

Show your work.

Name _____

You may use one sheet of notes and your calculator. Fill in the blanks, circle the correct answers, etc.

1. (202) Quickies

- a) Phasor $V = 43/-22^\circ$ V. The frequency is 65 Hz. $v(t) =$ _____
- b) A circuit consists of a 55Ω resistor, a 300 mH inductor, and a $.2 \mu\text{F}$ capacitor, all in parallel. The resonant frequency is _____ Hz. At resonance, the impedance is _____ Ω .
- c) Cache RAM on a microprocessor chip is usually (static, dynamic, flash, non-volatile, magnetic).
- d) (ROM, OTP, Flash, dynamic RAM, eidetic) memory is found in USB drives (aka thumb drives).
- e) One of the possible outputs of a 3-state device is *not* (logic zero, logic one, hi impedance, ground, floating).
- f) A D flip-flop has a logic one on the D input. When a pulse arrives on the clock input, the Q output will become (logic zero, logic one, high impedance, unchanged, undefined, unusual).
- g) A certain A/D converter is sampled 3000 times per second. The highest frequency that should be present in the analog input is _____ Hz.
- h) What company made the 4004, 8080, and Pentium microprocessors? _____
- i) What kind of processor is in most mobile phones? (BISC, CISC, DISC, FISC, PISC, RISC, TISC)
- j) A circuit consists of a 1.5 V battery, a silicon diode, and a 100Ω resistor in series. Depending on the orientation of the diode (which way it's pointing) the current in the circuit could be either _____ mA or _____ mA.
- k) The 2N2222 NPN BJT has a β (h_{FE}) of 75, a V_{CBO} of 60 V, and a V_{CEO} of 40 V. It is put into a circuit with a V_{CC} of 9 V, and a base current of $40 \mu\text{A}$ results. The collector current will be _____ mA.
- l) In an emitter-follower circuit, the emitter voltage is almost the same as the _____ voltage.
- m) A good amplifier for use in music systems will have very low harmonic _____.
- n) Coax cable has a characteristic impedance of _____ Ω .
- o) If a battery has a capacity of 150 mAh, it should provide a current of 5 mA for _____ hours.
- p) If a linear voltage regulator gets too hot, you should add a(n) _____.

q) For most instrumentation amplifiers, it is desirable to have a (low, moderate, high) input impedance and a (low, moderate, high) output impedance.

r) _____ amplifiers are better at eliminating common-mode noise than single-ended amplifiers.

s) Noise can be introduced in the cabling between a sensor and an amplifier. Name three kinds of cabling that can help reduce this noise: _____, _____, and _____.

t) A certain motor is rated at 20 hp. Its torque is 80 Nm. The shaft speed is _____ rpm.

u) In a DC motor, the field winding is usually on the (armature, rotor, stator, top, bottom).

v) A frequent problem with DC motors and universal motors is that the _____ and _____ wear out.

w) A 12 V automobile battery delivers 3 A to a tail light. How much charge flows through the battery in 5 minutes? _____

x) An induction motor runs at 885 rpm under load. What speed will it approach with no load? _____ rpm

y) A 15 HP motor is 95.7% efficient. Its input electrical power is _____ W.

z) A device having an internal resistance of $30\ \Omega$ uses 3000 J in 1 minute. This device consumes _____ W.

aa) A "100 Ω " resistor has a tolerance of 5%. Its actual resistance could be anywhere from _____ Ω to _____ Ω .

bb) A "black box" has two terminals sticking out of it. The box is known to contain only voltage sources, current sources, and resistors. A voltmeter connected to the box reads 50 V. An ammeter connected to the box reads 2 A. The Thevenin equivalent voltage of the black box is _____ V. The Thevenin equivalent resistance of the black box is _____ Ω .

cc) A circuit consists of a battery, a current source, and several resistors, one of which has a resistance of $20\ \Omega$. When the battery is replaced with a short circuit, the current in the $20\ \Omega$ resistor is 3 A. When the current source is replaced with an open circuit, the current in the $20\ \Omega$ resistor is 2 A. With both the battery and the current source in the circuit, the current in the $20\ \Omega$ resistor will be _____ A.

- dd) The solution of the above problem requires application of the principle of _____.
- ee) The current in a 40 mH inductor is $50 + 3\sin 4t$ A. The voltage across the inductor is _____ V.
- ff) Of capacitors, inductors, and resistors, which is the LEAST ideal? _____
- gg) For a capacitor, energy is stored in the _____ field.
- hh) The material between the plates of a capacitor is called the _____.
- ii) Which one of these is NOT an application for capacitors: (fire flash lamp, link circuits, reduce hum, solenoid component)
- jj) A(n) _____ may have a core of air, iron, or ferrite.
- kk) A device has an impedance of $j30 \Omega$. Its reactance is _____ Ω .
- ll) From this list, circle the charges that a residential user of electricity is likely to pay: (base charge, demand charge, energy charge, power factor penalty, season-of-year charge)
- mm) Three-phase power distribution is (less efficient than, more efficient than, the same efficiency as) single-phase power distribution.
- nn) We say that three-phase is _____ when the voltages on all the phases have the same magnitude and the currents for all phases have the same magnitude.
- oo) A Y-connected generator has a phase voltage of 100 V. The line voltage is _____ V.
- pp) Two amplifiers are in series. The first has a gain of 12. The second has a gain of 0.5. A voltage of .03 V rms is applied to the input of the first amplifier. The second amplifier will have an output of _____ V rms.
- qq) Convert 0110 1110 to decimal. _____
- rr) If a memory chip loses its values when the power is shut off, we say that the memory is _____.
- ss) Which type of memory requires refresh? _____
- tt) _____ Law states that computer power doubles approximately every 18 months.
- uu) (Compact fluorescent, incandescent, LED) light bulbs are about 2% efficient at converting electrical energy into visible light.
- vv) What device, used as a light sensor, leaks current in the presence of light? _____
- ww) The iron in transformers and motors is laminated to reduce _____ currents.

xx) _____ EMF in motors is proportional to motor speed and field strength.

yy) (BX, COAX, conduit, Romex) is the most common electrical wiring in residences.

zz) For electrical safety, it is important to use properly grounded electrical tools, especially when working outdoors. (True, False)

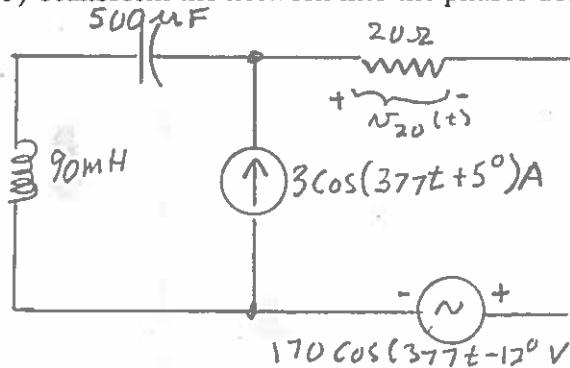
aaa) Embedded applications, intended for a specific purpose, usually use _____ rather than microprocessors.

bbb) An op-amp produces an output voltage with a maximum of 8.3 V. The power supply voltages for this op-amp should be _____ V and _____ V.

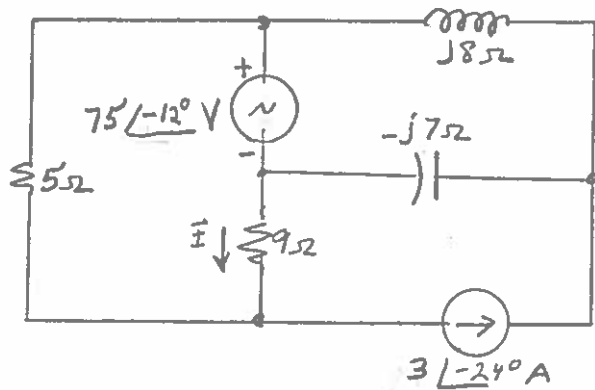
ccc) A NiMH battery has a nominal voltage of _____ V.

ddd) Random errors: When making a measurement in the presence of noise, it is frequently a good idea to repeat the measurement several times. The accuracy of the result will be proportional to the _____ root of the number of measurements.

2. (15) Transform the network into the phasor domain. Sketch and label the transformed network.

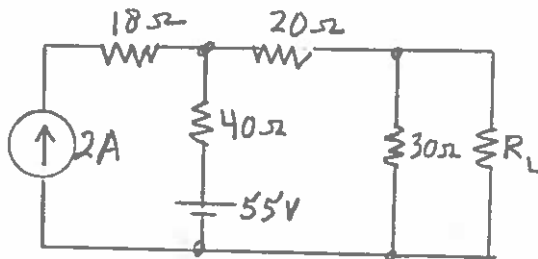


3. (15) Completely label the diagram. Write enough equations to solve for the phasor I . Do not solve.



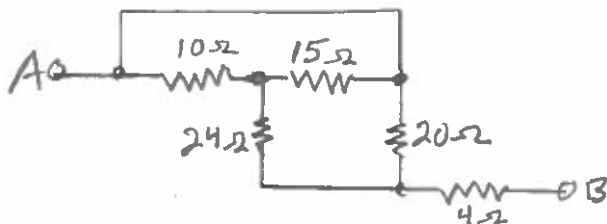
4. (15) The KVL equations for a network are:
 $j200(I_2 - I_1) - 180\angle 0^\circ = 0$
 $150(I_1 - .8\angle 60^\circ) - j100 + j200(I_1 - I_2) = 0$
 Solve for I_2 . Give your answer in polar form.

5. (10) What resistor R_L will consume the most power? The answer is an integer.

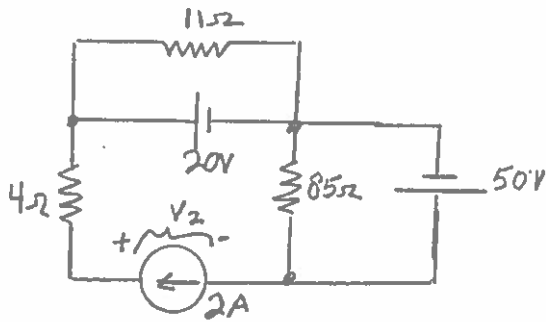


6. (10) A three-phase motor is connected to a three-phase source with a line voltage of 440 V. If the motor consumes a total of 55 kW at .73 power factor lagging, what is the line current?

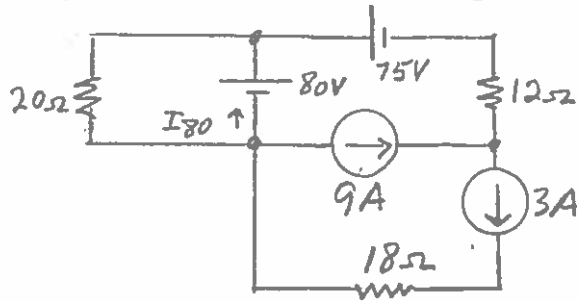
7. (10) Find the resistance between A and B. The answer is an integer.



8. (10) Find V_2 . The answer is an integer.

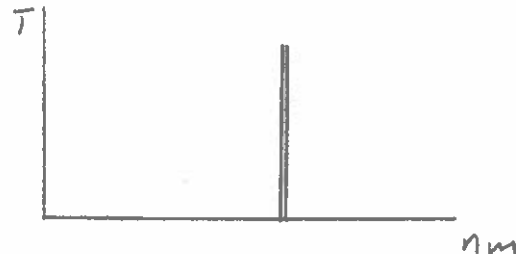
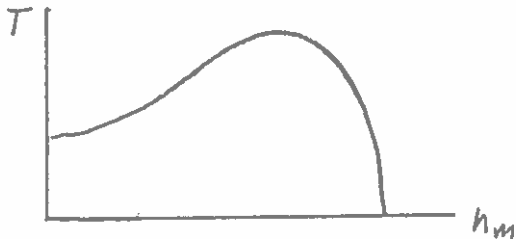
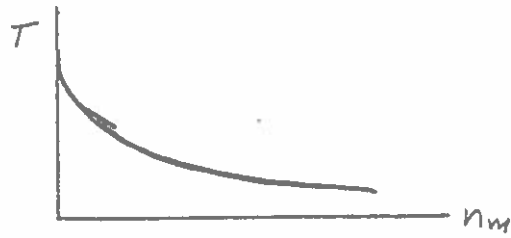
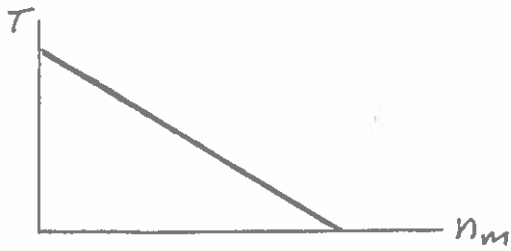


9. (10) Find I_{80} . The answer is an integer.



10. (25) A 20 KVA motor at .85 PF lagging, a lighting load of 10 kW, and an air conditioner consuming 8 kW at .8 PF leading are connected across a 220 V single-phase line. What is the total line current feeding the three devices?

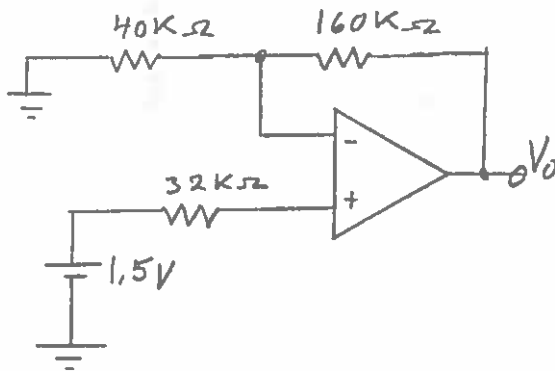
11. (12) In the space beneath each torque-speed curve below, write the type of motor.



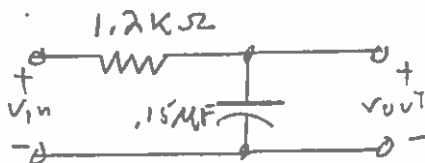
12. (14) $v(t) = 5\cos(250t + 27^\circ)$ V.

$V_{\max} =$ _____ V
 $\omega =$ _____ rad/s
 $f =$ _____ Hz
 $v(.001s) =$ _____ V
 $V_{\text{rms}} =$ _____ V

13. (20) Label the diagram. Carefully show your analysis using the assumptions for an ideal op-amp. Find V_o .



14. (15) The filter shown below is _____-pass. Find the gain of this filter in dB at a frequency of 2,000 Hz.



15. (15) An 8-bit A/D converter has $V_{ref+} = 3.5 \text{ V}$ and $V_{ref-} = -1.3 \text{ V}$. If the analog input is 1 V, the binary output is _____. If the analog input is 4 V, the binary output is _____.

16. (10) The LED shown has a forward voltage drop of 3.5 V and a maximum continuous current of 25 mA. $R =$ _____ to get the most light out of the LED without burning it up.



17. (10) Indicate, in the spaces provided, a recommended secondary battery type (SLA, NiCd, NiMH, or Li-ion) for each of the applications below.

Inexpensive toy car: _____

Laptop computer: _____

Automobile battery: _____

Cellular telephone: _____

Flashlight: _____

18. (15) Transformer nameplate data is as follows: "Pri. 120 V, 60 Hz, Sec. 24 V, 8 VA." This transformer is plugged into the wall and the output terminals are connected to a resistor. a) Sketch and label the circuit. b) If the current in the secondary is 30 mA, what is the current in the primary? c) For safe operation of the transformer, what should the maximum current in the primary be?

19. (16) For each of the applications below, select the most appropriate motor type from the following list: Brushless DC, three-phase induction, single-phase induction, permanent magnet, series (universal), shunt, stepper, three-phase synchronous, single-phase synchronous.

Power factor correction: _____

Small battery-operated toy: _____

20,000 hp, industrial motor with a large constant load: _____

Industrial motor, with simple, rugged construction: _____

Kitchen electric mixer: _____

Print head motor for ink jet printer: _____

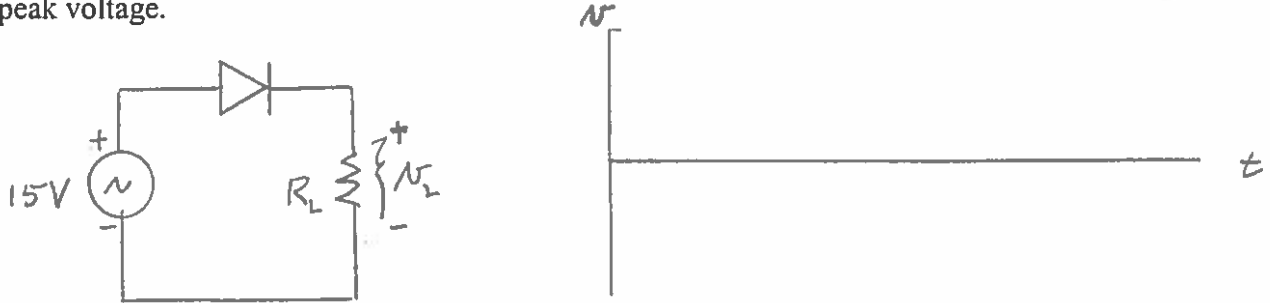
Industrial 600 rpm motor with precise speed: _____

Automotive fan: _____

20. (15) In residential wiring, name the colors of these wires:

<u>Wire name</u>	<u>Wire Color</u>
Hot	_____
Return or Neutral	_____
Ground	_____

21. (15) Assume the diode is ideal. In the space provided, sketch v_L giving a numeric value for the peak voltage.



BONUS (+3) Simultaneous multithreading (SMT) is a technique for inserting instructions from other _____ into the wait states (bubbles) of a pipeline.