

Conceptual Physics Review (Chapter 17, Periodic Table, Moles, and Significant Figures)

Chapter 17

- Describe atoms and elements.
- Compare the ages of atoms to the ages of the materials they compose.
- State evidence for the existence of atoms.
- Describe molecules.
- Describe compounds.
- Identify and describe the building blocks that make up an atom.
- Know the relative masses and charges of the subatomic particles, as well as their locations in the atom.
- Explain the organization of the periodic table, referring to the significance of both the period and the group an element is in, as that position relates to the arrangement of electrons in the atom.
- Know the names and symbols for the most common elements (p. 245 of the textbook).
- Know what the atomic number of an element tells you about that element.
- Know what the average atomic mass of an element tells you about that element, and explain why it is an average.
- Describe, briefly, how the electrons are arranged around the nucleus of an atom.
- Describe what happens if the number of protons in an atom is changed.
- Describe what happens if the number of neutrons in an atom is changed.
- Describe what happens if the number of electrons in an atom is changed.
- What is an isotope? What is meant by carbon-12 and what is meant by carbon-14? How do these two isotopes of carbon differ from each other?
- What is an ion? How do atoms form ions? Which group of elements rarely forms ions? What can you say about the electron arrangement in the atoms of that particular group?
- Predict based on the group an element is in what type of ions (charge) its atoms tend to form.

Moles

- What is a mole? Can you count other things besides atoms using moles?
- What is Avogadro's number? What is the significance of this number? Why is it useful?
- What is the molar mass of a substance? How do you use the periodic table to calculate the molar mass directly?
- Be able to convert between mass of a substance and moles of the substance, using the molar mass of the substance.
- Be able to convert between moles of a substance of number of elementary units (molecules, atoms, ions) in that amount of the substance.
- Be able to convert between mass of a substance and number of atoms or molecules of the substance, by first converting to moles.

Unit Conversions

Know the definitions of the metric prefixes and be able to show your work converting between different metric units. Study and review all worksheets on this topic!!!

Measurement and significant figures

- Distinguish between precision and accuracy for data.
- Define precision for an instrument.
- Describe what is meant by uncertainty in measurement and explain how many digits a measurement should include (how many certain digits and how many uncertain digits).
- Be able to count how many significant figures a particular measurement has.
- Know the rules for how many sig figs the answer to a multiplication or division problem should have.
- Know the rules for how many sig figs the answer to an addition or subtraction problem should have.

Sample Calculations

1. Fill in the table:

Symbol (Atom or Ion)	# of protons	# of neutrons (approximate)	# of electrons
Ca ²⁺			
Br ⁻			
Xe			
Rb ⁺			
P ³⁻			
S ²⁻			

2. What happens when two protons are added to a neutral carbon atom?

3. What happens when a neutral sodium atom loses one electron?

4. Why does a sodium atom tend to lose one electron?

5. How many electron shells (energy levels) does a neutral calcium atom have? How many electrons are in its outermost shell? How can you answer these two questions using the location of Ca on the periodic table?

6. How many electron shells does a calcium ion (+2 charge) have? How many electrons are in its outermost shell? What element (in its neutral state) has the same electron arrangement as the calcium ion?

7. About how many molecules of air are in a liter (one breath) of air?

8. About how many liters of air are in the Earth's atmosphere?

9. What do the elements in group 2 (alkaline earth metals) have in common? How do they each differ from each other? Answer both questions in terms of the arrangement of their electrons around the nucleus.

10. What is the molar mass of nitrogen dioxide (NO₂)?

11. What is the molar mass of carbon tetrachloride (CCl_4)?

12. What is the molar mass of Argon (Ar)?

For the following problems, show your calculations using conversion factors with units:

13. How many moles are in 17.2 grams of water?

14. How many moles are in 23.5 grams of water?

15. How many moles are in 43.8 grams of carbon dioxide (CO_2)?

16. How many molecules of water are there in 2.2 moles of water?

17. How many molecules of carbon dioxide are there in 3.5 moles of carbon dioxide?

18. How many molecules of oxygen gas (O_2) are there in 4.2 moles of oxygen gas?

19. How many atoms are there in 2.2 moles of water?

20. How many atoms are there in 3.5 moles of carbon dioxide?

21. How many atoms are there in 4.2 moles of oxygen gas?

22. How many molecules are there in 34.9 grams of carbon dioxide?

23. How many atoms are there in 5.2 grams of water?

24. How many atoms are there in 33.3 grams of oxygen gas?

25. What is the mass of 3.5 moles of nitrogen dioxide?

26. What is the mass of 4.4 moles of carbon dioxide?

27. What is the mass of 5.7 moles of water?

28. What is the mass of 8.94×10^{24} molecules of water?

29. What is the mass of 3.01×10^{23} molecules of carbon dioxide?

30. What is the mass of 100 molecules of water? Give your answer in amus *and* grams.

31. For each of the following pairs, circle the quantity that is greater.

a) 1 nm 1 mm

b) 1 Gm 1 pm

c) 1 kHz 1 MHz

d) 1 m 1 Mm

e) 1 g 1 cg

f) 1 μm 1 km

32. For each of the following conversions, **SHOW** your steps, including conversion factors **WITH UNITS**.

a) 470 nm = _____ pm

b) 4.9 Gm = _____ km

c) 2.4 g = _____ mg

d) 5.5×10^{14} Hz = _____ MHz

e) 720 μm = _____ m

f) 3.0×10^8 m/sec = _____ km/hr

33. Fill in the blanks.

a) 1 m = _____ mm

b) 1 mm = _____ m

c) 4 g = _____ kg

d) 4 kg = _____ g

e) 1 Mm = _____ m

f) 1 m = _____ Gm

34. How many significant figures does each of the following measurements have? If it's ambiguous, explain why, and give examples of how the measurement could be rewritten to eliminate the ambiguity.

a) 0.0002020 g

b) 4.000 m

c) 40.0 cm

d) 5000 miles

e) 3.42 inches

f) 2.5 seconds

35. For each problem, calculate the solution and leave your answer with the correct number of significant figures and proper units.

a) $3.4 \text{ cm} \times 5239 \text{ cm} =$

b) $5280 \text{ ft} / 3.0 =$

c) $4001.6 \text{ miles} / 2.5 \text{ hours} =$

36. For each problem, calculate the solution and leave your answer with the correct number of significant figures and proper units. Some problems might require unit conversions before you can perform the calculation!!

a) $4.25 \text{ m} + 2.1 \text{ m} =$

b) $52.4 \text{ ft} - 0.5 \text{ ft} =$

c) $1248.72 \text{ m} + 36 \text{ mm} =$