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ENGLISH

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EXAM IN TFY 4185 Measurement Technique/Måleteknikk

1 Dec 2014
Time: 09:00-13:00

Number of pages: 9

Permitted aids: 1) Dictionary (ordinary or bi-lingual)
2) All calculators
3) 1 side of an A5 sheet with printed or handwritten formulas permitted

You can answer in either Norwegian or English. The weight for each multiple-choice question is 4%, the weight for each calculation problem is given in parenthesizes.

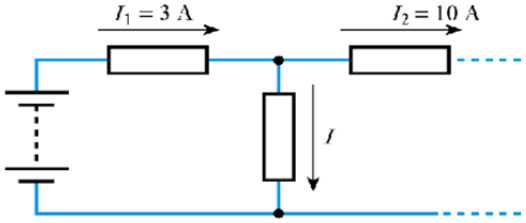
Multiple Choice Questions-1 (40% total).

There is only **one** correct answer so you must **choose the best answer**. Answer A, B, C… (Capital letters), or leave the answer blank. Correct answer gives +4; incorrect answers give 0, and blank (unanswered) gives +1.

Write the answers for the multiple choice questions **on the answer sheet you turn in** using a table similar to the following:

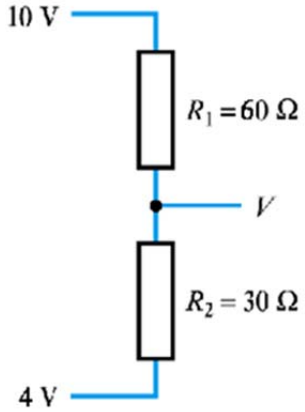
Question	1	2	3	4	5	6	7	8	9	10
Answer										

1. **Calculate the magnitude of the current I in the following circuit:**



A) -7 A B) 13 A C) 7 A D) -13 A

2. **Calculate the output voltage *V* of the following circuit:**

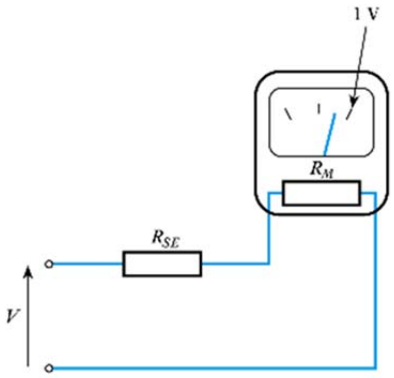


A) 2 V B) 4 V C) 6 V D) 8 V

3. **If a sinusoidal voltage $v = V_p \sin \omega t$ is applied across a capacitor, *C*, what is the average value of the power dissipated in the capacitor?**

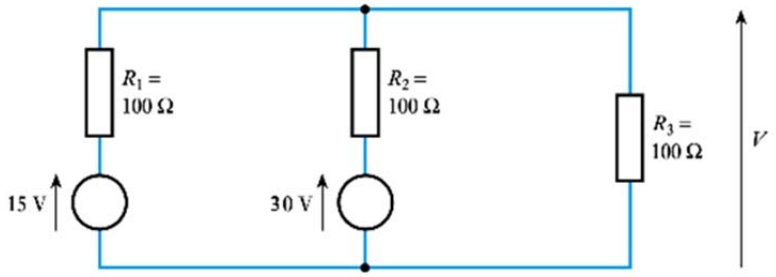
A) 0 B) CV_p^2 C) V_p^2 / C D) $2CV_p^2$

4. **A moving-coil meter produces a full-scale deflection for a current of 100 µA and has a resistance of 500 Ω. Select a series resistor (R_{SE}) that will turn this device into a voltmeter with an full scale deflection of 1 V.**



A) 8.5 kΩ B) 9 kΩ C) 9.5 kΩ D) 10 kΩ

5. **Use the principle of superposition to determine the output voltage V of the following circuit.**



A) 5 V B) 7.5 V C) 12 V D) 15 V

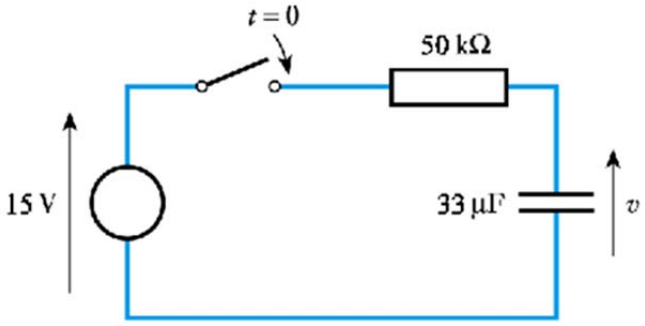
6. **Which one of the following statements is correct in relation to alternating waveforms:**

A) In a capacitor, the voltage leads the current.
B) In an inductor, the voltage lags the current.
C) In a capacitor, the current leads the voltage.
D) In an inductor, the current leads the voltage.

7. **Which of the following combination of components represents an impedance of 110 + j 314 Ω at a frequency of 100 Hz?**

A) A resistor of 100 Ω in series with a capacitor of 5 µH
B) An inductor of 50 mH in series with a capacitor of 5 µH
C) A resistor of 314 Ω in series with an inductor of 5 mH
D) A resistor of 110 Ω in series with an inductor of 500 mH

8. **The switch in the following circuit closes at $t = 0$. If the capacitor is initially discharged, calculate the time, t, at which the voltage on the capacitor is 12.6V.**



A) 1.21 ns B) 3.0 s C) 12.6 s D) 15 s

9. **When unconnected to any other circuit elements, an amplifier has a voltage gain of 20, an input resistance of 500 ohms and an output resistance of 50 ohms. The amplifier is connected to a voltage source that produces an output voltage of 1 V and has an output resistance of 75 ohms (when unconnected to any other circuit elements), and to a load resistance of 800 ohms. What will the voltage across the load resistor be when this circuit is connected?**

A) 20 V B) 16.4 V C) 18.8 V D) 17.4 V

10. **What is the voltage gain of the amplifier in question 9 when it is connected to the source and load resistance?**

A) 18.9 B) 20 C) 17.4 D) 16.4

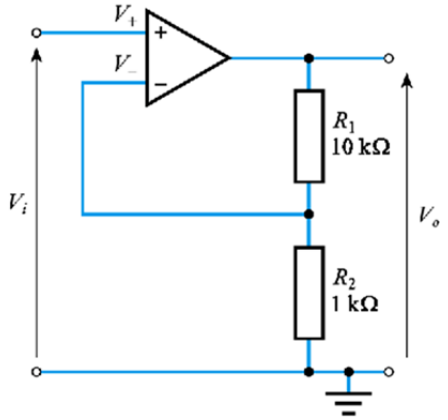
Multiple Choice Questions-2 (40% total).

There is only **one** correct answer so you must **choose the best answer**. Answer A, B, C, … (Capital letters), or leave the answer blank. Correct answer gives +4; incorrect answers give 0, and blank (unanswered) gives +1.

Again, **on the answer sheet you turn in** use a table similar to the following:

Question	11	12	13	14	15	16	17	18	19	20
Answer										

11. What is the voltage gain of this circuit?



A) 0.091 B) 0.1 C) 10 D) 11

12. A Zener diode:

A) Has a high forward voltage rating
B) Has a sharp breakdown at low reverse voltage
C) Is useful as an amplifier
D) None of the above

13. A long section of p-type semiconductor material:

A) Is positively charged
B) Is electrically neutral
C) Has an electric field directed along its length
D) None of the above

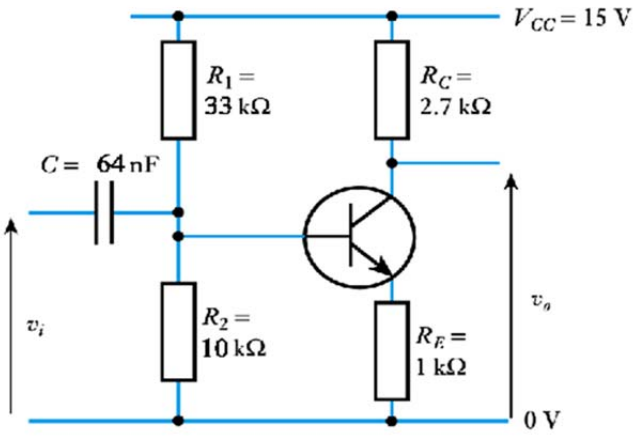
14. The drain current in JFET is always controlled by:

A) Voltage drop along the channel
B) Magnitude of the depletion
C) Channel length
D) Reverse-bias at the gate

15. A bipolar junction transistor is in the saturation region if:

A) Base-emitter junction is reverse-biased and base-collector junction is forward-biased.
B) Both the junctions are reverse-biased.
C) Both the junctions are forward-biased.
D) Base-emitter junction is forward-biased and base-collector junction is reverse-biased.

16. In the following circuit, how is the input to the base filtered?

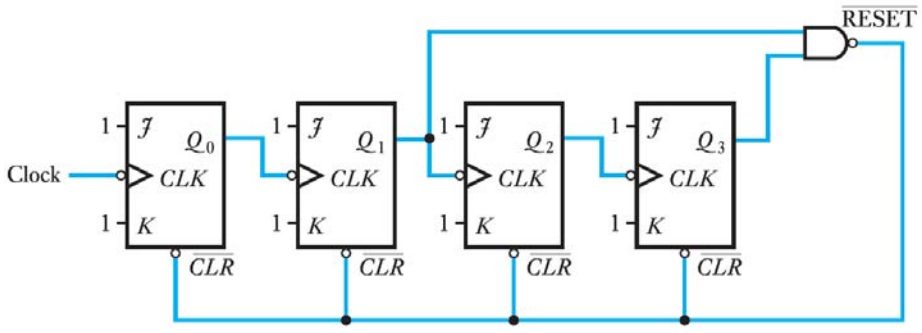


A) It is high-pass filtered.
B) It is low-pass filtered.
C) It is band-pass filtered.
D) It is notch-filtered

17. Determine the lower-frequency cut-off of the input to the base in the circuit of question 16.

A) 18 Hz B) 178 Hz C) 324 Hz D) 2037 Hz

18. What is the function of the following circuit?



A) A modulo-12 counter.
B) A modulo-10 counter.
C) A modulo-8 counter.
D) A modulo-6 counter.

19. What is the resolution of a 10-bit analogue to digital data converter?

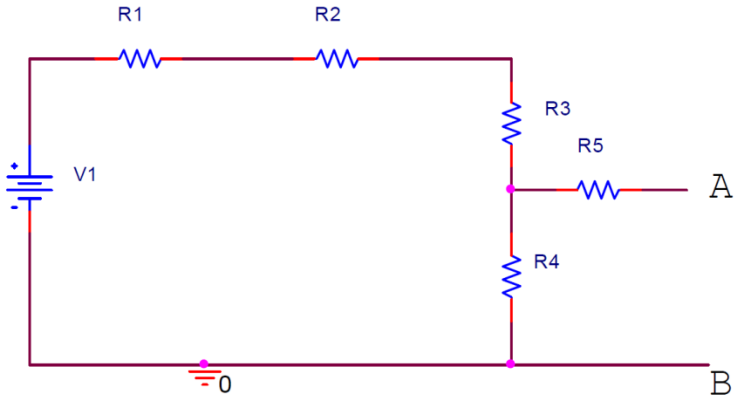
A) 0.00098% B) 0.098% C) 0.024% D) 0.41%

20. A signal contains components with frequencies up to 10 kHz, although no useful information is contained at frequencies above 6 kHz. What is the minimum frequency at which the signal should be sampled?

A) 6 kHz. B) 12 kHz. C) 14.4 kHz. D) 20 kHz.

Calculations (20% total)

21. You build the following circuit with $V_1 = 6$ V, and $R_1 = 30\ \Omega$, $R_2 = 2$ kΩ, $R_3 = 3$ kΩ, $R_4 = 2$ kΩ and $R_5 = 1$ kΩ.



a) **Find the Thévenin Equivalent voltage, $V_{th}=V_{OC}$, of this circuit between point A and point B (2%)**

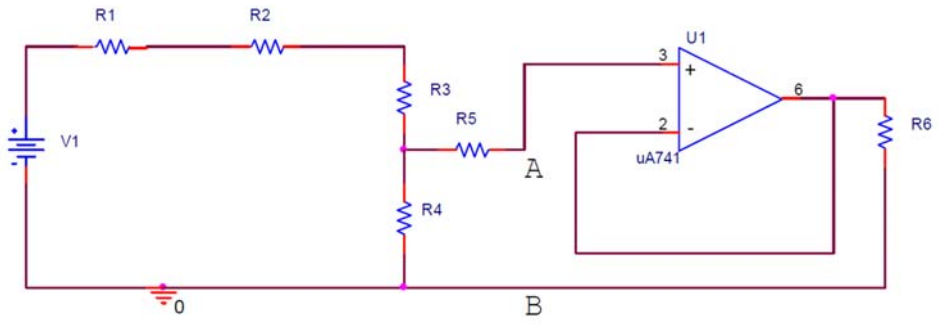
b) **Find the Thévenin Equivalent Resistance, R_{th}, of this circuit between points A and B. (2%)**

c) **Find the Norton Equivalent Current, I_{SC}, of this circuit between points A and B. (1%)**

d) **Redraw the Thévenin and Norton equivalent circuits. (2%)**

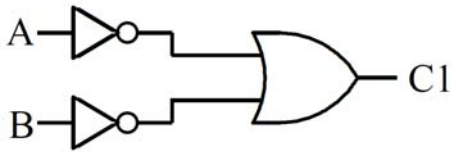
e) **A 2 kΩ load is connected between A and B. What is the voltage and current through this load? (2%)**

f) **Instead of connecting directly to the load, A and B are connected to a 741 operational amplifier in the circuit shown below, where R_6 is the 2 kΩ load. Estimate the voltage and current through the load, R_6, now? (1%)**

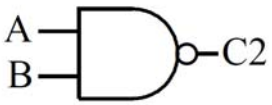


22. Digital logic

a) Show that circuits A and B are equivalent by setting up a truth table for the two circuits. What is the Boolean expression for the circuits? (2%)



Circuit A



Circuit B

b) For the following truth table, write down and simplify the Boolean expression. (2%)

A	B	C	X
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	0

c) Using logic gates, implement the simplified Boolean expression of part b. (3%)

d) Re-draw the waveforms for the circuits below and include the waveform at the Q output. (3%)