# Section 1-3: Measurements in physics are based on standard units of time, length, and mass.

**1. Which of the following is a fundamental unit of the SI system of units?**

A. kilometer

B. joule

C. kilogram

D. gram

E. newton

**Ans: C Section: 1-3 Type: Factual**

**2. The SI unit for mass is**

A. μg

B. mg

C. g

D. kg

E. lb

**Ans: D Section: 1-3 Type: Factual**

**3. The prefix “giga” stands for**

A. 1012.

B. 106 .

C. 103.

D. 109.

E. 1015.

**Ans: D Section: 1-3 Type: Factual**

**4. Which of the following is NOT one of the fundamental physical quantities in the SI system?**

A. mass

B. length

C. force

D. time

E. All of these are fundamental physical quantities in the SI system.

**Ans: C Section: 1-3 Type: Factual**

**5. The prefix “mega” means**

A. 102.

B. 109.

C. 10–3.

D. 106.

E. 10–6.

**Ans: D Section: 1-3 Type: Factual**

**6. The prefix “pico” means**

A. 10–12.

B. 10–6.

C. 10–3.

D. 106.

E. 109.

**Ans: A Section: 1-3 Type: Factual**

**7. The prefix “micro” means**

A. 10–12.

B. 10–6.

C. 10–3.

D. 10–2.

E. 10–1.

**Ans: B Section: 1-3 Type: Factual**

**8. The prefix “milli” means**

A. 10–12.

B. 10–6.

C. 10–3.

D. 10–2.

E. 10–1.

**Ans: C Section: 1-3 Type: Factual**

**9. The prefix “centi” means**

A. 10–12.

B. 10–6.

C. 10–3.

D. 10–2.

E. 10–1.

**Ans: D Section: 1-3 Type: Factual**

**10. The prefix “kilo” means**

A. 10–12.

B. 10–6.

C. 10–3.

D. 103.

E. 101.

**Ans: D Section: 1-3 Type: Factual**

**11. The prefix “nano” means**

A. 10–12.

B. 10–6.

C. 10–3.

D. 10–2.

E. None of these is correct.

**Ans: E Section: 1-3 Type: Factual**

**12. Which of the following prefixes does NOT represent a fractional part of a whole unit?**

A. nano

B. micro

C. kilo

D. milli

E. deci

**Ans: C Section: 1-3 Type: Factual**

**13. Which of the following prefixes does NOT represent a quantity larger than a single unit?**

A. kilo

B. mega

C. giga

D. tera

E. femto

**Ans: E Section: 1-3 Type: Factual**

**14. Which of the following is NOT one of the fundamental units in the SI system?**

A. Newton

B. meter

C. kilogram

D. second

E. All of these choices are fundamental units in the SI system

**Ans: A Section: 1-3 Type: Factual**

**15. The fundamental physical quantities are**

A. mass, length, time, temperature, amount of a substance, current, and luminous intensity.

B. weight, length, time, temperature, amount of a substance, current, and luminous intensity.

C. mass, length, time, temperature, force, current, and luminous intensity.

D. mass, length, time, force, momentum, amount of a substance, and current.

E. weight, length, time, temperature, amount of a substance, potential energy, and luminous intensity.

**Ans: A Section: 1-3 Type: Factual**

**16. The density of seawater was measured to be 1.07 g/cm3. This density in SI units is**

A. 1.07  10–3 kg/m3

B. (1/1.07)  103 kg/m3

C. 1.07  103 kg

D. 1.07  10–3 kg

E. 1.07  103 kg/m3

**Ans: E Section: 1-3 Type: Numerical**

**17. To convert a quantity from km/h to m/s, you must**

A. multiply by 1000 and divide by 60.

B. multiply by 1000 and divide by 3600.

C. multiply by 60 and divide by 1000.

D. multiply by 3600 and divide by 1000.

E. None of these options are correct.

**Ans: B Section: 1-3 Type: Numerical**

**18. To convert a quantity from m/s to km/h, you must**

A. multiply by 1000 and divide by 60.

B. multiply by 1000 and divide by 3600.

C. multiply by 60 and divide by 1000.

D. multiply by 3600 and divide by 1000.

E. None of these options are correct.

**Ans: D Section: 1-3 Type: Numerical**

**19. To convert a quantity from km/(h · s) to m/s2, you must**

A. multiply by 1000 and divide by 60.

B. multiply by 1000 and divide by 3600.

C. multiply by 60 and divide by 1000.

D. multiply by 3600 and divide by 1000.

E. None of these options are correct.

**Ans: B Section: 1-3 Type: Numerical**

**20. To convert a quantity from g/cm3 to kg/m3, you must**

A. multiply by 0.01.

B. multiply by 100.

C. multiply by 1000.

D. multiply by 0.001.

E. multiply by 1,000,000.

**Ans: C Section: 1-3 Type: Numerical**

**21. In doing a calculation, you arrive at an expression in which the numerator is in kilometers and the denominator is in meters per second. When the calculation is completed, the result will be in units of**

A. meters, if you divide by 1000.

B. meters, if you multiply by 1000.

C. seconds, if you divide by 1000.

D. seconds, if you multiply by 1000.

E. meters squared per second, if you multiply by 1000.

**Ans: D Section: 1-3 Type: Numerical**

**22. You are traveling at a speed of 80 km/h. Your speed in mph is approximately**

A. 30.

B. 40.

C. 50.

D. 60.

E. 70.

**Ans: C Section: 1-3 Type: Numerical**

**23. In doing a calculation, you end up with a fraction having m/s in the numerator and m/s2 in the denominator. The result will have units of**

A. m2/s3.

B. s–1.

C. s3/m2.

D. s.

E. m/s.

**Ans: D Section: 1-3 Type: Conceptual**

**24. The density of an object equals its mass divided by its volume. The mass of Earth is 6  1024 kg and its radius is 4  103 miles. The mass of the Sun is 2  1033 g and its radius is 7  105 km. Determine the ratio of the Earth’s density to that of the Sun.**

A. 4  101

B. 4  102

C. 4  100

D. 4  101

E. None of these choices

**Ans: C Section: 1-3 Type: Numerical**

**25. Evaluate:**

A. 12  1010

B. 1.2  10–10

C. 12  10–5

D. 1.2  10–1

E. 12  10–10

**Ans: D Section: 1-3 Type: Numerical**

**26. Evaluate:**

****

A. 1.1  105

B. 1.7  10–4

C. 3.6  10–8

D. 4.5  105

E. 1.1

**Ans: E Section: 1-3 Type: Numerical**

**27. Compute:**



A. 1  1017

B. 6  107

C. 6  107

D. 4  107

E. None of these are correct

**Ans: D Section: 1-3 Type: Numerical**

**28. Compute:**



A. 3.3  10–6

B. 5.1  106

C. 5.1  10–12

D. 3.3  10–1

E. None of these are correct

**Ans: D Section: 1-3 Type: Numerical**

**29. When we look up in the sky the Sun appears about as big as the moon; however, we know that the Sun is much further away. Given that the radius of the Sun is about 7  108 m and that the radius of the moon is about 2  106 m, calculate approximately the number of times the moon could fit inside the Sun.**

A. 4  102

B. 4  106

C. 4  107

D. 1  105

E. 2  105

**Ans: C Section: 1-3 Type: Numerical**

|  |
| --- |
| **30. Compute:**  **(12  106  2  107) / (12  107 + 7  106)**  A. 7.1  102  B. 7.0  106  C. 2.0  108  D.7.1  102 |
| E. 2  105 |
| **Ans: A Section: 1-3 Type: Numerical**   1. **The SI unit for temperature is**    1. Celsius [oC]    2. Fahrenheit [oF]    3. Kelvin [K]    4. Rankine [oR]    5. Newton [oN]   **Ans: C Section: 1-3 Type: Factual**   1. **List the prefixes from the largest to the smallest.**    1. milli – micro – nano – femto – pico    2. milli – micro – femto – pico – nano    3. milli – micro – pico – nano – femto    4. micro – milli – nano – pico – femto    5. milli – micro – nano – pico – femto   **Ans: E Section 1-3 Type: Factual**   1. **Table below shows fundamental quantities, their SI units and unit abbreviations. Fill in the missing entries.**  |  |  |  | | --- | --- | --- | | **Fundamental Quantities and Their SI Units** | | | | **Quantity** | **Unit** | **Abbreviation** | |  | second |  | |  |  | m | | mass |  |  | | temperature |  |  | |  | ampere |  | |  |  | mol | | luminous intensity |  |  |   **ANS: Missing entries (from top-left, by row): time, s; length, meter; kilogram, kg; kelvin, K; (electric) current, A; amount of substance, mole; candela, cd**  **Section: 1-3 Type: Factual**   1. **Which of the following *does not* result in a ratio of ?**   **Ans: E Section: 1-3 Type: Factual/Numerical**   1. **The number of femtoseconds in a millisecond is**    1. .    2. .    3. .    4. .   **Ans: D Section: 1-3 Type: Numerical**   1. **The prefix “M” means**    1. micro.    2. milli.    3. mega.    4. mole.    5. multi.   **Ans: C Section: 1-3 Type: Factual**   1. **Basketball player Stephen Curry is 1.90 m tall. When converted to feet (1 ft = 0.3048 m) and inches (1 in. = 0.0254 m), his height is closest to**    1. 6 ft 3 in.    2. 6 ft 2 in.    3. 6 ft 23 in.    4. 7 ft 5 in.    5. 6 ft ¼ in.   **Ans: A Section: 1-3 Type: Numerical**   1. **Lebron James’ height is 6’ 8” (1’ = 0.3048 m, 1” = 0.0254 m). Tallest player to ever play in NBA was Gheorghe Muresan, who is 231 cm tall. Determine the absolute difference between players height rounded to three significant figures).**    1. 26.7 cm    2. 16.7 cm    3. 17.8 cm    4. 27.8 cm    5. 11.9 cm   **Ans: D Section: 1-3 Type: Numerical**   1. **When driving on a highway at 100 km/h, the distance the distracted driver covers during the 5 s it takes to read a text message is closest to**    1. 5 m.    2. 10 m.    3. 50 m.    4. 100 m.    5. 500 m.   **Ans: D Section: 1-3 Type: Numerical**   1. **Average acceleration due to gravity is . What is the value of the acceleration due to gravity in ?**   **Ans: A Section: 1-3 Type: Numerical**   1. In 1849 Fizeau measured the speed of light to be 313,000 km/s with the error of 5000 km/h. The relative uncertainty (ratio of the error to the value) is    1. 0.01.    2. 0.02.    3. 0.0160.    4. 0.016.    5. 60.   **Ans: B Section: 1-3/1-4 Type: Numerical**   1. **The spectrum of visible light covers wavelength between 450 nm and 700 nm. Which of the following properly expresses the wavelength range in proper scientific notation?**   **Ans: B Section: 1-3/1-4 Type: Numerical/Conceptual** |

# Section 1-4: Correct use of significant figures helps keep track of uncertainties in numerical values.

1. **The measurement 5.130  10–4 has \_\_\_\_\_ significant figures.**
   1. two
   2. three
   3. one
   4. seven
   5. four

**Ans: E Section: 1-4 Type: Conceptual**

1. **The measurement 23.0040 has \_\_\_\_\_ significant figures.**
   1. six
   2. three
   3. five
   4. four
   5. two

**Ans: A Section: 1-4 Type: Conceptual**

1. **The momentum of a body is defined to be the product of its mass and its velocity. If the mass of an air-track glider is known to be 225 g and its velocity is measured to be 3.1 cm/s, its momentum should be reported as**
   1. 697.5 g · cm/s.
   2. 698 g · cm/s.
   3. 7.0  102 g · cm/s.
   4. 6.98  102 g · cm/s.
   5. 6.975  102 g · cm/s.

**Ans: C Section: 1-4 Type: Numerical**

1. **The net force acting on a body is defined to be the product of the mass of the body and its resultant acceleration. If the mass of a body is known to be 184 kg and its acceleration is measured to be 2.4 m/s2, the resultant force should be reported as**
   1. 4.4  102 kg · m/s2.
   2. 441.6 kg · m/s2.
   3. 442 kg · m/s2.
   4. 4.416 kg · m/s2.
   5. 4.42  102 kg · m/s2.

**Ans: A Section: 1-4 Type: Numerical**

1. **Which of the following represents a value of current measured to at least five significant figures?** 
   1. 2.375  104 A
   2. 0.00347 A
   3. 3.0  105 A
   4. 23.75  101 A
   5. 50.300 A

**Ans: E Section: 1-4 Type: Numerical**

1. **The number of seconds in a month is of the order of**
   1. 103.
   2. 108.
   3. 105.
   4. 1010.

E. 106.

**Ans: E Section: 1-4 Type: Numerical**

1. **Earth's population, expressed as an order of magnitude, is closest to**
   1. 106.
   2. 1010.
   3. 105.
   4. 108.
   5. 107.

**Ans: B Section: 1-4 Type: Factual**

|  |
| --- |
| 1. **The chemical agent dioxin can be toxic or hazardous to humans in concentrations as small as one part per billion. If I am testing a soil sample that has a mass of 1.0 kg, how much dioxin would have to be present for me to label it toxic or hazardous?** |

* 1. a picogram
  2. a kilogram
  3. a microgram
  4. a milligram
  5. a nanogram

**Ans: C Section: 1-4 Type: Numerical**

1. **An impurity in a manufacturing process will cause a batch to be rejected if the impurity exceeds one part per million. What is the maximum amount of impurity that could be present if the batch contains 100 kg of the product?** 
   1. 100 micrograms
   2. 100 nanograms
   3. 100 grams
   4. 100 megagrams
   5. 100 nanograms

**Ans: E Section: 1-4 Type: Numerical**

1. **What is the order of magnitude of Earth's tallest mountain heights?**
   1. 108 m
   2. 104 m
   3. 106 m
   4. 103 m
   5. 105 m

**Ans: B Section: 1-4 Type: Factual**

1. **The longest bridge on Earth is of the order of**
   1. 103  m.
   2. 104  m.
   3. 105  m.
   4. 106  m.
   5. 107 m.

**Ans: B Section: 1-4 Type: Numerical**

1. **A person inhales about 1 *L* of air per breathe. Estimate the number of air molecules inhaled.**
   1. 1010.
   2. 1014.
   3. 1018.
   4. 1022.
   5. 1026.

**Ans: D Section: 1-4 Type: Factual**

1. **Estimate the number of raindrops needed to fill a volume of 1m** × **1m** × **1cm.**
   1. 103
   2. 105
   3. 107
   4. 109
   5. 1011

**Ans: C Section: 1-4 Type: Numerical**

1. **Light travels at 3  108 m/s, and it takes about 8 min for light from the sun to travel to Earth. Based on this, the order of magnitude of the distance from the sun to Earth is**
   1. 1010 m.
   2. 108 m.
   3. 109 m.
   4. 106 m.
   5. 1011 m.

**Ans: E Section: 1-4 Type: Numerical**

1. **The size of a proton is of the order of 10–15 m and the size of the visible universe is of the order of 1026 m. From this information you can conclude that**
   1. the size of the universe is 26 orders of magnitude greater than that of the proton.
   2. the size of the universe is 41 orders of magnitude greater than that of the proton.
   3. the size of the proton is 11 orders of magnitude greater than that of the universe.
   4. the size of the universe is 15 orders of magnitude greater than that of the proton.
   5. the size of the proton is 15 orders of magnitude greater than that of the universe.

**Ans: B Section: 1-4 Type: Conceptual**

1. **The mass of an electron is of the order of 10–30 kg and the mass of the universe is believed to be of the order of 1052 kg. From this information you can conclude that**
   1. the mass of Earth is 52 orders of magnitude greater than that of the electron.
   2. the mass of Earth is 30 orders of magnitude greater than that of the electron.
   3. the mass of the electron is 82 orders of magnitude greater than that of Earth.
   4. the mass of Earth is 82 orders of magnitude greater than that of the electron.
   5. the mass of the electron is 30 orders of magnitude greater than that of Earth.

**Ans: D Section: 1-4 Type: Conceptual**

1. **Light travels at 3  108 m/s, and the size of a proton is about 1 fm. Calculate the order of magnitude for the time taken for light to pass across a proton.**

A.  s

B.  s

C.  s

D. s

E.  s

**Ans: D Section: 1-4 Type: Numerical**

1. **If Earth is approximately 4.5 billion years old, estimate the order of magnitude for the number of times it has rotated about its own axis. (Assume a constant rate of rotation.)**
   1. 109
   2. 1010
   3. 1011
   4. 1012
   5. 1014

**Ans: D Section: 1-4 Type: Numerical**

1. **If you have a music CD collection of about 150 discs, estimate the order of magnitude of the number of heartbeats you would have if you listened all the way through your collection.**
   1. 106
   2. 108
   3. 1010
   4. 104
   5. 103

**Ans: A Section: 1-4 Type: Numerical**

1. **A diehard music lover still prefers to listen to his vinyl records, which rotate at 331/3 revolutions per minute. If he listens for an average of three hours per day, estimate the order of magnitude for the number of revolutions his turntable makes in a year.**
   1. 107
   2. 102
   3. 106
   4. 105
   5. 104

**Ans: A Section: 1-4 Type: Numerical**

1. **The second is defined to be the amount of time required for a cesium atom to emit 9,192,631,770 cycles of radio waves. The number of significant digits in the quoted value is**
   1. 3.
   2. 6.
   3. 9.
   4. 10.
   5. impossible to identify.

**Ans: D Section: 1-4 Type: Conceptual**

1. **Density of styrofoam is . This number has**
   1. 1 significant digit.
   2. 2 significant digits.
   3. 3 significant digits.
   4. 4 significant digits.
   5. 5 significant digits.

**Ans: C Section: 1-4 Type: Conceptual**

1. **When writing a number, all zeros to the right of the decimal point are significant figures,**
   1. True
   2. False

**Ans: B Section 1-4 Type: Factual**

1. **When multiplying or dividing numbers, the result has the same numbers of significant figures as the input number with fewest significant figures.**
   1. True
   2. False

**Ans: A Section: 1-4 Type: Factual**

1. **When adding or subtracting numbers, the result should have the same number of digits to the right of the decimal point as the input number with the most digits to the right of the decimal point.**
   1. True
   2. False

**Ans: B Section 1-5 Type: Factual**

# Section 1-5: Dimensional analysis is a powerful way to check the results of a physics calculation.

1. **The dimensions of mass density are**
   1. *MLT* –1.
   2. *ML*3.
   3. *ML*2.
   4. *ML*–1.
   5. None of these are correct.

**Ans: E Section: 1-5 Type: Conceptual**

1. **The dimensions of two quantities MUST be identical if you are either \_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_ the quantities.**
   1. adding; multiplying
   2. subtracting; dividing
   3. multiplying; dividing
   4. adding; subtracting
   5. All of these are correct

**Ans: D Section: 1-5 Type: Conceptual**

1. **In the expression *F*net = *ma*, *m* must have the dimensions**
   1. *ML*/*T* 2.
   2. *M.*
   3. *L*/*T* 2.
   4. *L*/*T.*
   5. *ML*2/*T* 2.

**Ans: B Section: 1-5 Type: Conceptual**

1. **If *K* has dimensions *ML*2/*T* 2, the in *K* = *mv* 2 must**
   1. have the dimensions *ML*/*T* 2.
   2. have the dimensions *M.*
   3. have the dimensions *L*/*T* 2.
   4. have the dimensions *L*2/*T* 2.
   5. be dimensionless.

**Ans: E Section: 1-5 Type: Conceptual**

1. **If *x* and *t* represent distance and time, respectively, the *C* in *x* = 1/2*Ct* 2 must**
   1. have the dimensions *ML*/*T* 2.
   2. have the dimensions *M.*
   3. have the dimensions *L*/*T* 2.
   4. have the dimensions *L*2/*T* 2.
   5. be dimensionless.

**Ans: C Section: 1-5 Type: Conceptual**

1. **If *v* and *t* represent velocity and time, respectively, *C*1 in must**
   1. have the dimensions *L*/*T.*
   2. have the dimensions *M.*
   3. have the dimensions *L*/*T* 2.
   4. have the dimensions *L*2/*T* 2.
   5. be dimensionless.

**Ans: A Section: 1-5 Type: Conceptual**

1. **If *v* and *t* represent velocity and time, respectively, *C*2 in  must**
   1. have the dimensions *ML*/*T* 2.
   2. have the dimensions *.*
   3. have the dimensions *L*/*T* 2.
   4. have the dimensions *L*2/*T* 2.
   5. be dimensionless.

**Ans: B Section: 1-5 Type: Conceptual**

1. **If *x* and *t* represent position and time, respectively, the *A* in *x* = *A* cos (*Bt)* must**
   1. have the dimensions *ML*/*T* 2.
   2. have the dimensions *M.*
   3. have the dimensions *L*.
   4. have the dimensions *L*2/*T* 2.
   5. be dimensionless.

**Ans: C Section: 1-5 Type: Conceptual**

1. **If *x* and *t* represent position and time, respectively, the *B* in *x* = *A* cos (*Bt)* must**
   1. have the dimensions *ML*/*T* 2.
   2. have the dimensions *.*
   3. have the dimensions *L*/*T* 2.
   4. have the dimensions *L*2/*T* 2.
   5. be dimensionless.

**Ans: B Section: 1-5 Type: Conceptual**

1. **In Newton's law of gravity the universal gravitational constant is *G* = *Fr*2/*m*1*m*2, where *F* is the gravitational force between the two masses, *m*1 and *m*2, and *r* is the distance between them. What are the dimensions of *G*?**
   1. *L*2*M*1*T* 2.
   2. *L*3*M*1*T* 2.
   3. *L*2*M*2*T* 2.
   4. *L*3*M*1*T* 2.
   5. *L*3*M*1*T* 3.

**Ans: B Section: 1-5 Type: Conceptual**

1. **The dimensions of energy, E, are *ML2/T 2*. Using dimensional analyzes, E is the product of which two quantities?**
   1. Mass divided by time squared
   2. Force times acceleration
   3. Mass times acceleration
   4. Force times distance
   5. Force times time

**Ans: D Section: 1-5 Type: Conceptual**

1. **Speed of sound in solids can be calculated using equation . If stands for density (with units of , constant must have dimensions of**
   1. .
   2. .
   3. .
   4. .
   5. .

**Ans: E Section: 1-5 Type: Conceptual**

1. **Electric current is defined as the amount of electric charge passing through a point in one second. Based on that definition, one can conclude that the units of the electric charge, coulomb, are equal to**
   1. .
   2. .
   3. .
   4. .
   5. .

**Ans: C Section: 1-3/1-5 Type: Conceptual/Factual**

1. **The amount of heat ( transferred during the thermal process can be calculated using equation If is *the amount* of the substance, is the change in temperature and has dimensions of the units of the constant are**
   1. .
   2. .
   3. .
   4. .
   5. .

**Ans: B Section: 1-5 Type: Conceptual**