Name Answer Key

Atmospheric Sciences 211 March 30, 2009

Math Survey (This will not affect your grade.)
Do not use a calculator, computer, etc.

1. Arithmetic

(a) 25% of 40 = $25\% = \frac{25}{100} = \frac{1}{4}$ so $\frac{1}{4}(40) = \boxed{10}$

(b) $\frac{1}{0.1} =$ $0.1 = \frac{1}{10}$ so $\frac{1}{1/10} = \boxed{10}$

(c) $2^4 =$ $2 \cdot 2 \cdot 2 \cdot 2 = \boxed{16}$

(d) $64^{1/2} =$ $\sqrt{64} = \boxed{8}$

(e) $2^{-2} =$ $\frac{1}{2^2} = \boxed{\frac{1}{4}}$

(f) $\frac{25\times10^8}{5\times10^{-5}} =$ $\left(\frac{25}{5}\right)\left(\frac{10^8}{10^{-5}}\right) = \boxed{5 \times 10^{13}}$

2. Express in scientific notation:

(a) 0.00012 = 1.2×10^{-4}

(b) 300,000 = 3×10^5

3. Geometry and trigonometry

(a) The area of a circle of radius *r* is: πr^2

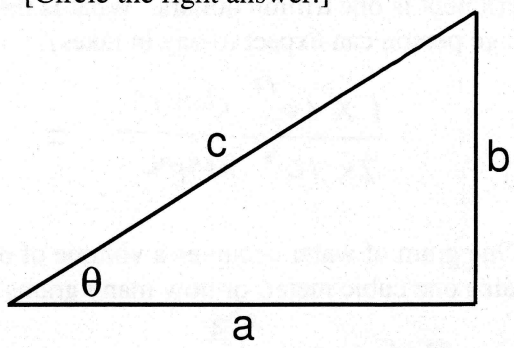
(b) The surface area of a sphere of radius *r* is: $4\pi r^2$

(c) cos θ = a/b, b/a, a/c, c/a, b/c, c/b [Circle the right answer.]

$\sin\theta = \frac{b}{c}$

$\cos\theta = \frac{a}{c}$

$\tan\theta = \frac{b}{a}$



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4. Algebra

(a) $PV = nRT$; solve for T.

$$\frac{PV}{nR} = \frac{\cancel{nR}T}{\cancel{nR}} \quad \text{so} \quad \boxed{T = \frac{PV}{nR}}$$

(b) $F = \varepsilon\sigma T^4$; solve for T.

$$\frac{F}{\varepsilon\sigma} = \frac{\cancel{\varepsilon\sigma}T^4}{\cancel{\varepsilon\sigma}} \Rightarrow (T^4)^{1/4} = \left(\frac{F}{\varepsilon\sigma}\right)^{1/4} \Rightarrow \boxed{T = \left(\frac{F}{\varepsilon\sigma}\right)^{1/4} \quad T = \sqrt[4]{\frac{F}{\varepsilon\sigma}}}$$

5. Functions. Put the appropriate letter (a,b,c, or d) in front of each equation. [Assume r is a positive constant.]

b	$y = rt$	(a) y increases exponentially with t.
c	$y = r/t$	(b) y is proportional to t.
a	$y = r^t$	(c) y is inversely proportional to t.
d	$y = t^r$	(d) y has power-law dependence on t.

6. Conversion of units.

(a) If your car can travel 20 miles on a gallon of fuel, and there are 4 quarts in a gallon, how many quarts are used on a 30-mile trip?

$$(30\ \text{mi})\left(\frac{1\ \text{gal}}{20\ \text{mi}}\right)\left(\frac{4\ \text{qts}}{1\ \text{gal}}\right) = \boxed{6\ \text{qts}}$$

(b) In a hypothetical country with 200 million people, the annual budget of the federal government is one trillion dollars. What is the per-capita federal budget (i.e., what an average person can expect to pay in taxes)?

$$\frac{1 \times 10^{12}\ \text{dollars}}{2 \times 10^{8}\ \text{people}} = 0.5 \times 10^{4} = \boxed{\$5{,}000}$$

Recall

10^3	thousand
10^6	million
10^9	billion
10^{12}	trillion

(c) One gram of water occupies a volume of one cubic centimeter. A canoe full of water contains one cubic meter, or how many grams?

$$\left(\frac{1\ \text{g}}{1\ \text{cm}^3}\right)\left(\frac{100\ \text{cm}}{1\ \text{m}}\right)^3 = (10^2)^3 = 10^6\ \text{g} = \boxed{1000\ \text{kg}}$$

density of water : $1\ \text{g/cm}^3$ or $1000\ \text{kg/m}^3$