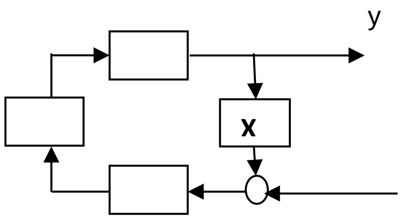
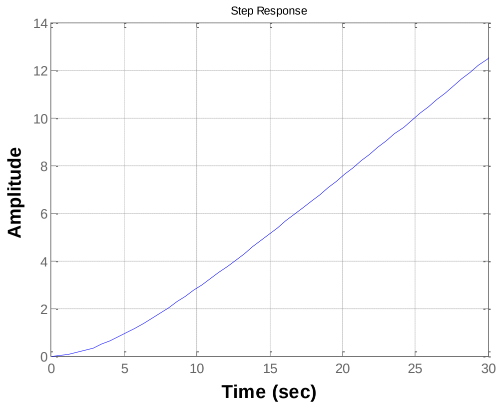
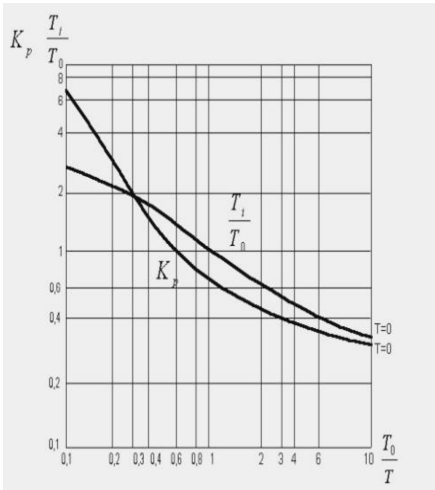
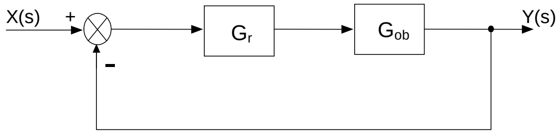
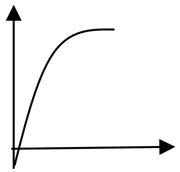
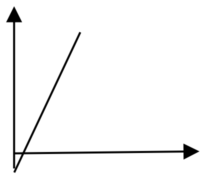
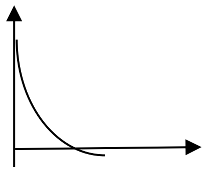
Examination questions on the subject of „Basic principles of automation”

Operational level			
Basic principles of automation			
Questions O/T - means Basic/Advanced			
Item	**O/T**	**Question**	**Correct answer**
1.	O	The enclosed drawing shows a block diagram of the closed adjustment system. The item marked with X represents: A. measuring transducer, B. controller, C. executive element, D. object of the control. 	A
2.	O	The serial correction unit attached to the multi-inertial control object is intended to increase the phase reserve. This can be achieved with the correction module A. PI type, B. P type with a reinforcement greater than single, C. it is not possible to increase the phase reserve by means of the correction module, which is switched on in series, D. PD type.	D
3.	O	The following is called the cascade control system: A. any system with two controllers, B. a system with additional couplings from the auxiliary output values of the object of control C. a system with two controllers operating in the master-slave system, D. a system having a cascading connection between the sensor and the actuator.	B
4.	O	The follow-up control system is called a system in which: A. the setpoint reference value is fixed, B. no feedback occurs, C. the controlled value keeps up with setpoint changes, D. the output signal from the measuring transducer is kept up with changes in the output value from the object.	C

5.	O	The measuring line in the closed-circuit feedback circuit shall include: A. a block that processes the output signal from the controller, B. a setpoint measuring device, C. a transducer-sensor unit measuring the controlled value and converting it into a standard output signal, D. a referencing-unit - sensor unit for measuring the control value.	C
6.	O	Calibration of the measuring transducer refers to: A. Assigning standard values for a given measuring range to the output signal from the transducer, B. Selecting the units in which the controlled value is measured, C. Setting the alarm values in the transducer, D. Connecting the measuring transducer to the controller.	A
7.		Output signal is not delayed with respect to the sinusoidal input signal in the: A. oscillatory module, B. differential module, C. integrating module, D. inertial module.	B
8.	O	Determine Laplace's transmittance $G(s)=\frac{y(s)}{u(s)}$ described in the following differential equation $9y(t)-5\dot{u}(t)+15\ddot{y}(t)=2u(t)-7\dot{y}(t)$ taking into account zero initial conditions Transmittance *G(s)* shall be equal to A. $G(s)=\frac{2s+5}{15s^2+9s+7}$, B. $G(s)=\frac{15s^2+7s+9}{5s+2}$, C. $G(s)=\frac{2s-7}{9s^2-5s+15}$, D. $G(s)=\frac{5s+2}{15s^2+7s+9}$.	D

9.	O	The diagram below shows the characteristics of the transmittance module: A. $G(s) = \dfrac{1}{1+2s}$, B. $G(s) = \dfrac{5}{s+10s^2}$, C. $G(s) = \dfrac{2}{1+2s}$, D. $G(s) = \dfrac{1}{2s(1+5s)}$.	 Fig. Step response	D
10.	O	Adjust the PI controller settings: *PI* : K_{pr}, T_i such that the overregulation in the system does not exceed 20% and the adjustment time *is minimal when the transmittance of the object model is known to be equal*: $G(s) = \dfrac{4}{2+10s} \cdot e^{-3s}$ <u>NOTE</u> on the nomogram K_p means static amplification of the open system The correct settings are approximately as follows A. $K_{pr} = 1$ $T_i = 1.3$, B. $K_{pr} = 0.5$, $T_i = 3.9$, C. $K_{pr} = 2$, $T_i = 7.5$, D. $K_{pr} = 0.2$, $T_i = 10.5$.	 Fig. Nomograms for setting *PI* regulator settings for 20% over-adjustment and minimum setting time t_r	A

11.	O	What is the determined offset that will occur in the tracking control system when the input signal is equal to $x(t) = 4t \cdot 1(t)$ and the transmittances of the controller and the facility are $G_r(s) = \frac{K_I}{s}, G_{ob}(s) = \frac{5}{3s^2 + 5s + 2}$. Controller enhancement $K_I = 0.1$ A) 0, B) 10, C) 12, D) 16.	 Fig. Block diagram of the layout from the task	D
12.	O	The displayed response to the step function relates to the following element: A. proportional, B. inertial, C. integrating, D. differentiating.		B
13.	O	The displayed response to the step function relates to the following element: A. proportional, B. inertial, C. integrating, D. differentiating.		C
14.	O	The displayed response to the step function relates to the following element: A. proportional, B. inertial, C. integrating, D. differentiating actual.		D

15.	O	In a cascade control system: A. one controller with one input and two outputs is used, B. at least two two-way controls shall be used to control, C. no proportional regulators P are used, D. interference to the actuators is partially compensated in the internal loop.	D
16.	O	The MRAC (Model Reference Adaptive Control) adaptive control system uses a reference model which: A. which is a model of the control object, B. is part of the controller, C. corresponds to the desired transmittance of the closed system, D. reflect the transmittance of the entire open circuit.	C
17.	O	Adaptive adjustment with intermediate identification is based on the fact that: A. the controller is tuned based on the deviation between the reference model and the object, B. that the dynamics of the object is determined and then, based on this knowledge, the controller is itself synthesize, C. that the dynamics of actuators and measuring track are determined and then the controller is synthesized based on these data, D. that once the dynamics of the controller have been identified, the control object is identified.	B
18.	O	Control deviation A. in closed circuit with feedback is the output signal from the controller, B. in the steady state, when the object is integrating, it is always equal to zero, C. is equal to the difference of the setpoint signal and the adjustable value, D. is the difference between the control signal and the adjustable value.	C
19.	O	The transmittance of the controller is: A. a differential equation determining the course of the controller output value as a function of time u (t), B. a ratio of the controller output signal u (t) to the input signal e (t), C. a ratio of the Laplace u (s) output signal u (t) of the controller to the transform of the input signal e (s) at zero initial conditions, D. a time sequence of the controller output signal u (t) in response to e (t).	C

20.	O	Which of the closed circuits will certainly be unstable It will be a closed circuit A. with negative feedback, whose open circuit is an inertial object of the 3rd order with delay, B. with positive feedback, whose 2nd order open circuit has a static amplification greater than unity, C. with positive feedback, whose open circuit is an inertial 2nd order object with amplification less than unity, D. with negative feedback, whose open circuit is a 3rd order object.	B
21.	O	Which of the closed circuits with negative feedback listed below will be stable for sure? It will be the one whose open layout A. has amplification of less than 10, B. k has a phase delay of less than -180 ^{o} for the full pulsation response range, C. is the second order inertia with delay, D. contains two integrating units combined in series.	B
22.	O	The transmittance of the open circuit shall be equal to $G_o(s) = \frac{K}{s^3 + 2s^2 + 4s + 2}$. At what amplification of the open *K* circuit, this circuit, after closing a) the individual negative loop feedback unit, will be at the stability limit ? A. K = 2, B. K = 4, C. K = 6, D. K = 8.	C

<table>
<tr>
<td>23.</td>
<td>O</td>
<td>The following diagrams show the Bode plot of the open system. On the basis of this, it is not possible to determine that the reserve of the phase $\Delta\varphi$ and the reserve of the module ΔM of the closed circuit, i. e. after the feedback loop is closed, will be as follows

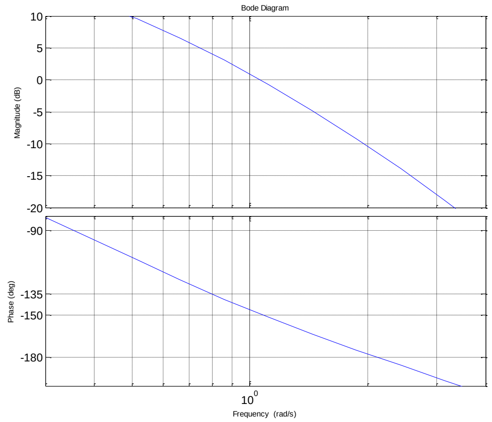
A. 150 ^{o} and -12 dB,
B. 30^{o} and 12 dB,
C. 135 ^{o} and 4 dB,
D. the closed circuit will be unstable.</td>
<td>

Fig. Bode plot of the open system</td>
<td>C</td>
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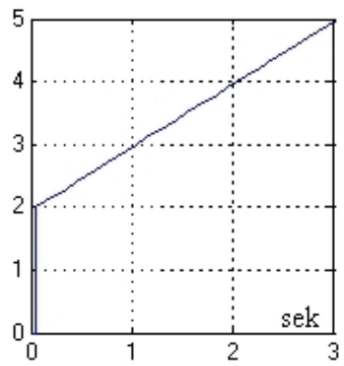
<td>24.</td>
<td>O</td>
<td>Using the following step characteristic of the PI controller for individual excitation, determine the following values: amplification factor k_p , integration time constant T_i, proportionality range X_p :

A. 2.0, 2.0, 50%,
B. 1.0, 3.0, 100%,
C. 2.0, 3.0, 50%,
D. 1.0, 3.0, 100%.</td>
<td>
</td>
<td>A</td>
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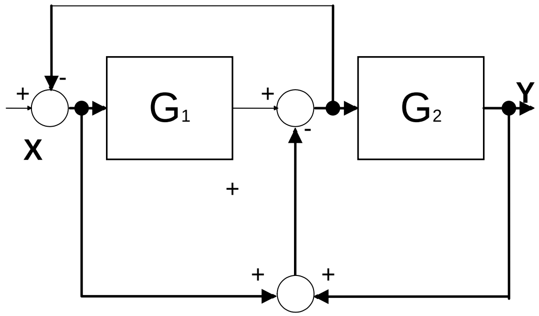
25.	O	The resultant transmittance of the system $G(s)=\frac{y(s)}{x(s)}$ of the diagram shown in the figure shall be equal to: A. $G(s)=\frac{G_1-G_2}{G_1+G_1G_2}$, B. $G(s)=\frac{G_1G_2}{G_1+(1+G_1G_2)}$, C. $G(s)=\frac{(G_1-1)G_2}{G_1+G_2}$, D. none of the above.	 Fig. System diagram	C
26.	O	Switching on the auto-tuning function in the controller allows for: A. adjustment of the controller settings, B. selection of manual control in the controller, C. manual adjustment of the controller settings for the *'automatic control'* mode., D. automatic switching of the controller operating mode depending on the average value of the control deviation.		A
27.	O	When selecting the controller settings by Ziegler-Nichols method, knowledge of the following is required: A. parameters of the limit cycle and the phase reserve, B. module and phase reserve and critical amplification, C. limit cycle parameters or parameters of the first order model (static amplification, inertia time constant and resultant delay time), D. Selection of controller settings based on the course of the computer model controlled value.		C

28.	O	Spectral transmittance G(jω) is created from operator transmittance G(s) y substituting the following expression for the operator Laplace *s:* A. 0, B. Jω, C. –jω, D. σ+ jω.	B
29.	O	The deviation of regulation *e(t) – 2 1(t)* was put on the *PI* controller input and on the serial-parallel structure with K_P = 2 and K_I = 0.5 settings. What value will the control signal reach after 6 seconds from the occurrence of the adjustment error, assuming that the deviation value will not change, because the system had an interrupted feedback A. 4, B. 8, C. 12, D. 16.	D
30.	O	The automation element is described in the following differential equation: $T\dot{y} + y = ku$ A. it is an inertial element of the first order, B. it is an integrating element, C. it is a differentiating element, D. it is an inertia integrating element.	A
31.	O	The closed-circuit control system with PI controller and linear object is placed at the limit of stability, and a sinusoidal vibration is generated at its output with a constant amplitude and frequency. To increase oscillation damping and thus reduce overregulation and shorten the adjustment time, it is necessary to: A. reduce open circuit amplification and increase integration time constant, B. reduce the doubling time, i. e. Ti integration time constant, C. increase the amplification of the open system, D. change the feedback sign to positive.	A

32.		The automation element is described in the following differential equation: $T\dot{y} + y = ku$ The status matrices of this element are as follows: A. $A = [1/T], B = [-k/T], C = [1], D = [0];$ B. $A = [-1/T], B = [-k/T], C = [1], D = [0];$ C. $A = [-1/T], B = [k/T], C = [1], D = [0];$ D. $A = [-1/T], B = [k/T], C = [0], D = [1];$	C
33.	O	Dominant poles of the closed-circuit system A. are those elements of the characteristic equation which lie in the right semi-plane of the composite variable, thus dominating over the stable poles, B. tare poles which determine the ability of the system to compensate for the set deviation, C. are two poles which are located much closer to the imaginary axis than the other poles, which makes them decisive for the time of adjustment of the closed-circuit system, D. are elements whose absolute value of the actual part is greater than unity, thus providing good damping of the adjustable value.	C
34.	O	Two amplifiers: one with 10 V/V amplification and the other with 2 V/V amplification are connected in series. The total total amplification shall be: A. 12 V/V, B. 5 V/V, C. 20 V/V, D. 6 V/V.	C
35.	T	The lengths of the double-sided lever arms are x and y. When the arm x is affected by the input force F_x the arm y is affected by the force F_y. The amplification ratio of this lever is: A. *x/y,* B. x/(x+y), C. y/(x+y), D. *y/x.*	A
36.	O	The oil damper (mass with spring running in a viscous medium) has the following characteristics: A. oscillatory, B. inertial of the first order, C. integrating, D. differentiating.	A

37.	O	The differentiating-integrating adjustment called PID correction A. for certain pulsations accelerates the phase and for others it delays it, B. delays phase in the whole pulsation range, C. accelerates the phase throughout the whole pulsation range, D. is able to delay the open circuit phase to 200 degrees.	A
38.	O	Moving the transmittance poles of a closed circuit with available measurement variables is A. possible due to feedback from the status variables, B. possible due to a combination of forward feedback and forward coupling, C. possible due to forward coupling from the status variables, D. possible due to feedback from the control value.	A
39.	O	The astatic system in relation to the given value is called the system A. with self-compensation, B. with a delay on the main track, C. with at least one neutral pole, D. with at least one pole in the right semi-plane of the composite variable.	C
40.	O	In order to be able to synthesize a system with any pole position and thus any dynamic properties, it is required that: A. the open-circuit system was an oscillatory module, B. the closed-circuit system was a second order system, C. the system has available, measurable status variables, D. the number of poles of the closed-circuit system was greater than that of the open-circuit system.	C

41.	O	The deviation of regulation *e(t) – 2 1(t)* was put on the *PI* controller input and on the serial-parallel structure with $K_P = 2$ and $K_I = 0.5$ settings. What value will the control signal reach after 6 seconds from the occurrence of the adjustment error, assuming that the deviation value will not change, because the system had an interrupted feedback A. 4, B. 8, C. 12, D. 16.	 D
42.	T	The amplifier with a very high amplification factor was covered by a negative feedback loop with transmittance G (s). What is the transmittance of the entire system? A. $\approx 1/(G(s))$, B. $\approx 1/(1+G(s))$, C. $(G(s))/(1+G(s))$, D. $1/(1-G(s))$.	A
43.	O	Transmittance of the PD acceleration module is equal to: A. $G_{aPD}(s)=\frac{T_2}{T_1}\cdot\frac{1+T_1 s}{1+T_2 s}\quad T_1>T_2$, B. $G_{bPD}(s)=\frac{T_2}{T_1}\cdot\frac{1+T_2 s}{1+T_1 s}\quad T_1>T_2$, C. $G_{cPD}(s)=\frac{T_2 s}{T_1}\cdot\frac{1+T_1 s}{1+T_2 s}$, D. $G_D(s)=\frac{(T_4 s+1)\cdot(T_2 s+1)}{(T_3 s+1)\cdot(T_1 s+1)}\quad T_1 T_2=T_3 T_4$,	A
44.	O	Adjustment of the adjustment system by means of a proportional element: A. does not change the transmittance phase shift of the control system, B. does not change the transmittance module of the control system, C. does not change the phase shift and transmittance module of the control system, D. changes the phase shift and transmittance module of the control system.	A
45.	O	Extreme control systems can therefore be achieved by adding an optimization module to the basic control system.	

		Its task is to: A. Automatically select the setpoint so that the resulting control signal level ensures that the maximum value of the controlled value is reached, B. find a minimum control value to ensure that the setpoint value is reached, C. minimize the adjustment time, D. minimize energy consumption in the process of controlling an adjustable value.	C
46.	O	An integrating and differentiating compensator (lead-lag compensator) has the following transmittance $(1+\alpha Ts)/(1+Ts)$. It is differentiating for: A. α<1, B. α<<1, C. α>1, D. α=0.	C
47.	O	Discrete transmittance T (z) of the system is: A. ratio of discrete transform of the output signal Y (z) to discrete transformer of the input signal X (z) B. ratio of discrete transformer of input signal X (z) to discrete transformer of output signal Y (z), C. ratio of discrete transform of the output signal Y (z) to discrete transform of the input signal X (z) multiplied by the sampling period T_{s}, D. ratio of discrete transform of the input signal X (z) to discrete transform of the output signal Y (z) divided by the sampling period T_{s}.	A
48.	O	Discrete transmittance T (z) can be obtained from continuous transmittance T (s) by the following substitution (T_s means sampling time): *A.* $s = z$, B. $\mathrm{s} = (\mathrm{z}-1)/\mathrm{T\_s}$, C. $s = (z+1)/T\_s$, D. $\mathrm{s} = (-\mathrm{z}+1)/\mathrm{T\_s}$.	B

49.	O	Discrete transmittance T (z) can be obtained from continuous transmittance T (s) by substitution T_s means sampling time): A. $s = z$, B. $s = (z-1)/ 〚zT〛 \_s$, C. $s = (z+1)/(zT\_s)$, D. $s = (-z+1)/(zT\_s)$.	B
50.	O	Discrete transmittance T (z) can be obtained from continuous transmittance T (s) by substitution T_s means sampling time): A. $s = z$, B. $s = 2/T\_s \ (z-1)/(z+1)$, C. $s = T\_s/2 \ (z-1)/(z+1)$, D. $s = 2/T\_s \ (z+1)/(z-1)$.	B
51.	O	Are the courses of the step characteristics plotted for discrete transmittance obtained from continuous transmittance and the step characteristics obtained for this continuous transmittance the same:: A. yes, B. no, C. yes, regardless of the sampling period, D. yes, but this depends on the approximation method used.	B
52.	O	There is given the following discrete transmittance: $G(z) = 5/(10z-2)$. In the input signal path, a signal delay block has been set for 3 sampling periods. Now the discrete transmittance is as follows: A. $G(z) = 5/(10z-2)\ z\^3$, B. $G(z) = 2.5/(5z-1)\ z\^3$, C. $G(z) = 5/(10z\^(-3)-2)$, D. $G(z) = 5/(10z-2)\ z\^(-3)$.	D
53.	T	There is given the following discrete transmittance of a certain system: $G(z) = 5/(10z-2)$. Is it the system stable? A. no, because one factor in the denominator is negative, B. no, because the pole is positive, C. yes, because the pole z = 0.2, D. yes, because the pole z = 0.2.	C

54.	T	Transmittance of the discrete object is equal to $P(z) = 1/(z(z-2))$, and the controller to $C(z)$ =k. Transmittance (output-input) of the closed-circuit control system consisting of these elements shall be equal to: A. $k/(z^2 - 2z + k)$, B. $k/(z^2 + 2z + k)$, C. $1/(z^2 - 2z + k)$, D. $1/(z^2 + 2z + k)$.	A
55.	T	The characteristic equation of the discrete adjustment system is as follows: $z^2 + 0{,}1z - 0.72 = 0.$ The system is: A. unstable because one element is positive, B. stable, C. stable because one element is negative, D. unstable because one equation factor is negative.	B
56.	O	Discrete PID controllers can implement either positioning or incremental algorithm. An incremental algorithm is used when: A. the actuator controlled by the controller is of a proportional nature, B. the actuator controlled by the controller is of differentiating nature, C. the actuator controlled by the controller is of a proportional - differentiating nature, D. the actuator controlled by the controller is of an integrating nature.	D

57.	O	Discrete PID controllers can implement either positioning or incremental algorithm. The positional algorithm is used when: A. the actuator controlled by the controller is of an integrating nature, B. the actuator controlled by the controller is of differentiating nature, C. the actuator controlled by the controller is of a proportional - differentiating nature, D. the actuator controlled by the controller is of a proportional nature.	D
58.	O	The settings of the discrete PID controller are: A. amplification factor, integration and differentiation times, B. range of proportionality, integration and differentiation times, C. amplification factor, integration time and sampling period, D. range of proportionality, integration and differentiation times and sampling period.	D
59.	O	The discrete control system is stable when its characteristic equation $1+G_{open}(z)=0$: A. has all factors positive, B. the elements of that z_k equation meet the condition that $\|z_k\|>1$, C. the elements of that z_k equation meet the condition that $\|z_k\|<1$, D. the elements of that z_k equation meet the condition that $\|z_k\|<\infty$.	C
60.	O	If an integration element with delay is introduced in series into the open circuit, then in this system: A. the phase delay shall increase by between -45 and -90 degrees, B. the module reserve is increased and phase reserve is decreased, C. the module will remain unchanged and phase reserve will be decreased by more than 90 degrees, D. the module and phase delay will decrease.	C
61.	O	In the adaptive control system with gain scheduling A. the integration constant is adjusted according to the adjustment deviation, B. the reference model is used, C. based on the selected lead value, one of the controller parameters is selected, e. g. proportional amplification, D. intermediate adaptation of one of the controller's settings is carried out.	C

62.	O	The diagram on phase plane: A. has the following coordinates (x, y)→(e, $\dot{e}$), B. has the following coordinates (x, y)→($\dot{e}, e$), C. has the following coordinates (x, y)→($\ddot{e}, \dot{e}$), D. has the following coordinates (x, y)→($\dot{e}, \ddot{e}$).	A
63.	O	Phase plane graphs are used to illustrate the performance of the following systems: A. second order, B. third order, C. of any order, D. stable.	A
64.	O	Step control system is a system containing: A. an actuating motor and dual-setting controller with corrective feedback, B. an actuating motor and tripe-setting controller with corrective feedback, C. an actuating motor and controller for continuous operation, D. triple-position adjuster.	B
65.	O	The method of presenting the properties of the non-linear system by means of a description function is to: A. the harmonic linearization of the non-linear segment followed by a performing analysis using a frequency method, B. development of the function around the working point into the Taylor expansion, C. creating a functional relationship between output and input using a neural model, D. creating, in a wider range of changes in the size of the input non-linear static function describing the relationship between output and input in a steady state.	A
66.	O	The pressure switches are two-setting controllers of: A. temperature, B. level, C. flow, D. pressure.	D
67.	O	The biggest difference between the logarithmic characteristics of the spectral characterization of the inertial segment and its substitute characterization - asymptotic - is: A. approximately 20 dB, B. approximately 4 dB, C. approximately 3 dB, D. less than 1 dB.	C