1.1 MEASUREMENT IN PHYSICS *HW/Study Packet*

SL/HL	
Required: READ Hamper, pp 2-6, pp 14-15 Tsokos, pp 1-5, pp 11-12 Mars Climate Orbiter Reading Cleaning the Kilogram The Higgs Boson	Supplemental: READ Cutnell and Johnson, pp 1-6 DO Tsokos questions: pp 6-7: # 5, 8, 9, 18, 19, 20, 21, 25, 31 pp 19-20: # 5, 8, 10

REMEMBER TO….

- ✓ *Work through all of the 'example problems' in the texts as you are reading them*
- ✓ *Refer to the **IB Physics Guide** for details on what you need to know about this topic*
- ✓ *Refer to the **Study Guides** for suggested exercises to do each night*
- ✓ *First try to do these problems using only what is provided to you from the **IB Data Booklet***
- ✓ *Refer to the solutions/key ONLY after you have attempted the problems to the best of your ability*

UNIT OUTLINE

I. MAGNITUDES AND QUANTITIES IN THE UNIVERSE

A. ORDERS OF MAGNITUDE, POWERS OF 10, AND PREFIXES
B. RANGES OF MAGNITUDES
C. RATIOS AND ESTIMATING
D. SIGNIFICANT FIGURES

II. UNITS OF MEASURE AND THE SI SYSTEM

A. FUNDAMENTAL AND DERIVED UNITS
B. DIMENSIONAL ANALYSIS

FROM THE IB DATA BOOKLET

Prefix	Abbreviation	Value
peta	P	10^{15}
tera	T	10^{12}
giga	G	10^{9}
mega	M	10^{6}
kilo	k	10^{3}
hecto	h	10^{2}
deca	da	10^{1}
deci	d	10^{-1}
centi	c	10^{-2}
milli	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}
femto	f	10^{-15}

$$1 \text{ radian (rad)} = \frac{180°}{\pi}$$

WHAT YOU SHOULD BE ABLE TO DO AT THE END OF THIS TOPIC

- □ Estimate the various orders of magnitude and perform mental order-of-magnitude calculations
- □ Understand the need for and be able to apply simplifying assumptions in various situations
- □ Recognize the difference between fundamental and derived units
- □ Recognize the difference between units and quantities
- □ Be able to express answers with the proper number of significant figures
- □ Be able to use dimensional analysis to verify an equation
- □ State values in scientific notation and in SI format
- □ Convert between units of different quantities

HOMEWORK PROBLEMS:

1. Express the following numbers in scientific notation, to two significant figures:
a) 0.00342 b) 0.005291 c) 0.145 d) 153.2 e) 674

2. Without (and with) a calculator, find the value of:
a) $10^3 \times 10^6$ b) $1 \times 10^2 \times 1 \times 10^4$ c) $3 \times 10^6 \times 2 \times 10^3$ d) $10^{-3} \times 10^{-6}$

e) $\frac{10^6}{10^3}$ f) $\frac{1}{1 \times 10^3}$ g) $\frac{15 \times 10^6}{5 \times 10^{-3}}$

3. Express the following quantities in the appropriate base unit in scientific notation.
a) 6.34 cm b) 12 mm c) 832 km

d) 546 nm e) 53.4 g f) 500 tonnes

g) 123 mg h) 2.3 μg i) 30 minutes

j) 23 ms k) 24 hours

4. Express the following volumes in m^3 and scientific notation in two sig figs.
a) 7.8 cm^3 b) 34 mm^3 c) 9.8 km^3 d) 47 litres

5. Express the following areas in m^2
a) 1.6 cm^2 b) 5.3 mm^2 c) 0.0017 cm^2

6. Write down the following quantities as numbers in scientific notation together with the appropriate unit without any prefix:
a) 470 pm b) 1.5 kV c) 50 MW d) 40 ns

7. A car travels at 75 kmh^{-1}. How many ms^{-1} is this? **[21 ms^{-1}]**

8. Using *1 mile = 1.609 km*, find the number of miles in 1 km. **[0.6215 mi]**

9. Use the above to convert 30.0 miles/hour to km/hour. **[48.3 km hr^{-1}]**

10. The mileage rating of my car is 8.0 kmL^{-1}.(L = liters) How many miles per gallon is this? **[19 mi gal^{-1}]**

11. How many baseballs can be carried in 5 carts? *Given: 1 cart = 12 sacks* **[500 baseballs]**
3 sacks = 1 basket
1 basket = 25 baseballs

12. A spacecraft travels at a speed of 8/10 of a mile per second. How many days does it take it to travel from the Earth to the Moon, a distance of 240,000 miles? **[3.5 days]**

13. What is the weight of 6.5 gallons of water? How many cubic feet of water is this?
Given: 1 gallon of water weighs 8.34 pounds, 1 cubic foot of water weighs 62.4 pounds
[54.2 lbs, 0.869 ft^3]

14. Perform the operation as indicated and state the answer with the correct number of significant figures. Don't forget the proper units!

a) 16.2 m + 5.008 m + 13.48 m

b) 78.05 cm^2 - 32.046 cm^2

c) 15.07 kg - 12.0 kg

d) 5.006 m + 12.0077 m + 8.0084 m

e) 27.807 mm × 4.2 mm

f) 20.008 m - 7.0 s

g) 245 cm × 5.8 cm

h) (5.6×10^3 m) - (2.8×10^{12} m)

i) 3.28 cm - 12.47826 cm

15. Rearrange the following formulae to make the letter in brackets the subject (solve for the letter in brackets).

$v = u + at \quad (u)$ $\qquad F = ma\ (a)$ $\qquad P = \frac{F}{A}\ (A)$ $\qquad v^2 = u^2 + 2as\ (a)$

$E = mc^2 \quad (c)$ $\qquad P = \frac{V^2}{R} \quad (V)$ $\qquad F = mv^2r \quad (v)$ $\qquad E = \frac{4Mgl}{\pi ed^2} \quad (d)$

$C = \frac{2F}{\rho v^2 A} \quad (v)$ $\qquad F = k\rho v^2 r^2 \quad (r)$ $\qquad T = \sqrt{\frac{p}{d}}\ (d)$ $\qquad F = \frac{q_1 q_2}{4\pi\varepsilon_0 r^2} \quad (r)$

16. As a sphere of radius r moves with a constant velocity v through a liquid of density ρ, the force F on it is given by the equation:

$$F = k\rho r^2 v^2$$ *Show that k is a dimensionless constant.*

17. The drag coefficient of a car C_D moving with a speed v through air of density ρ is given by

$$C_D = \frac{F}{\frac{1}{2}\rho v^2 A}$$

where F is the force, and A is the maximum cross-sectional area of the car perpendicular to the direction of travel. *Show that C_D is dimensionless.*

18. Check to see if the following equations are dimensionally correct:

a) $F = mv^2 r$, where F = Force, m = mass, v = velocity and r = radius.

b) $E = mv^2$, where E = energy, m = mass and v = velocity.

c) $c = \sqrt{\frac{p}{d}}$, where c = velocity, p = pressure and d = density.