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. 10^{12}.
B. 10^{6}.
C. 10^{3}.
D. 10^{9}.
E. 10^{15}.
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. 10^{2}.
B. 10^{9}.
C. 10^{-3}.
D. 10^{6}.
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. 10^{6}.
E. 10^{9}.

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. 10^{3}.
E. 10^{1}.

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/cm^3. This density in SI units is

A. 1.07×10^{-3} kg/m^3

B. $(1/1.07) \times 10^3$ kg/m^3

C. 1.07×10^3 kg

D. 1.07×10^{-3} kg

E. 1.07×10^3 kg/m^3

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/s^2, 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/cm^3 to kg/m^3, 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/s^2 in the denominator. The result will have units of

A. m^2/s^3.
B. s^{-1}.
C. s^3/m^2.
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 6×10^{24} kg and its radius is 4×10^3 miles. The mass of the Sun is 2×10^{33} g and its radius is 7×10^5 km. Determine the ratio of the Earth's density to that of the Sun.

A. 4×10^{-1}
B. 4×10^2
C. 4×10^0
D. 4×10^1
E. None of these choices

Ans: C Section: 1-3 Type: Numerical

25. Evaluate:

$$(4.0\times10^{-6})(3.0\times10^{4})$$

A. 12×10^{10}

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:

$$\frac{(2\pi\times10^{3})(3.0\times10^{7})}{(4.2\times10^{5})^{2}}$$

A. 1.1×10^{5}

B. 1.7×10^{-4}

C. 3.6×10^{-8}

D. 4.5×10^{5}

E. 1.1

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

27. Compute:

$$\frac{(3\times10^{8})(8\times10^{4})}{(6\times10^{5})}$$

A. 1×10^{17}

B. 6×10^{7}

C. 6×10^{7}

D. 4×10^{7}

E. None of these are correct

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

28. Compute:

$$\frac{(6.2\times10^{-4})+(4.0\times10^{-5})}{(2.0\times10^{-3})}$$

A. 3.3×10^{-6}

B. 5.1×10^{6}

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 7×10^8 m and that the radius of the moon is about 2×10^6 m, calculate approximately the number of times the moon could fit inside the Sun.

A. 4×10^2
B. 4×10^6
C. 4×10^7
D. 1×10^5
E. 2×10^5

Ans: C Section: 1-3 Type: Numerical

30. Compute:

$(12 \times 10^6 - 2 \times 10^7) / (-12 \times 10^7 + 7 \times 10^6)$

A. 7.1×10^{-2}
B. 7.0×10^6
C. 2.0×10^{-8}
D. -7.1×10^{-2}
E. 2×10^5

Ans: A Section: 1-3 Type: Numerical

31. The SI unit for temperature is

A. Celsius [°C]
B. Fahrenheit [°F]
C. Kelvin [K]
D. Rankine [°R]
E. Newton [°N]

Ans: C Section: 1-3 Type: Factual

32. List the prefixes from the largest to the smallest.

A. milli – micro – nano – femto – pico
B. milli – micro – femto – pico – nano
C. milli – micro – pico – nano – femto
D. micro – milli – nano – pico – femto
E. milli – micro – nano – pico – femto

Ans: E Section 1-3 Type: Factual

33. 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

34. Which of the following *does not* result in a ratio of 1.0×10^6?

A. $\frac{1.0\ mm}{1.0\ nm}$

B. $\frac{10\ hm}{1.0\ mm}$

C. $\frac{1.0\ Ym}{1.0\ Em}$

D. $\frac{100\ km}{1.0\ dm}$

E. $\frac{1.0\ \mu m}{1.0\ fm}$

Ans: E Section: 1-3 Type: Factual/Numerical

35. The number of femtoseconds in a millisecond is

A. 10^3.

B. 10^6.

C. 10^9.

D. 10^{12}.

E. 10^{15}.

Ans: D Section: 1-3 Type: Numerical

36. The prefix "M" means

A. micro.

B. milli.

C. mega.

D. mole.

E. multi.

Ans: C Section: 1-3 Type: Factual

37. 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

A. 6 ft 3 in.
B. 6 ft 2 in.
C. 6 ft 23 in.
D. 7 ft 5 in.
E. 6 ft ¼ in.

Ans: A Section: 1-3 Type: Numerical

38. 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).

A. 26.7 cm
B. 16.7 cm
C. 17.8 cm
D. 27.8 cm
E. 11.9 cm

Ans: D Section: 1-3 Type: Numerical

39. **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**

A. 5 m.
B. 10 m.
C. 50 m.
D. 100 m.
E. 500 m.

Ans: D Section: 1-3 Type: Numerical

40. Average acceleration due to gravity is $g = 9.81 \frac{m}{s^2}$. What is the value of the acceleration due to gravity in $\frac{km}{h^2}$?

A. 1.27×10^{5}
B. 7.60×10^{-10}
C. 2.72
D. 7.60×10^{-7}
E. 35.3

Ans: A Section: 1-3 Type: Numerical

41. 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

A. 0.01.
B. 0.02.
C. 0.0160.
D. 0.016.
E. 60.

Ans: B Section: 1-3/1-4 Type: Numerical

42. 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?

A. $\left(450 \times 10^{-9} - 700 \times 10^{-9}\right)\ m$
B. $\left(4.50 \times 10^{-7} - 7.00 \times 10^{-7}\right)\ m$
C. $\left(4.50 \times 10^{-9} - 7.00 \times 10^{-9}\right)\ m$
D. $\left(0.450 \times 10^{-6} - 0.700 \times 10^{-6}\right)\ m$
E. $\left(450 - 700\right)\ nm$

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.

43. The measurement 5.130×10^{-4} has _____ significant figures.

A. two
B. three
C. one
D. seven
E. four

Ans: E Section: 1-4 Type: Conceptual

44. The measurement 23.0040 has _____ significant figures.

A. six
B. three
C. five
D. four
E. two

Ans: A Section: 1-4 Type: Conceptual

45. 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

A. 697.5 g · cm/s.
B. 698 g · cm/s.
C. 7.0×10^2 g · cm/s.
D. 6.98×10^2 g · cm/s.
E. 6.975×10^2 g · cm/s.

Ans: C Section: 1-4 Type: Numerical

46. 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/s^2, the resultant force should be reported as

A. 4.4×10^2 kg · m/s^2.
B. 441.6 kg · m/s^2.
C. 442 kg · m/s^2.
D. 4.416 kg · m/s^2.
E. 4.42×10^2 kg · m/s^2.

Ans: A Section: 1-4 Type: Numerical

47. Which of the following represents a value of current measured to at least five significant figures?

A. 2.375×10^4 A
B. 0.00347 A
C. 3.0×10^5 A
D. 23.75×10^1 A
E. 50.300 A

Ans: E Section: 1-4 Type: Numerical

48. The number of seconds in a month is of the order of

A. 10^3.
B. 10^8.
C. 10^5.
D. 10^{10}.
E. 10^6.

Ans: E Section: 1-4 Type: Numerical

49. Earth's population, expressed as an order of magnitude, is closest to

A. 10^6.
B. 10^{10}.
C. 10^5.
D. 10^8.
E. 10^7.

Ans: B Section: 1-4 Type: Factual

50. 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?

A. a picogram
B. a kilogram
C. a microgram
D. a milligram
E. a nanogram

Ans: C Section: 1-4 Type: Numerical

51. 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?

A. 100 micrograms
B. 100 nanograms
C. 100 grams
D. 100 megagrams
E. 100 nanograms

Ans: E Section: 1-4 Type: Numerical

52. What is the order of magnitude of Earth's tallest mountain heights?

A. 10^8 m
B. 10^4 m
C. 10^6 m
D. 10^3 m
E. 10^5 m

Ans: B Section: 1-4 Type: Factual

53. The longest bridge on Earth is of the order of

A. 10^3 m.
B. 10^4 m.
C. 10^5 m.
D. 10^6 m.
E. 10^7 m.

Ans: B Section: 1-4 Type: Numerical

54. A person inhales about 1 *L* of air per breathe. Estimate the number of air molecules inhaled.

A. 10^{10}.
B. 10^{14}.
C. 10^{18}.
D. 10^{22}.
E. 10^{26}.

Ans: D Section: 1-4 Type: Factual

55. Estimate the number of raindrops needed to fill a volume of 1m $\times$ 1m $\times$ 1cm.

A. 10^3
B. 10^5
C. 10^7
D. 10^9
E. 10^{11}

Ans: C Section: 1-4 Type: Numerical

56. Light travels at 3×10^8 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

A. 10^{10} m.
B. 10^8 m.
C. 10^9 m.
D. 10^6 m.
E. 10^{11} m.

Ans: E Section: 1-4 Type: Numerical

57. 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 10^{26} m. From this information you can conclude that

A. the size of the universe is 26 orders of magnitude greater than that of the proton.
B. the size of the universe is 41 orders of magnitude greater than that of the proton.
C. the size of the proton is 11 orders of magnitude greater than that of the universe.
D. the size of the universe is 15 orders of magnitude greater than that of the proton.
E. the size of the proton is 15 orders of magnitude greater than that of the universe.

Ans: B Section: 1-4 Type: Conceptual

58. 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 10^{52} kg. From this information you can conclude that

A. the mass of Earth is 52 orders of magnitude greater than that of the electron.
B. the mass of Earth is 30 orders of magnitude greater than that of the electron.
C. the mass of the electron is 82 orders of magnitude greater than that of Earth.
D. the mass of Earth is 82 orders of magnitude greater than that of the electron.
E. the mass of the electron is 30 orders of magnitude greater than that of Earth.

Ans: D Section: 1-4 Type: Conceptual

59. Light travels at 3×10^8 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. 10^{-7} s
B. 10^{-8} s
C. 10^{-22} s
D. 10^{-24} s
E. 10^{+23} s

Ans: D Section: 1-4 Type: Numerical

60. 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.)

A. 10^9
B. 10^{10}
C. 10^{11}
D. 10^{12}
E. 10^{14}

Ans: D Section: 1-4 Type: Numerical

61. 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.

A. 10^6
B. 10^8
C. 10^{10}
D. 10^4
E. 10^3

Ans: A Section: 1-4 Type: Numerical

62. A diehard music lover still prefers to listen to his vinyl records, which rotate at $33^{1/3}$ 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.

A. 10^7
B. 10^2
C. 10^6
D. 10^5
E. 10^4

Ans: A Section: 1-4 Type: Numerical

63. 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

A. 3.
B. 6.
C. 9.
D. 10.
E. impossible to identify.

Ans: D Section: 1-4 Type: Conceptual

64. Density of styrofoam is $0.0320\,\frac{g}{cm^3}$. This number has

A. 1 significant digit.
B. 2 significant digits.
C. 3 significant digits.
D. 4 significant digits.
E. 5 significant digits.

Ans: C Section: 1-4 Type: Conceptual

65. When writing a number, all zeros to the right of the decimal point are significant figures,

A. True
B. False

Ans: B Section 1-4 Type: Factual

66. When multiplying or dividing numbers, the result has the same numbers of significant figures as the input number with fewest significant figures.

A. True
B. False

Ans: A Section: 1-4 Type: Factual

67. **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.**

A. True
B. 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.

68. The dimensions of mass density are

A. MLT^{-1}.
B. ML^3.
C. ML^2.
D. ML^{-1}.
E. None of these are correct.

Ans: E Section: 1-5 Type: Conceptual

69. The dimensions of two quantities MUST be identical if you are either _____ or _____ the quantities.

A. adding; multiplying
B. subtracting; dividing
C. multiplying; dividing
D. adding; subtracting
E. All of these are correct

Ans: D Section: 1-5 Type: Conceptual

70. In the expression $F_{net} = ma$, m must have the dimensions

A. ML/T^2.
B. M.
C. L/T^2.
D. L/T.
E. ML^2/T^2.

Ans: B Section: 1-5 Type: Conceptual

71. If K has dimensions ML^2/T^2, the α in $K = \alpha mv^2$ must

A. have the dimensions ML/T^2.
B. have the dimensions M.
C. have the dimensions L/T^2.
D. have the dimensions L^2/T^2.
E. be dimensionless.

Ans: E Section: 1-5 Type: Conceptual

72. If x and t represent distance and time, respectively, the C in $x = {}^1/_2Ct^2$ must

A. have the dimensions ML/T^2.
B. have the dimensions M.
C. have the dimensions L/T^2.
D. have the dimensions L^2/T^2.
E. be dimensionless.

Ans: C Section: 1-5 Type: Conceptual

73. If *v* and *t* represent velocity and time, respectively, C_1 in $v = C_1 e^{-C_2 t}$ must

A. have the dimensions *L*/*T.*
B. have the dimensions *M.*
C. have the dimensions L/T^2.
D. have the dimensions L^2/T^2.
E. be dimensionless.

Ans: A Section: 1-5 Type: Conceptual

74. If *v* and *t* represent velocity and time, respectively, C_2 in $v = C_1 e^{-C_2 t}$ must

A. have the dimensions ML/T^2.
B. have the dimensions T^{-1}.
C. have the dimensions L/T^2.
D. have the dimensions L^2/T^2.
E. be dimensionless.

Ans: B Section: 1-5 Type: Conceptual

75. If *x* and *t* represent position and time, respectively, the *A* in *x* = *A* cos (*Bt)* must

A. have the dimensions ML/T^2.
B. have the dimensions *M.*
C. have the dimensions *L*.
D. have the dimensions L^2/T^2.
E. be dimensionless.

Ans: C Section: 1-5 Type: Conceptual

76. If *x* and *t* represent position and time, respectively, the *B* in *x* = *A* cos (*Bt)* must

A. have the dimensions ML/T^2.
B. have the dimensions T^{-1}.
C. have the dimensions L/T^2.
D. have the dimensions L^2/T^2.
E. be dimensionless.

Ans: B Section: 1-5 Type: Conceptual

77. In Newton's law of gravity the universal gravitational constant is $G = Fr^2/m_1m_2$, 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?

A. $L^2M^{-1}T^2$.
B. $L^3M^{-1}T^{-2}$.
C. $L^2M^{-2}T^{-2}$.
D. $L^3M^{-1}T^2$.
E. $L^{-3}M^1T^3$.

Ans: B Section: 1-5 Type: Conceptual

78. The dimensions of energy, E, are ML^2/T^2. Using dimensional analyzes, E is the product of which two quantities?

A. Mass divided by time squared
B. Force times acceleration
C. Mass times acceleration
D. Force times distance
E. Force times time

Ans: D Section: 1-5 Type: Conceptual

79. Speed of sound in solids can be calculated using equation $v = \sqrt{\frac{Y}{\rho}}$. If ρ stands for density (with units of kg/m^3), constant Y must have dimensions of

A. $\frac{M T^2}{L}$.

B. $\frac{MT}{L^2}$.

C. $\frac{M}{T L^2}$.

D. $\frac{ML}{T^2}$.

E. $\frac{M}{T^2 L}$.

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

80. 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

A. $\frac{A}{s}$.

B. $\frac{s}{A}$.

C. $A \cdot s$.

D. $A \cdot s^2$.

E. $A^2 \cdot s$.

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

81. The amount of heat (Q) transferred during the thermal process can be calculated using equation $Q = M C_V \Delta T$. If m is *the amount* of the substance, ΔT is the change in temperature and Q has dimensions of $\frac{M L^2}{T^2}$, the units of the constant C_V are

A. $\frac{m^2}{K\ s^2}$.

B. $\frac{kg\ m^2}{mol\ K\ s^2}$.

C. $\frac{mol\ m^2}{kg\ K\ s^2}$.

D. $\frac{kg\ \ m}{mol\ \ K\ \ s^2}$.

E. $\frac{mol\ \ m^2}{kg\ \ K\ \ m^2}$.

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