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1. **C. Discrete time!** $0.075 = 75/1000 = 3/40$ lowest terms \rightarrow period=denominator=40.
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2. **A.** $\sin(32\pi\frac{n}{40}) + \sin(48\pi\frac{n}{40}) = \sin(0.8\pi n) + \sin(1.2\pi n) = 0$.
Replace “sin” with “cos” throughout and the answer is (e).
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3. **C.** We get $\{(1)(4), (1)(5) + (2)(4), (1)(6) + (2)(5) + (3)(4), (2)(6) + (3)(5), (3)(6)\}$.
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4. **C.** $Y(z)[1 + 2z^{-1} + 3z^{-2}] = X(z)[4 + 5z^{-1} + 6z^{-2}] \rightarrow H(z) = \frac{Y(z)}{X(z)} = \frac{4z^2+5z+6}{z^2+2z+3}$.
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5. **E.** $H(z) = \mathcal{Z}\{h[n]\} = \frac{z}{z-1} \frac{z-2}{z-2} + \frac{z}{z-2} \frac{z-1}{z-1} = \frac{2z^2-3z}{z^2-3z+2}$.
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6. **E.** $\frac{z}{z-2} + \frac{z}{z-3} = \frac{z}{z-2} \frac{z-3}{z-3} + \frac{z}{z-3} \frac{z-2}{z-2} = \frac{2z^2-5z}{z^2-5z+6}$.
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7. **E.** $\frac{H(z)}{z} = \frac{6}{z(z-2)(z+1)} = \frac{1}{z-2} + \frac{2}{z+1} - \frac{3}{z}$. $H(z) = \frac{z}{z-2} + \frac{2z}{z+1} - 3$. $h[n] = 2^n u[n] + 2(-1)^n u[n] - 3\delta[n]$.
- OR:** $H(z) = \frac{2}{z-2} - \frac{2}{z+1} \rightarrow h[n] = 2(2)^{n-1} u[n-1] - 2(-1)^{n-1} u[n-1]$ agrees with (e).
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8. **A.** $\{1, -3, 2\} * u(n) = u(n) - 3u(n-1) + 2u(n-2) = \{1, -2\} \cdot (1-3z^{-1}+2z^{-2}) \frac{z}{z-1} = \frac{z^2-3z+2}{z(z-1)} = \frac{z-2}{z}$.
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9. **D.** $H(z) = \frac{2-2z^{-1}}{1+\frac{z}{z-2}} \frac{z-2}{z-2} = \frac{2z-6+4z^{-1}}{2z-2} = 1-2z^{-1} \rightarrow h[n] = \{1, -2\}$. Same as #8!
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10. **A. 1-sided:** $Y^+(z) - 2z^{-1}Y^+(z) - 2y(-1) = 0 \rightarrow Y^+(z) = \frac{2z}{z-2} \rightarrow y[n] = 2(2)^n u(n)$.
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11. **B.** Poles $\{2, 3\}$ both outside unit circle \rightarrow unstable. I should have specified “causal.”
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12. **C.** $H(z) = \frac{Y(z)}{X(z)} = \frac{z^2-7z+6}{z^2-5z+6}$. Cross-multiply: $Y(z)(z^2-5z+6) = X(z)(z^2-7z+6)$. \mathcal{Z}^{-1} .
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13. **A.** $Y(z) = H(z)X(z) = \frac{z^2-7z+6}{z^2-5z+6} \frac{z^2-5z+6}{z^2} = \frac{z^2-7z+6}{z^2} \rightarrow y[n] = \{1, -7, 6\}$.
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14. **A.** $y[n] = h[n] * 7 = 7 \sum_{n=0}^{\infty} h(n) = 7H(1) = 0$. OK, I shouldn't have asked this one.
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15. **D.** $\frac{H(z)}{z} = \frac{(z-1)(z-6)}{z(z-2)(z-3)} = \frac{1}{z} + \frac{2}{z-2} - \frac{2}{z-3} \rightarrow H(z) = 1 + 2\frac{z}{z-2} - 2\frac{z}{z-3}$.
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16. (i) $(0.5)^{n-1} u[n-1] - 3^{n-1} u[n-1]$ $\{z : |z| > 3\}$ causal unstable
(ii) $(0.5)^{n-1} u[n-1] + 3^{n-1} u[-n]$ $\{z : 0.5 < |z| < 3\}$ noncausal stable
(iii) $3^{n-1} u[-n] - (0.5)^{n-1} u[-n]$ $\{z : |z| < 0.5\}$ anticausal unstable

SCORES	#ugrad	#grad	PROBLEM	GRADING COMMENTS
100	5	1	1	Discrete time! Aargh...
95 – 99	12	3	7	(d) : Must replace $n \rightarrow n - 1$
90 – 94	14	2	12	Trouble with this? Aargh...
85 – 89	12	0	14	Much harder than I thought
80 – 84	10	0	16	-3 if thought $\frac{z}{z-0.5} - \frac{z}{z-3}$
75 – 79	4	0	16	I admit it : I forgot z' s
70 – 74	5	0	16	-2 if $u[-n-2]$ not $u[-n]$
65 – 69	3	1	16	$u[-(n-1)-1] = u[-n]$. Delay :
50 – 65	3	0	16	Replace $n \rightarrow n - 1$ everywhere
TOTAL	68	7	7, 15	Put answer in different form
MEAN	85.5	90.3		Pretty good! Was it too easy?