

ME307 EXAM 2 - Example Questions

NAME: _____

NOTE:

- CLOSED BOOK, CLOSED NOTES.
- NO CALCULATORS ALLOWED.
- DO YOUR WORK ON THE EXAM ONLY (NO SCRATCH PAPER ALLOWED).
- READ THE QUESTION AND ALL ANSWERS CAREFULLY AND SELECT THE **BEST ANSWER**.
- ALL QUESTIONS ARE WEIGHTED EQUALLY.

USEFUL EQUATIONS:

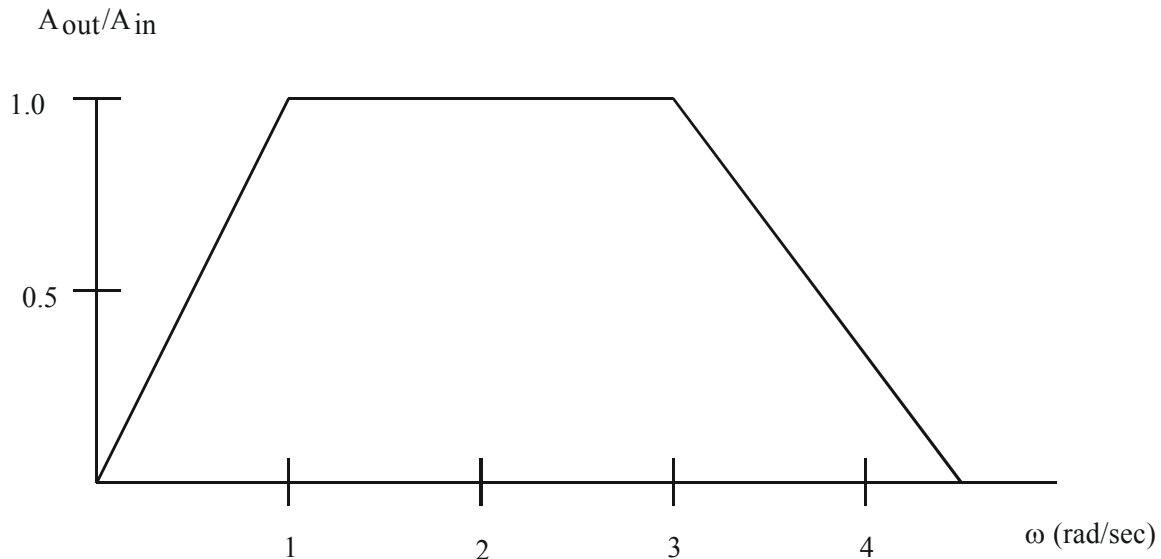
2nd-Order Mechanical System:

$$\zeta = \frac{b}{2\sqrt{km}} \quad b_c = 2m\omega_n$$

$$\frac{X_o}{F_o/k} = \frac{1}{\left(\left[1 - \left(\frac{\omega}{\omega_n} \right)^2 \right]^2 + 4\zeta^2 \left(\frac{\omega}{\omega_n} \right)^2 \right)^{1/2}} \quad \phi = -\tan^{-1} \left(\frac{2\zeta}{\frac{\omega_n}{\omega} - \frac{\omega}{\omega_n}} \right)$$

- (1) A "good" measurement system exhibits
- amplitude linearity, large bandwidth, and phase linearity
 - amplitude linearity, small bandwidth, and constant phase
 - amplitude linearity, large bandwidth, and constant phase
 - amplitude linearity, small bandwidth, and phase linearity

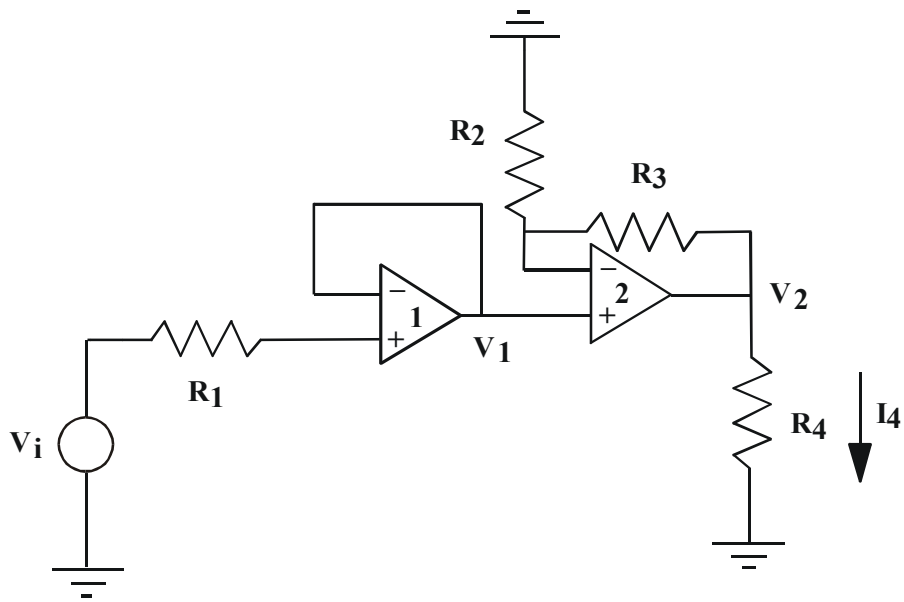
Questions 2 through 4 deal with a measurement system with a frequency response as shown below:



- (2) What is the bandwidth of the system
- 0 rad/sec to 4.5 rad/sec
 - 1 rad/sec to 3 rad/sec
 - 0.707 rad/sec to 3.439 rad/sec
 - 0.707 rad/sec to 3.707 rad/sec
 - 0.707 rad/sec to 4.5 rad/sec
- (3) If the system is used to measure a sinusoidal input of frequency 0.5 rad/sec and of amplitude 2 V, the output will have an amplitude of
- 0 V
 - 0.5 V
 - 1 V
 - 2 V
 - 2.5 V
- (4) For all input frequencies above 4.5 rad/sec, the system output amplitude will be
- attenuated, but nonzero
 - amplified
 - 1
 - 0
 - negative
- (5) What is the natural frequency, in Hertz, of an undamped 2nd order spring-mass system with $m=100$ grams and $k = 100$ N/m?
- $1/(2\pi)$
 - 2π
 - $31.62/(2\pi)$
 - $2\pi/31.62$
 - $1000/(2\pi)$

- (6) For low frequencies, the frequency response of a second order system predicts that the output will be out of phase from the input by
- (a) 0°
 - (b) 90°
 - (c) 180°
 - (d) -90°
 - (e) -180°
- (7) Current in an electrical system is analogous to what in a hydraulic system?
- (a) pressure
 - (b) volumetric flow rate
 - (c) mass flow rate
 - (d) volume
 - (e) fluid momentum
- (8) The current into the inverting input terminal of an ideal op amp is always
- (a) zero
 - (b) nonzero and the negative of the current into the noninverting input terminal
 - (c) the same as the output current
 - (d) positive
 - (e) negative
- (9) The closed-loop gain of an inverting amplifier circuit is
- (a) positive
 - (b) negative
 - (c) zero
 - (d) almost infinite for an ideal op amp
- (10) If a shunt resistor is placed in parallel with the feedback capacitor of an ideal integrator circuit, the resulting circuit will fail to operate as an integrator when the input frequency is
- (a) high
 - (b) low
 - (c) mid-range for the circuit bandwidth
 - (d) a or b
- (11) What is the approximate maximum output voltage swing for a 741 op amp powered by a ± 15 V supply?
- (a) 0 to 15 V
 - (b) 0 to 13.6 V
 - (c) -15 to 15 V
 - (d) -13.6 to 13.6 V
 - (e) -13.6 to 15 V

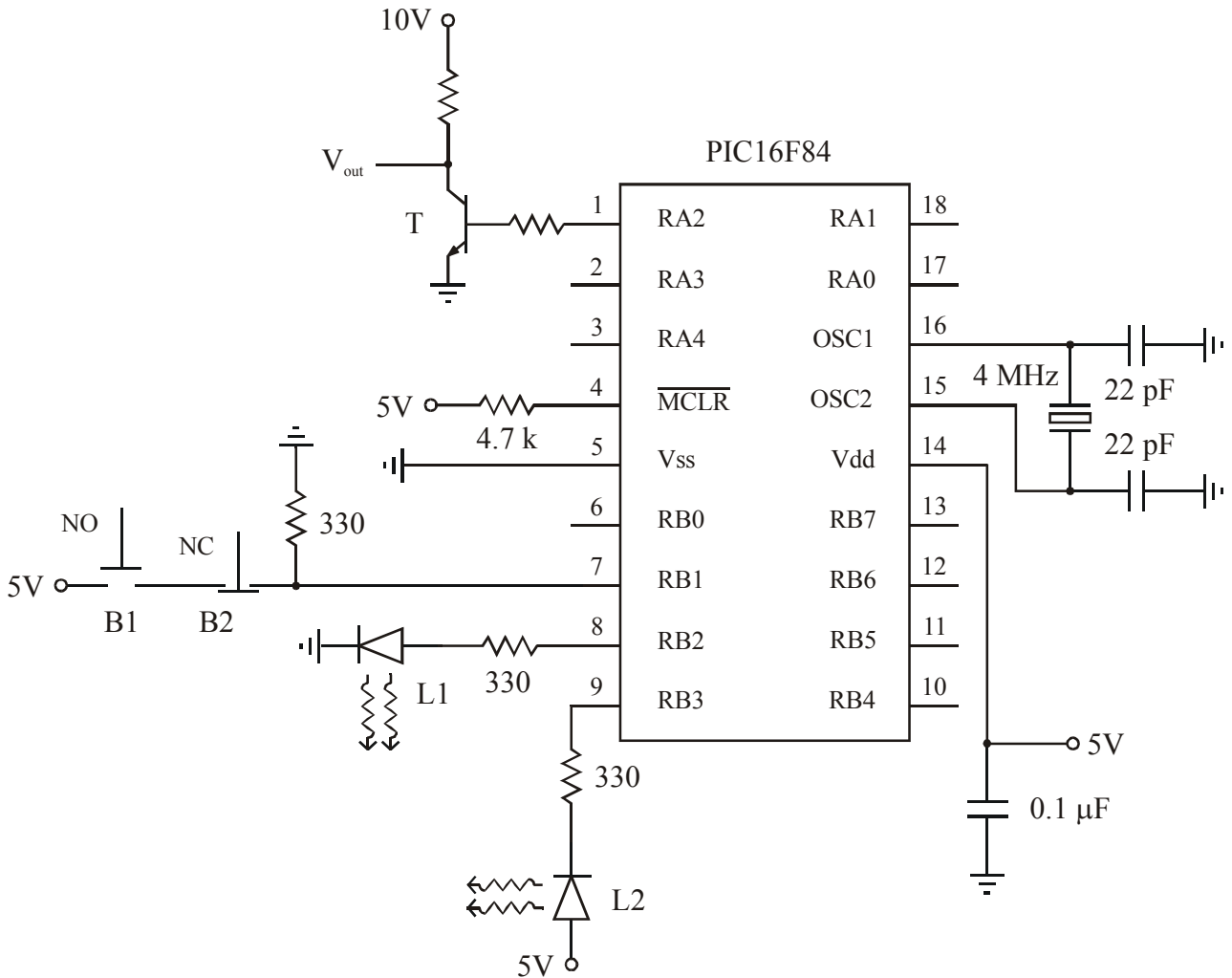
Questions 12 through 14 deal with the circuit below where the op amps are LM741's powered by a ± 15 V power supply. Assume $R_1 = R_2 = R_3 = R_4 = R$.



- (12) If $V_i = 1$ V, V_1 would be
- (a) 0 V
 - (b) 1 V
 - (c) 13.6 V
 - (d) 2 V
- (13) If $V_1 = 1$ V, V_2 is
- (a) 0 V
 - (b) 1 V
 - (c) 2 V
 - (d) -2 V
 - (e) -1 V
- (14) If $V_2 = 2$ V, the current output by op amp 2 is
- (a) 0
 - (b) $1 / R$
 - (c) $2 / R$
 - (d) $3 / R$
 - (e) $2 / 3R$

- (15) The sampling rate for standard audio CD technology is approximately 44 kHz because the highest frequency a human (with good hearing) can hear is approximately
- (a) 20 Hz
 - (b) 10 kHz
 - (c) 20 kHz
 - (d) 40 kHz
 - (e) 80 kHz
- (16) If a 100 kHz sine wave is sampled at 25 kHz, the resulting signal will exhibit
- (a) attenuation
 - (b) high fidelity
 - (c) amplification
 - (d) inversion
 - (e) aliasing
- (17) If we sample a signal at 100 Hz, the Sampling Theorem states that the resulting output will be acceptable only if the highest frequency component in the signal is
- (a) greater than 200 Hz
 - (b) less than 200 Hz
 - (c) greater than 50 Hz
 - (d) less than 50 Hz
 - (e) exactly equal to 100 Hz
- (18) How many different output states can a 5 bit A/D converter represent?
- (a) 5
 - (b) 10
 - (c) 25
 - (d) 31
 - (e) 32
- (19) What is the voltage quantization size for a 4-bit A/D converter operating over a 30 V voltage range?
- (a) 0.25 V
 - (b) 1.875 V
 - (c) 2 V
 - (d) 4 V
 - (e) 7.5 V

Questions 20 through 29 deal with the figure below. Assume all outputs are low to begin with unless indicated otherwise.



- (20) What does the following PICBASIC code do?
HIGH PORTB.2
(a) turns on LED L1
(b) turns off LED L1
- (21) What does the following PICBASIC code do?
LOW PORTB.2
(a) turns on LED L1
(b) turns off LED L1
- (22) What does the following PICBASIC code do?
HIGH PORTB.3
(a) turns on LED L2
(b) turns off LED L2

- (23) What does the following PICBASIC code do?
LOW PORTB.3
(a) turns on LED L2
(b) turns off LED L2
- (24) After the following PICBASIC code, what will be the approximate value for V_{out} ?
HIGH PORTA.2
(a) 0 V
(b) 10 V
(c) -10 V
(d) 5 V
(e) -5 V
- (25) After the following PICBASIC code, what will be the approximate value for V_{out} ?
LOW PORTA.2
(a) 0 V
(b) 10 V
(c) -10 V
(d) 5 V
(e) -5 V
- (26) If buttons B1 and B2 are both being held down, what is the value for PORTB.1?
(a) 0
(b) 1
- (27) If buttons B1 and B2 are both being held down, what does the following PICBASIC code do?
IF (PORTB.1 == 1) THEN
HIGH PORTB.2
ELSE
LOW PORTB.2
(a) turns on LED L1
(b) turns off LED L1
- (28) If button B1 is held down and B2 is up (i.e., not pressed), what is the value for PORTB.1?
(a) 0
(b) 1
- (29) If button B1 is up (i.e., not pressed) and B2 is held down, what is the value for PORTB.1?
(a) 0
(b) 1
- (30) In PICBASIC, what is the equivalent base ten value for (%100 + %100)?
(a) 4
(b) 8
(c) 16
(d) 100
(e) 200

- (31) In PICBASIC, what is the equivalent base ten value for $(\$10 + \$10)$?
- (a) 10
 - (b) 16
 - (c) 20
 - (d) 32
 - (e) 64