Math/Science Seminar Quarter Review

ANSWER THESE QUESTIONS ON A SEPARATE PIECE OF PAPER TO PREPARE FOR YOUR FINAL QUARTER EXAM.

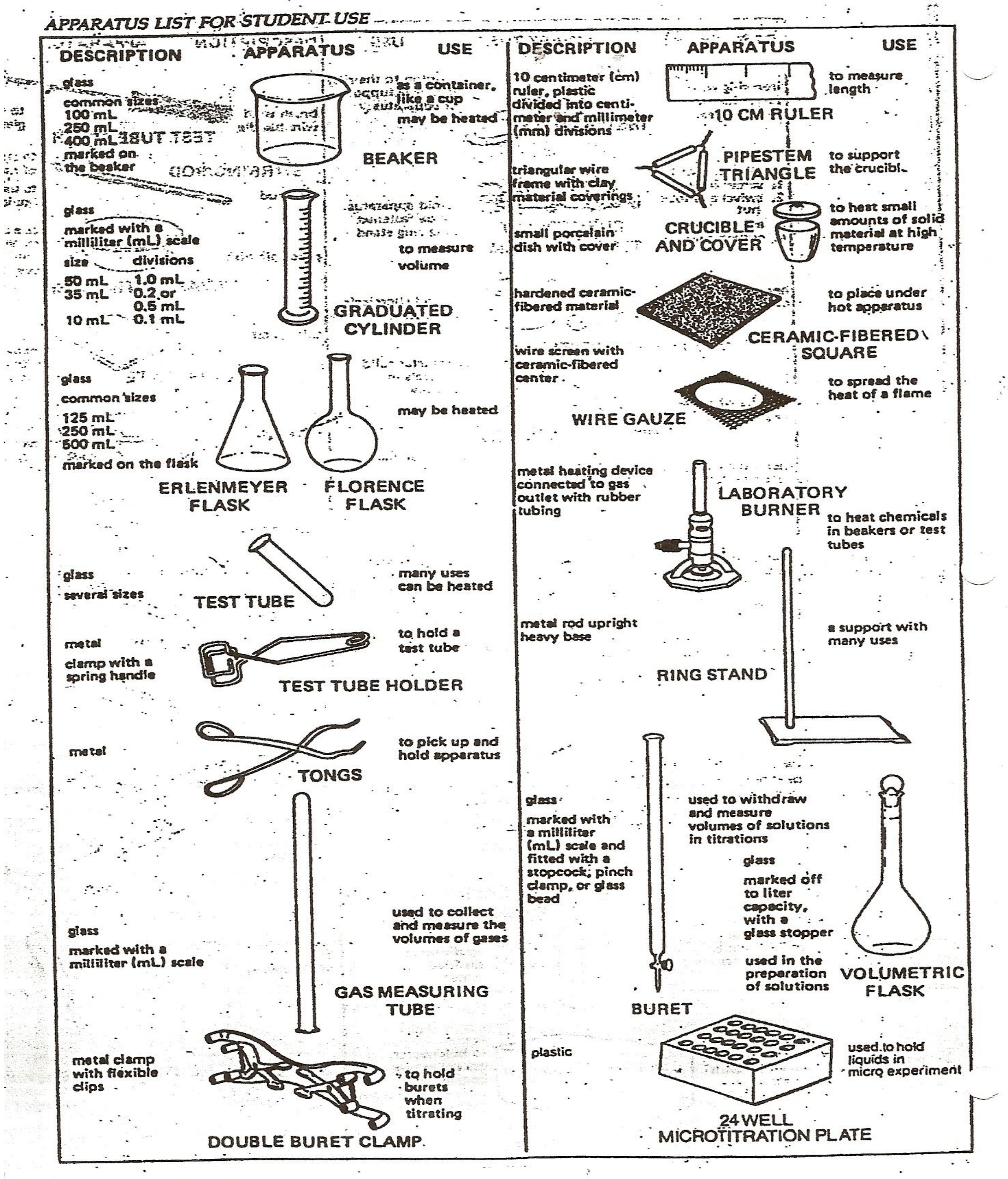
1. What is STEM? Science technology engineering and mathematics
2. What are some STEM careers? Ex. Biomedical engineer; civil engineer; microbiologist; doctor
3. Why is mathematics important for science? Mathematics is applied in science
4. Explain the steps of the engineering design process (EDP): identify the problem, research the problem, develop possible solutions, select the best solution, construct a prototype, test and evaluate, communicate and REDESIGN
5. Compare/contrast the EDP to the scientific method:

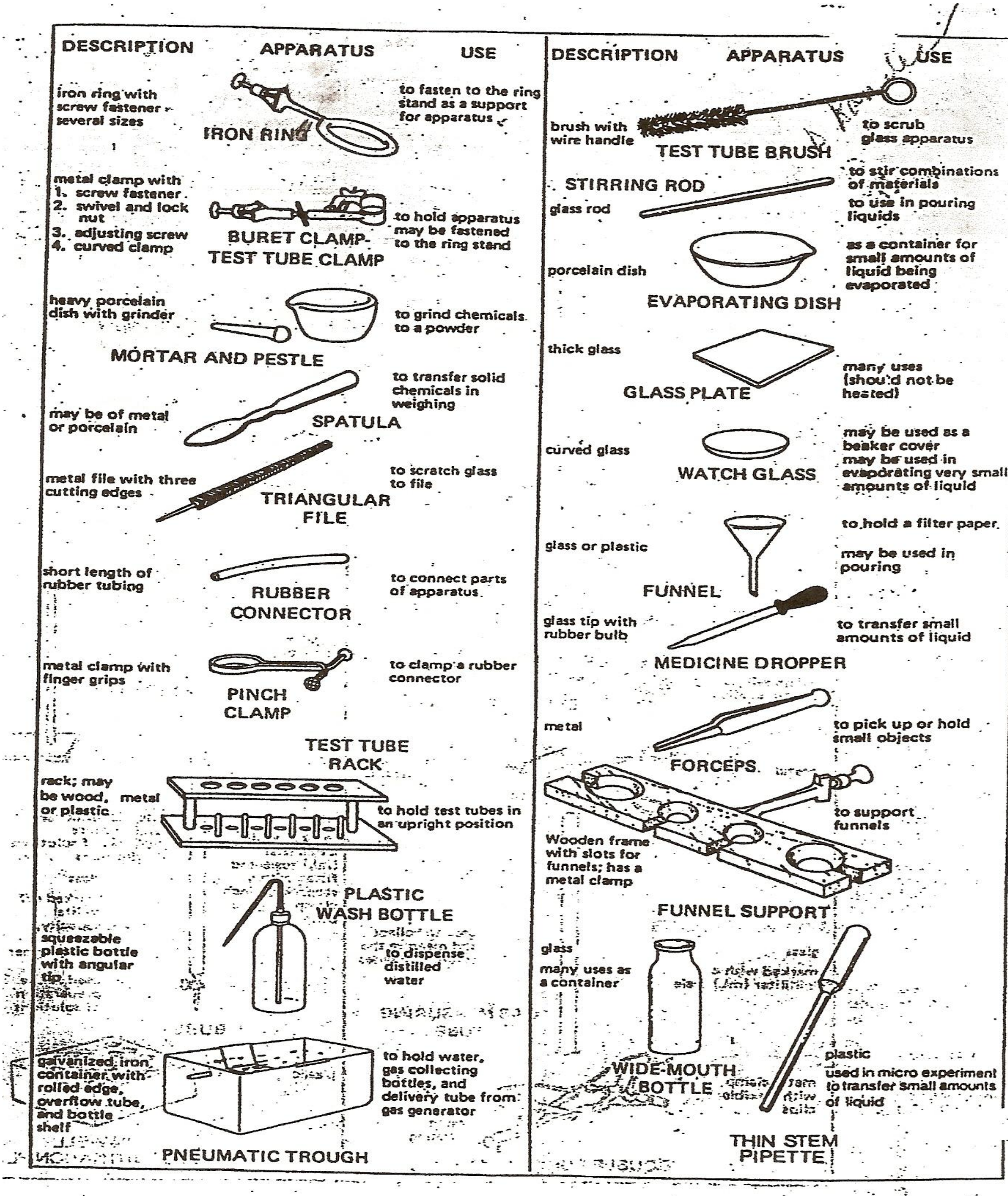
The Scientific Method	The Engineering Design Process
State your question	Define the problem
Do background research	Do background research
Formulate your hypothesis, identify variables	Specify requirements
Design experiment, establish procedure	Create alternative solutions, choose the best one and develop it
Test your hypothesis by doing an experiment	Build a prototype
Analyze your results and draw conclusions	Test and redesign as necessary
Communicate results	Communicate results
Steps of The Scientific Method	Steps of The Engineering Design Process

6. How does the design process begin? Defining the problem or need
7. What do you think is the difference between an engineer and a technician? a technician is a person employed to look after technical equipment or do practical work in a laboratory whereas an engineer is designing the process or equipment
8. What are some constraints engineers usually have to consider? Time, money, materials
9. What are examples of some criteria engineers have to consider? Market, needs and desires ie. Ecofriendly, built out of recyclable material, cost
10. How do you calculate material cost? See your worksheets from class
11. How do you calculate labor cost? See your worksheets from class
12. How do you calculate overhead cost? See your worksheets from class
13. What are some other factors that go into determining the cost of a product? See your worksheets from class
14. What factors can engineers consider when trying to limit cost? Reduce waste of material or material used, design so that a lot can easily fit in the packaging box to reduce shipping cost
15. What is the "least count" on a measuring device? Give an example: smallest marking on the device in the unit you are measuring in (ex. Tenth of a cm or 1mm)
16. Can you convert the following using the method we learned in class?
    a. Feet to inches
    b. Meters to km
    c. Km to m
    d. Seconds to years
    e. Miles to meters
    f. M to cm
17. What are the rules for significant figures?
    You don't have to memorize these. The rules will be given to you on the test, but you do need to be able to use them.
18. How many significant figures do the following have?

a. 1232 4
b. 1009380 6
c. .00890 3
d. 0.09 1
e. 101 3
f. 10.001 5
g. 90.0900 6
h. 0.000000001 1
i. 0.900005

19. Neon gas makes up 0.0018% by volume of the air around us. How many significant figures are being given in this percentage? 2
20. Can you identify all the pieces of lab equipment by what they look like? See pictures below:





DESCRIPTION	APPARATUS	USE
iron ring with screw fastener several sizes	IRON RING	to fasten to the ring stand as a support for apparatus
metal clamp with 1. screw fastener 2. swivel and lock nut 3. adjusting screw 4. curved clamp	BURET CLAMP-TEST TUBE CLAMP	to hold apparatus may be fastened to the ring stand
heavy porcelain dish with grinder	MORTAR AND PESTLE	to grind chemicals to a powder
may be of metal or porcelain	SPATULA	to transfer solid chemicals in weighing
metal file with three cutting edges	TRIANGULAR FILE	to scratch glass to file
short length of rubber tubing	RUBBER CONNECTOR	to connect parts of apparatus
metal clamp with finger grips	PINCH CLAMP	to clamp a rubber connector
rack; may be wood, metal or plastic	TEST TUBE RACK	to hold test tubes in an upright position
squeezable plastic bottle with angular tip	PLASTIC WASH BOTTLE	to dispense distilled water
galvanized iron container with rolled edge, overflow tube, and bottle shelf	PNEUMATIC TROUGH	to hold water, gas collecting bottles, and delivery tube from gas generator

DESCRIPTION	APPARATUS	USE
brush with wire handle	TEST TUBE BRUSH	to scrub glass apparatus
glass rod	STIRRING ROD	to stir combinations of materials to use in pouring liquids
porcelain dish	EVAPORATING DISH	as a container for small amounts of liquid being evaporated
thick glass	GLASS PLATE	many uses (should not be heated)
curved glass	WATCH GLASS	may be used as a beaker cover may be used in evaporating very small amounts of liquid
glass or plastic	FUNNEL	to hold a filter paper. may be used in pouring
glass tip with rubber bulb	MEDICINE DROPPER	to transfer small amounts of liquid
metal	FORCEPS	to pick up or hold small objects
Wooden frame with slots for funnels; has a metal clamp	FUNNEL SUPPORT	to support funnels
glass	WIDE-MOUTH BOTTLE	many uses as a container
plastic	THIN STEM PIPETTE	used in micro experiment to transfer small amounts of liquid

21. Can you identify the function of all the equipment used in the lab? see above
22. Are you able to look at a measuring device and determine how to take a precise measurement?
23. When taking measurements, how do you know what digit to round to? You round one digit beyond the least count on a measuring device. Example: if a ruler has a tenth of a cm, you will round to 0.001 cm when recording your answers
24. What is scientific notation? Shorthand way of writing really large or small numbers

25. Can you write the following in scientific notation?
    a. 1000000000 1 x 10 ^9
    b. 90900000 9.09 x 10 ^7
    c. 0.000023 2.3 x 10 ^-5
    d. 0.0000023200 2.32 x 10 ^-6
26. If the speed of light through glass is quoted as 2×10^8 meters per second , what is the speed of light in its conventional form? (not scientific method) 200000000 meters per second
27. What is a ratio? quantitative relation between two amounts showing the number of times one value contains or is contained within the other.
28. Write and resolve one of the word problems from your ratio worksheet: do not need to do
29. How do you calculate percent error? expresses as a percentage the difference between an approximate or measured value and an exact or known value;
    |accepted value - experimental value| \ accepted value x 100%
30. You are an employee of Welch's Juice are testing to see how much sugar is in grape juice. After performing the experiment you determine that there is 7 grams of sugar in one serving of juice, but there is supposed to be only 2 grams of sugar (theoretical yield) in a serving. What is the percent error in the experiment?

    2-7/2 x 100 = 250%
31. How do you determine precision? Using a percent difference equation
32. How do you determine accuracy? Percent error formula
33. Jack, John and Jake all attempt to measure how tall Joe is. Jack measures Joe to be 6.2 ft tall, John thinks Joe is 6.0 ft tall and Jake also thinks Joe is 6.4ft tall. Were the girls relatively precise in their measurements?

$$\text{percent difference} = \left(\frac{\text{Largest Value - Smallest Value}}{\text{Average Value}}\right)$$

6.4-6.0/6.2 x 100 = 6.45%

34. If Joe is really 6.4ft tall, was the group as a whole accurate?

$$\text{Percent Error} = 100 \times \frac{(\text{Experimental value - Standard value})}{\text{Standard value}}$$

6.2-6.4/6.4 x 100 = 3.12%

35. Can you be precise but not accurate?Yes, if all your measurements are similar but are not close to the theoretical or actual value.
36. What measuring device would you use to measure precise amounts of liquid? A graduated cylinder or pipette
37. Is a beaker a good device to use when taking liquid measurements?
    No, a beaker is not precise
38. What digit would you round to when taking a measurement using a beaker?
    Beakers usually go up by 50's so you could round to the one's place
39. Fill in the spaces to the left of the Design Processes List. Number them in order from one to eight. See number 5 above
    _____ Make a Prototype
    _____ Define the Problem
    _____ Communicate
    _____ Choose the Best Solution
    _____ Develop Possible Solutions
    _____ Test and Evaluate
    _____ Research the Problem
    _____ Redesign
40. Think about how an engineer goes about solving a problem. Explain below: See number 5 above