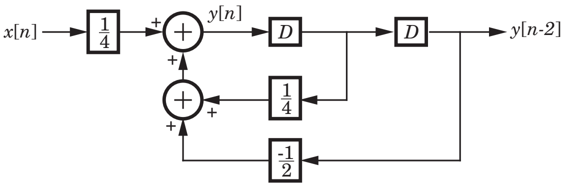


Fig. P5.2.45

(A) Stable and causal

(B) Stable but not causal

(C) Causal but unstable

(D) unstable and not causal

46. The impulse response of a LTI system is given as

$$h[n]=\left(-\frac{1}{2}\right)^n u[n].$$

The step response is

(A) $\frac{1}{3}\left(2-\left(-\frac{1}{2}\right)^{n+1}\right)u[n]$ (B) $\frac{1}{3}\left(2-\left(-\frac{1}{2}\right)^{n}\right)u[n]$

(C) $\frac{1}{3}\left(2+\left(-\frac{1}{2}\right)^{n+1}\right)u[n]$ (D) $\frac{1}{3}\left(2+\left(-\frac{1}{2}\right)^{n}\right)u[n]$

47. The difference equation representation for a system is

$$y[n]-\frac{1}{2}y[n-1]=2x[n], \quad y[-1]=3$$

The natural response of system is

(A) $\frac{3}{2}\left(-\frac{1}{2}\right)^n u[n]$ (B) $\frac{2}{3}\left(-\frac{1}{2}\right)^n u[n]$

(C) $\frac{3}{2}\left(\frac{1}{2}\right)^n u[n]$ (D) $\frac{2}{3}\left(\frac{1}{2}\right)^n u[n]$

48. The difference equation representation for a system is

$$y[n]-2y[n-1]+y[n-2]=x[n]-x[n-1]$$

If $y[n]=0$ for $n<0$ and $x[n]=\delta[n]$, then $y[2]$ will be

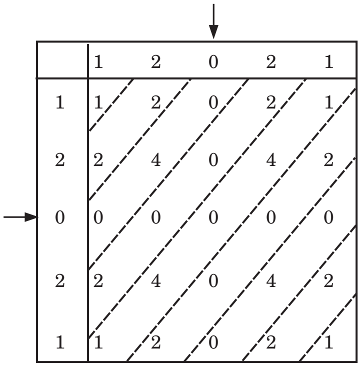
(A) 2 (B) –2

(C) –1 (D) 0

49. Consider a discrete-time system S whose response to a complex exponential input $e^{j\pi n/2}$ is specified as

$$S: e^{j\pi n/2} \Rightarrow e^{j\pi 3n/2}$$

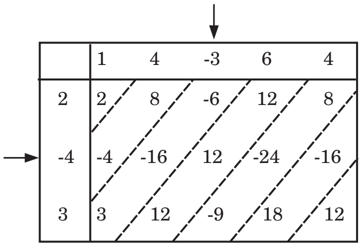
24. (B) $y[n] = \{1,\ 4,\ 4,\ \underset{\uparrow}{10},\ 4,\ 4,\ 4,\ 1\}$



	1	2	0	2	1
1	1	2	0	2	1
2	2	4	0	4	2
0	0	0	0	0	0
2	2	4	0	4	2
1	1	2	0	2	1

Fig. S5.2.24

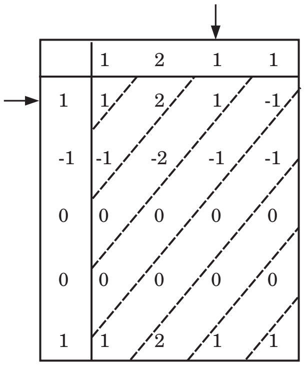
25. (A) $y[n] = \{2,\ 4,\ -19,\ \underset{\uparrow}{36},\ -25,\ 2,\ 12\}$



	1	4	-3	6	4
2	2	8	-6	12	8
-4	-4	-16	12	-24	-16
3	3	12	-9	18	12

Fig. S5.2.25

26. (B) $x[n] = \{1,\ 2,\ \underset{\uparrow}{1},\ 1\}$, $h[n] = \{\underset{\uparrow}{1},\ -1,\ 0,\ 0,\ 1\}$



	1	2	1	1
1	1	2	1	-1
-1	-1	-2	-1	-1
0	0	0	0	0
0	0	0	0	0
1	1	2	1	1

Fig. S5.2.26

$y[n] = \{1,\ 1,\ \underset{\uparrow}{-1},\ 0,\ 0,\ 2,\ 1,\ 1\}$

$y[n] = \delta[n+2] + \delta[n+1] - \delta[n] + 2\delta[n-3] + \delta[n-4] + \delta[n-5]$

27. (D) $y[n] = \sum_{k=n-2}^{\infty}(-1)^k 2^{n-k} = 2^n \sum_{k=n-2}^{\infty}\left(-\frac{1}{2}\right)^k$

$$= \frac{2^n\left(-\frac{1}{2}\right)^{n-2}}{1+\frac{1}{2}} = \frac{8}{3}(-1)^n$$

28. (C) For $n+2<0$ or $n<-2$, $y[n]=0$

for $n+2\ge 0$ or $n\ge -2$, $y[n]=\sum_{k=0}^{n+2}\frac{1}{4}k = \frac{4}{3}-\frac{1}{12}\frac{1}{4^n}$,

$$\Rightarrow\quad y[n]=\left(\frac{4}{3}-\frac{1}{12}\left(\frac{1}{4}\right)^n\right)u[n+2]$$

29. (D) For $n-2\le 3$ or $n\le 5$, $y[n]=\sum_{k=\infty}^{n-2}3^k = \frac{3^n}{6}$

for $n-2 \ge 4$ or $n \ge 6$, $y[n]=\sum_{k=-\infty}^{3}3^k = \frac{81}{2}$,

$$\Rightarrow\quad y[n]=\begin{cases}\frac{3^n}{6}, & n\le 5\\ \frac{81}{2}, & n\ge 6\end{cases}$$

30. (A) For $n-3<-3$ or $n<0$, $y[n]=0$

for $n-3 \ge -3$ or $n>0$, $y[n]=\sum_{k=-3}^{n-3}1 = n+1$,

$y[n]=(n+1)u[n]$

31. (A) For $n-1<0$ or $n<1$, $y[n]=0$

For $n-1 \ge 0$ or $n \ge 1$, $y[n]=\sum_{k=0}^{n-1}\cos\left(\frac{\pi}{2}k\right)$

$$\Rightarrow\quad y[n]=\begin{cases}1, & n=4m+1,\ 4m+2\\ 0, & n=4m,\ 4m+3\end{cases}$$

32. (B) $y_1[n]=rect\,(v[n])$, $y_2[n]=rect\,(kv[n])$

$y_2[n]\ne k\,y_1[n]$ (Not Homogeneous not linear)

$y_1[n]=rect\,(v[n])$, $y_2[n]=rect\,(v[n-n_o])$

$y_1[n-n_o]=rect\,(v[n-n_o])=y_2[n]$ (Time Invariant)

At any discrete time $n=n_o$, the response depends only on the excitation at that discrete time. (Causal)

No matter what values the excitation may have the response can only have the values zero or one. (Stable)

33. (C) $y_1[n]=nv[n]$, $y_2[n]=nkv[n]$

$ky_1[n]=y_2[n]$ (Homogeneous)

Let $x_1[n]=v[n]$ then $y_1[n]=nv[n]$

Let $x_2[n]=w[n]$ then $y_2[n]=nw[n]$

Let $x_3[n]=v[n]+w[n]$ then

$y_3[n]=n(v[n]+w[n])=nv[n]+nw[n]$

$=y_1[n]+y_2[n]$ (Additive)

Since the system is homogeneous and additive, it is also linear.

$y_1[n-n_o]=(n-n_o)v[n-n_o]\ne y_n[n]=nv[n-n_o]$

(Time variant)

At any discrete time, $n = n_o$ the response depends only on the excitation at that same time. (Causal)

If the excitation is a constant, the response is unbounded as n approaches infinity. (Unstable)

34. (C) $y_1[n] = \sum_{m=-\infty}^{n+1} v[m]$, $y_2[n] = \sum_{m=-\infty}^{n+1} kv[m]$

$y_2[n] = ky_1[n]$ (Homogeneous)

$y_1[n] = \sum_{n=-\infty}^{n+1} v[m]$, $y_2[n] = \sum_{n=-\infty}^{n+1} w[m]$

$y_3[n] = \sum_{m=-\infty}^{n+1} (v[n] + w[m])$

$= \sum_{m=-\infty}^{n+1} v[m] + \sum_{m=-\infty}^{n+1} w[n] = y_1[n] + y_2[n]$ (Additive)

Since the system is homogeneous and additive it is also linear

$y_1[n] = \sum_{m=-\infty}^{n+1} v[n]$, $y_2[n] = \sum_{m=-\infty}^{n+1} v[m - n_o]$

$y_1[n - n_o] = \sum_{m=-\infty}^{n-n_o+1} v[m] = \sum_{q=-\infty}^{n+1} v[q - n_o] = y_2[n]$

(Time Invariant)

At any discrete time, $n = n_o$, the response depends on the excitation at the next discrete time in future.

(Anti causal)

If the excitation is a constant, the response increases without bound. (Unstable)

35. (A) $y_1[n] = \sqrt{v[n]}$, $y_2 = \sqrt{kv[n]} = \sqrt{k}\sqrt{v[n]}$

$ky_1[n] = k\sqrt{v[n]} \neq y_2[n]$ (Not Homogeneous Not linear)

$y_1[n] = \sqrt{v[n]}$, $y_2[n] = \sqrt{v[n - n_o]}$

$y_1[n - n_o] = \sqrt{v[n - n_o]} = y_2[n]$ (Time Invariant)

At any discrete time $n = n_o$, the response depends only on the excitation at that time (Causal)

If the excitation is bounded, the response is bounded.

(Stable).

36. (B) $y[n] = 2x^2[n]$

Let $x_1[n] = v[n]$ then $y_1[n] = 2v^2[n]$

Let $x_2[n] = kv[n]$ then $y_2[n] = 2k^2v^2[n]$

$ky[n] \neq y_2[n]$ (Not homogeneous Not linear)

Let $x_1[n] = v[n]$ then $y_1[n] = 2v^2[n]$

Let $x_2[n] = v[n - n_o]$ then $y_2[n] = 2v^2[n - n_o]$

$y_1[n - n_o] = 2v[n - n_o] = y_2[n]$ (Time invariant)

At any discrete time, $n = n_o$, the response depends only on the excitation at that time. (Causal)

If the excitation is bounded, the response is bounded.

(Stable).

37. (B) $y_1[n] = 10v[n] - 5$, $y_2[n] = 10kv[n] - 5$

$y_2[n] \neq ky_1[n]$ (Not Homogeneous so not linear)

$y_1[n] = 10v[n] - 5$, $y_2[n] = 10v[n - n_o] - 5$

$y_1[n - n_o] = 10v[n - n_o] - 5, \ = y_2[n]$ (Time Invariant)

At any discrete time, $n = n_o$ the response depends only on the excitation at that discrete time and not on any future excitation. (Causal)

If the excitation is bounded, the response is bounded.

(Stable).

38. (B) $y[n] = x[n] + y[n-1]$, $y[n-1] = x[n-1] + y[n-2]$

$y[n] = x[n] + x[n-1] + y[n-2]$, Then by induction

$y[n] = x[n-1] + x[n-2] + \dots x[n-k] + \dots = \sum_{k=0}^{\infty} x[n-k]$

Let $m = n - k$ then $y[n] = \sum_{m=n}^{-\infty} x[m] = \sum_{m=-\infty}^{n} x[m]$

$y_1[n] = \sum_{m=-\infty}^{n} v[m]$, $y_2[n] = \sum_{m=-\infty}^{n} kv[m] = ky_1[n]$

(Homogeneous)

$y_3[n] = \sum_{m=-\infty}^{n} \left(v[m] + w[m]\right) = \sum_{m=-\infty}^{\infty} v[m] + \sum_{m=-\infty}^{n} w[m]$

$= y_1[n] + y_2[n]$ (Additive)

System is Linear.

$y_1[n] = \sum_{m=-\infty}^{\infty} v[m]$, $y_2 = \sum_{m=-\infty}^{n} v[n - n_o]$

$y_1[n]$ can be written as

$y_1[n - n_o] = \sum_{m=-\infty}^{n-n_o} v[m] = \sum_{q=-\infty}^{n} v[q - n_o] = y_2[n]$

(Time Invariant)

At any discrete time $n = n_o$ the response depends only on the excitation at that discrete time and previous discrete time. (Causal)

If the excitation is constant, the response increase without bound. (Unstable)

39. (C) Only statement (b) is false. For example

$S_1 : y[n] = x[n] + b$, and $S_2 : y[n] = x[n] - b$, where $b \neq 0$

$S\{x[n]\} = S_2\{S_1\{x[n]\}\} = S_2\{x[n] + b\} = x[n]$

Hence S is linear.

40. (B) For example

$S_1 : y[n] = nx[n]$ and $S_2 : y[n] = nx[n+1]$

If $x[n] = \delta[n]$ then $S_2\{S_1\{\delta[n]\}\} = S_2[0] = 0,$