№1 **B1.** $W(s)=\frac{1}{1+sT}$; $W(s)=\frac{1}{T}\left(\frac{1}{1/T+s}\right)$; $w(t)\doteqdot W(s)$; $H(s)=\frac{1}{s}\cdot W(s)$;

$H(s)=\frac{1}{s}\cdot W(s)=\frac{1}{s}\cdot\frac{1}{T}\left(\frac{1}{1/T+s}\right)=\frac{1}{T}\left(\frac{1}{s}\cdot\frac{1}{1/T+s}\right)=\frac{1}{T}\left(\frac{1}{s(s+1/T)}\right)\doteqdot\left[\alpha=\frac{1}{T}\right]\doteqdot$

$\doteqdot\frac{1}{T}\cdot\left(T\cdot(1-e^{-t/T})\right)=1-e^{-t/T}=h(t)$; $w(t)=\frac{1}{T}\cdot e^{-\frac{1}{T}\cdot t}$, т. к. $\alpha=-\frac{1}{T}$;

B2 $W(s)=\frac{sT}{1+sT}$; $W(s)=\frac{sT+1-1}{1+sT}=\frac{sT+1}{1+sT}-\frac{1}{1+sT}=1-\frac{1}{1+sT}=1-\frac{1}{T}\cdot\frac{1}{(s+1/T)}\doteqdot$

$\doteqdot\left[\delta(t)-\frac{1}{T}\cdot(e^{-t/T})\right]=w(t)$; $H(s)=\frac{1}{s}W(s)=\frac{1}{s}\cdot\frac{sT}{1+sT}=\frac{T}{1+sT}=\frac{T}{(1/T+s)T}=\frac{1}{1/T+s}\doteqdot e^{-t/T}=h(t)$;

B3 $W(s)=\frac{1-sT}{1+sT}$; $W(s)=\frac{1-sT+1-1}{1+sT}=\frac{-1-sT}{1+sT}+\frac{2}{1+sT}=-1+\frac{2}{1+sT}=-1+\frac{2}{T(1/T+s)}\doteqdot$

$\doteqdot\left[-\delta(t)+\frac{2}{T}\cdot e^{-t/T}\right]=w(t)$; $H(s)=\frac{1}{s}\cdot W(s)=\frac{1}{s}\cdot\frac{1-sT}{1+sT}=\frac{1}{s}\cdot\frac{1-sT+sT-sT}{1+sT}=\frac{1}{s}\left(\frac{1+sT}{1+sT}-\frac{2sT}{1+sT}\right)=$

$=\frac{1}{s}-\frac{2T}{1+sT}=\frac{1}{s}-\frac{2T}{T(1/T+s)}=\frac{1}{s}-\frac{2}{s+1/T}\doteqdot 1-2\cdot e^{-t/T}=h(t)$;

B4 $W(s)=\frac{1+sT}{1+2sT}$; $W(s)=\frac{1+sT-1/2+1/2}{1+2sT}=\frac{sT+1/2}{2(1/2+sT)}+\frac{1-1/2}{1+2sT}=\frac{1}{2}+\frac{1}{2+4sT}=\frac{1}{2}+\frac{1}{4T\left(\frac{1}{2T}+s\right)}=$

$\doteqdot\left[\frac{1}{2}\delta(t)+\frac{1}{4T}\cdot e^{-t/2T}\right]=w(t)$; $H(s)=\frac{1}{s}W(s)=\frac{1}{s}\cdot\frac{1+sT}{1+2sT}=\frac{1+sT+sT-sT}{s(1+2sT)}=$

$=\frac{1+sT\cdot 2}{s(1+2sT)}-\frac{sT}{s(1+2sT)}=\frac{1}{s}-\frac{T}{1+sT\cdot 2}=\frac{1}{s}-\frac{T}{2T(1/2T+s)}=\frac{1}{s}-\frac{1}{2(1/2T+s)}\doteqdot\left[\alpha=-\frac{1}{2T}\right]$

$\doteqdot 1-\frac{1}{2}\cdot e^{-t/2T}=h(t)$;

№2 **B1** $W(s)=\frac{1}{s+1}+\frac{1}{s}$; $H(s)=\frac{1}{s}\cdot W(s)=\frac{1}{s}\left(\frac{1}{s+1}+\frac{1}{s}\right)=\frac{1}{s(s+1)}+\frac{1}{s^2}\doteqdot 1-e^{-t}+t=h(t)$

B2 $W(s)=\frac{s+1}{2s+1}+\frac{1}{s}$; $H(s)=\frac{1}{s}W(s)=\frac{s+1}{s(2s+1)}+\frac{1}{s^2}=\frac{s+1+s-s}{s(2s+1)}+\frac{1}{s^2}=\frac{2s+1}{s(2s+1)}-\frac{s}{s(2s+1)}+\frac{1}{s^2}$

$=\frac{1}{s}-\frac{1}{2s+1}+\frac{1}{s^2}=\frac{1}{s}+\frac{1}{s^2}-\frac{1}{2(s+1/2)}\doteqdot 1+t-\frac{1}{2}\cdot e^{-t/2}=h(t)$;

B3 $W(s)=\frac{s-1}{s+1}+e^{-s}$; $H(s)=\frac{1}{s}W(s)=\frac{1}{s}\cdot\left(\frac{s-1}{s+1}+e^{-s}\right)=\frac{s-1+s-s}{s(s+1)}+\frac{e^{-s}}{s(s+1)}=\frac{-s-1}{s(s+1)}+\frac{2s}{s(s+1)}+$

$+\frac{e^{-s}}{s(s+1)}=-1+\frac{2}{s+1}+\frac{e^{-s}}{s(s+1)}\doteqdot-\delta(t)+2e^{-t}+1(t-1)=h(t)$;

B4 $W(s)=e^{-s}\cdot\frac{s-1}{s+1}$; $H(s)=\frac{1}{s}\cdot W(s)=\frac{e^{-s}}{s}\cdot\frac{s-1}{s+1}=e^{-s}\left(\frac{s-1+s-s}{s(s+1)}\right)=e^{-s}\cdot\left(\frac{-s-1}{s(s+1)}+\frac{2s}{s(s+1)}\right)=$

$=e^{-s}\left(-\frac{1}{s}+\frac{2}{s+1}\right)=-\frac{1}{s}e^{-s}+\frac{2e^{-s}}{s+1}\doteqdot\left(-1+2e^{1-t}\right)\cdot 1(t-1)=h(t)$, т. к. $f(t-\tau)\doteqdot e^{-s\tau}\cdot F(s)$.

№3 **B1** $x(t)=1+t^2$; $t^2\to\frac{2}{s^3}$; $1\to\frac{1}{s}$; $X(s)=\frac{1}{s}+\frac{2}{s^3}$;

B2 $x(t)=1+(t-2)^3\cdot 1(t-2)$; $1\to 1/s$; $(t-2)^3\cdot 1(t-2)\to\frac{3!}{s^{3+1}}\cdot e^{-2s}$; $X(s)=\frac{1}{s}+\frac{6}{s^4}\cdot e^{-2s}$;

B3 $x(t)=2+e^{-t/T}$; $2\to 2/s$; $e^{-t/T}\to\frac{1}{s+1/T}$; $X(s)=\frac{2}{s}+\frac{T}{sT+1}$; $X(s)=\frac{2}{s}+\frac{1}{s+1/T}$;

B4 $x(t)=e^{-(t-\tau_0)/T}\cdot 1(t-\tau_0)$; по ф-ле $x(t-T)\doteqdot e^{-sT}\cdot X(s)$, $e^{-sa}\doteqdot\delta(t-a)$;

$X(s)=e^{-\tau_0 s}\cdot\frac{1}{s+1/T}=e^{-\tau_0 s}\cdot\frac{T}{sT+1}$;

№4 **B3** $W(s)=e^{-s}\cdot s^2$; $\lim_{s\to\infty}W(s)=\lim_{s\to\infty}(e^{-s}\cdot s^2)=\lim_{s\to\infty}\frac{s^2}{e^{s}}=0$ физ. реализ.; ~~$H(s)=\frac{1}{s}\cdot W(s)=\frac{1}{s}\cdot e^{-s}\cdot s^2=e^{-s}\cdot s$~~ ~~$\doteqdot h(t)$; $h(0+)=\lim_{t\to 0+}h(t)=$~~

B4 $W(s)=(1+e^{-s})\cdot\frac{s^2-1}{s+1}$; ~~$H(s)=\frac{1}{s}\cdot W(s)=\frac{1}{s}\cdot(1+e^{-s})\cdot\frac{(s-1)(s+1)}{s+1}=\frac{1}{s}\cdot(1+e^{-s})\cdot(s-1)=$~~

~~$=(1+e^{-s})(1-\frac{1}{s})=1-\frac{1}{s}+e^{-s}-\frac{e^{-s}}{s}\doteqdot\delta(t)-1+\delta(t-1)-\delta(t-1)$.~~

$\lim_{s\to\infty}W(s)=\lim_{s\to\infty}(1+e^{-s})\cdot\frac{s^2-1}{s+1}=\lim_{s\to\infty}(1+e^{-s})(s-1)=\infty\Rightarrow$ физ. нереализ.

№1 Сис-а физ. реализ., если $h(0+)=0$, т.е. $h(t)=\lim sH(s)=\lim W(s)$;

(В1) $W(s)=\frac{s-1}{s+1}$; $H(s)=\frac{1}{s}\cdot W(s)=\frac{1}{s}\cdot\frac{s-1}{s+1}=\frac{1}{s}\cdot\frac{s-1+1-1}{s+1}=\frac{1}{s}\left(\frac{s+1}{s+1}-\frac{2}{s+1}\right)=$

$=\frac{1}{s}\left(1-\frac{2}{s+1}\right) \risingdotseq 1-2(1-e^{-t})=1-2+2e^{-t}=2e^{-t}-1=h(t)$;

$h(0+)=\lim\limits_{t\to 0+} h(t)=\lim\limits_{t\to 0+}(2e^{-t}-1)=1\neq 0 \Rightarrow$ физ. нереал.;

(В2) $W(s)=e^{-s}\cdot\frac{s^2-1}{s+1}$; $H(s)=\frac{1}{s}W(s)=\frac{1}{s}\cdot e^{-s}\cdot\frac{s^2-1}{s+1}=\frac{1}{s}\cdot e^{-s}\cdot\frac{(s-1)\cancel{(s+1)}}{\cancel{s+1}}=\frac{e^{-s}(s-1)}{s}$ $\ominus$

$\lim\limits_{s\to\infty} W(s)=\lim\limits_{s\to\infty} e^{-s}\cdot\frac{s^2-1}{s+1}=\lim\limits_{s\to\infty}\frac{(s+1)(s-1)}{e^{s}(s+1)}=\lim\limits_{s\to\infty}\frac{s-1}{e^{s}}=0 \Rightarrow$ физ. реализуема

$e^{s}\rightarrow$ растёт быстрее

$\ominus\; e^{-s}-\frac{e^{-s}}{s}=\delta(t-1)-1(t-1)=h(t)$; $\lim\limits_{t\to 0} h(t)=\lim\limits_{t\to 0}(\delta(t-1)-1(t-1))=\delta(-1)-1(-1)=0$;

№2 (В1) $W(s)=\frac{1}{sT+1}$; 1) $u(t)=1(t)+5\cdot 1(t-1)$; $x(t)=\hat{W}(u(\cdot))=\hat{W}(u(t))=\hat{W}(1(t)+5\cdot 1(t-1))=$

$h(t)=\hat{W}(1(t))$; $\ominus\; \hat{W}(1(t))+\hat{W}(5\cdot 1(t-1))=\hat{W}(1(t))+5\hat{W}(1(t-1))=h(t)+5\cdot h(t-1)=1-e^{-t/T}+$

$+5+5e^{-(t-1)/T}=6-e^{-t/T}+5\cdot e^{-\frac{(t-1)}{T}}$; 2) $x(t)=\int\limits_0 w(t)\cdot u(t-\tau)$; $x(t)=\int\limits_0^{\infty}\frac{1}{T}\cdot e^{-t/T}\cdot u(t-\tau)\,d\tau$, т.к. $u(t)=0,\ t<0$;

(В2) $W(s)=\frac{sT}{1+sT}$; 1) $u(t)=\begin{cases}1, & t\in[0,2];\\ 0, & \text{иначе};\end{cases}$ $w(t)\leftarrow u(t)=\delta(t)$; $h(t)\leftarrow u(t)=1(t)$; тогда, отклик $u(t)=1(t)-1(t-2)$ это

~~[illegible]~~ $x(t)=\hat{W}(u(\cdot))=\hat{W}(u(t))=\hat{W}(1(t)-1(t-2))=\hat{W}(1(t))-\hat{W}(1(t-2))=$

$=h(t)-h(t-2)=e^{-t/T}-e^{-(t-2)/T}$; 2) $x(t)=\int\limits_0 w(t)\cdot u(t-\tau)=\int\limits_0^{\infty}\delta(t)-\frac{1}{T}(1-e^{-t/T})\cdot u(t-\tau)\,d\tau$, т.к. $u(t)=0,\ t<0$;

(В3) $W(s)=\frac{1-sT}{1+sT}$; 1) $u(t)=\begin{cases}0, & t<0;\\ 5, & t\in[0,5];\\ -1, & t>5;\end{cases}$ $u(t)=5\cdot 1(t)-6\cdot 1(t-5)$; $x(t)=\hat{W}(u(\cdot))=\hat{W}(u(t))=$

$=\hat{W}(5\cdot 1(t)-6\cdot 1(t-5))=\hat{W}(5\cdot 1(t))-\hat{W}(6\cdot 1(t-5))=5\hat{W}(1(t))-6\hat{W}(1(t-5))=5h(t)-6h(t-5)=$

$=5\cdot(1-2e^{-t/T})-6\left(1-2e^{-\frac{(t-5)}{T}}\right)=5-10e^{-t/T}-6+12e^{-\frac{(t-5)}{T}}=-1-10e^{-t/T}+12e^{-\frac{(t-5)}{T}}$;

2) $x(t)=\int\limits_0^{\infty} w(t)\cdot u(t-\tau)=\int\limits_0^{\infty}\left(-\delta(t)+\frac{2}{T}e^{-t/T}\right)\cdot u(t-\tau)\,d\tau$, т.к. $u(t)=0,\ t<0$;

(В4) $W(s)=\frac{1+sT}{1+2sT}$; 1) $u(t)=1(t)-1(t-1)$; $x(t)=\hat{W}(u(\cdot))=\hat{W}(u(t))=W(1(t)-1(t-1))=$

$=[h(t)-h(t-1)]=\left(1-\frac{1}{2}e^{-t/2T}\right)-\left(1-\frac{1}{2}e^{-\frac{(t-1)}{2T}}\right)=\frac{1}{2}\left(e^{-\frac{(t-1)}{2T}}-e^{-\frac{t}{2T}}\right)$;

2) $x(t)=\int\limits_0^{\infty} w(t)\cdot u(t-\tau)=\int\limits_0^{\infty}\left(\frac{1}{2}\delta(t)+\frac{1}{4T}e^{-t/2T}\right)\cdot u(t-\tau)\,d\tau$, т.к. $u(t)=0,\ t<0$.