

Chapter 1--Introduction

Student: _____

1. Since 1983 the standard meter has been defined in terms of which of the following?
 - A. specific alloy bar housed at Sevres, France
 - B. wavelength of light emitted by krypton-86
 - C. distance from the Earth's equator to the North Pole
 - D. the distance light travels in a certain fraction of a second

2. Since 1967 the standard definition for the second has been based on which of the following?
 - A. characteristic frequency of the cesium-133 atom
 - B. average solar day
 - C. sidereal day
 - D. Greenwich Civil Time

3. In mechanics, physicists use three basic quantities to derive additional quantities. Mass is one of the three quantities. What are the other two?
 - A. length and force
 - B. power and force
 - C. length and time
 - D. force and time

4. The prefixes which are abbreviated p, n, and G represent which of the following?
 - A. 10^{-2} , 10^{-6} , and 10^{15}
 - B. 10^{-9} , 10^6 , and 10^{10}
 - C. 10^{-12} , 10^{-9} , and 10^9
 - D. 10^{-15} , 10^{-6} , and 10^{12}

5. The ratio M/m of the prefixes M and m has what value?
 - A. 10^3
 - B. 10^6
 - C. 10^9
 - D. 10^{18}

6. One year is about _____ seconds while one day is exactly _____ seconds.

- A. 3.16×10^7 , 86 400
- B. 5.26×10^5 , 86 400
- C. 3.16×10^7 , 8 640
- D. 1.04×10^6 , 36 000

7. The nuclei of atoms contain

- A. electrons only.
- B. neutrons only.
- C. protons and electrons.
- D. protons and neutrons.

8. When was the existence of the neutron confirmed?

- A. in ancient times
- B. in 1895
- C. in 1932
- D. in 1969

9. The proton contains which of the following combination of quarks?

- A. two up quarks and one down quark
- B. one up quark and two down quarks
- C. one top quark and two bottom quarks
- D. two top quarks and one bottom quark

10. Which formula is dimensionally consistent with an expression yielding a value for velocity? (a is acceleration, x is distance, and t is time)

- A. v/t^2
- B. vx^2
- C. v^2/t
- D. at

11. Which expression is dimensionally consistent with an expression that would yield a value for time⁻¹? (v is velocity, x is distance, and t is time)

- A. v/x
- B. v^2/x
- C. x/t
- D. v^2t

12. If the displacement of an object, x , is related to velocity, v , according to the relation $x = Av$, the constant, A , has the dimension of which of the following?

- A. acceleration
- B. length
- C. time
- D. area

13. The speed of a boat is often given in knots. If a speed of 5 knots were expressed in the SI system of units, the units would be:

- A. m.
- B. s.
- C. m/s.
- D. kg/s.

14. If a is acceleration, v is velocity, x is position, and t is time, then which equation is not dimensionally correct?

- A. $t = x/v$
- B. $a = v^2/x$
- C. $v = a/t$
- D. $t^2 = 2x/a$

15. Suppose an equation relating position, x , to time, t , is given by $x = bt^3 + ct^4$, where b and c are constants. The dimensions of b and c are respectively:

- A. T^3, T^4 .
- B. $1/T^3, 1/T^4$.
- C. $L/T^3, L/T^4$.
- D. $L^2 \times T^3, L^2 \times T^4$.

16. Areas always have dimensions _____ while volumes always have dimensions _____.

- A. m^2, m^3
- B. L^2, L^3
- C. Both a and b are correct.
- D. No answer is correct because of the "always."

17. Which one of the choices below represents the preferred practice regarding significant figures when adding the following: $12.4 + 11 + 67.37 + 4.201$?

- A. 94.971
- B. 94.97
- C. 95.0
- D. 95

18. Which one of the choices below represents the preferred practice regarding significant figures when multiplying the following: $10.5 \times 8.8 \times 3.14$?

- A. 290
- B. 290.136
- C. 290.1
- D. 300

19. Calculate $(0.82 + 0.042) \times (4.4 \times 10^3)$, keeping only significant figures.

- A. 3 800
- B. 3 784
- C. 3 793
- D. 3 520

20. The length and width of a standard sheet of paper is measured, and then the area is found by calculation to be 93.50 in^2 . The number of significant figures in the width measurement must be at least:

- A. 1.
- B. 2.
- C. 3.
- D. 4.

21. The number 0.000 17 has how many significant figures?

- A. 2
- B. 3
- C. 5
- D. 6

22. Multiplying a 2 significant figure number by a 3 significant figure number and then dividing the product by a six significant figure number yields a number with how many significant figures?

- A. 5/6
- B. 1
- C. 2
- D. 11

23. Assume when using a meter stick measuring can be done so that the last significant figure is in the tenth of a millimeter digit. If you are measuring an object with length between 6 and 7 cm, how many significant figures will result if you only use the part of the meter stick between the 1-cm and 9-cm positions?

- A. 2
- B. 3
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- D. more than 4

24. Assume when using a meter stick measuring can be done so that the last significant figure is in the tenth of a millimeter digit. If you are measuring an object with length between 6 and 7 cm, how many significant figures will result if you only use the part of the meter stick between the 82- and 95-cm positions?

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25. Assume when using a meter stick measuring can be done so that the last significant figure is in the tenth of a millimeter digit. If you are measuring an object with length between 25 and 57 cm, how many significant figures will result if you only use the part of the meter stick between the 2- and 95-cm positions?

- A. 2
- B. 3
- C. 4
- D. more than 4

26. How many significant figures does the number 1 700 have?

- A. 2
- B. 3
- C. 4
- D. One cannot tell with certainty when the number is written in the given form, but it will be one of the other given answers.

27. In the text are the following conversion factors:

- i. $1 \text{ mi} = 1609 \text{ m}$
- ii. $1 \text{ m} = 39.37 \text{ in.}$
- iii. $1 \text{ ft} = 30.48 \text{ cm}$
- iv. $1 \text{ in.} = 2.54 \text{ cm}$

The 1 on the left hand side is assumed to have the same number of significant figures as the number on the right hand side of each of these equations. However, 2 of these conversion factors are exact, and this means they have the equivalent of an unlimited number of significant figures when used in calculations. Which 2 are the exact conversion factors?

- A. i and ii
- B. i and iii
- C. ii and iii
- D. iii and iv

28. On planet Q the standard unit of volume is called the guppy. Space travelers from Earth have determined that one liter = 38.2 guppies. How many guppies are in 150 liters?

- A. 5730 guppies
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- A. 5.2 feet
- B. 5.5 feet
- C. 5.8 feet
- D. 6.3 feet

30. A furlong is a distance of 220 yards. A fortnight is a time period of two weeks. A race horse is running at a speed of 5.00 yards per second. What is his speed in furlongs per fortnight?

- A. 27500 furlongs/fortnight
- B. 13700 furlongs/fortnight
- C. 6220 furlongs/fortnight
- D. 2750 furlongs/fortnight

31. A cereal box has the dimensions of $0.19 \text{ m} \times 0.28 \text{ m} \times 0.070 \text{ m}$. If there are 3.28 feet per meter, then what is the volume of the box in cubic feet?

- A. 0.13 cubic feet
- B. 0.040 cubic feet
- C. 0.012 cubic feet
- D. 0.0037 cubic feet

32. The distance to the Andromeda Galaxy is estimated at about 2×10^6 light years. A light year is the distance traveled by light in one year; if the speed of light is 3×10^8 m/s, about how far is it from our galaxy to Andromeda? (1 year = 3.15×10^7 s)

- A. 10×10^{15} m
- B. 1×10^{18} m
- C. 2×10^{22} m
- D. 6×10^{12} m

33. A cement truck can pour 20 cubic yards of cement per hour. Express this in ft^3/min .

- A. $1/3 \text{ ft}^3/\text{min}$
- B. $1.0 \text{ ft}^3/\text{min}$
- C. $3 \text{ ft}^3/\text{min}$
- D. $9 \text{ ft}^3/\text{min}$

34. Water flows into a swimming pool at the rate of 8.0 gal/min. The pool is 16 ft wide, 32 ft long and 8.0 ft deep. How long does it take to fill? (1 U.S. gallon = 231 cubic inches)

- A. 32 hours
- B. 64 hours
- C. 48 hours
- D. 24 hours

35. When NASA was communicating with astronauts on the moon, the time from sending on the Earth to receiving on the moon was 1.28 s. Find the distance from Earth to the moon. (The speed of radio waves is 3.00×10^8 m/s.)

- A. 240 000 km
- B. 384 000 km
- C. 480 000 km
- D. 768 000 km

36. The mass of the sun is 2.0×10^{30} kg, and the mass of a hydrogen atom is 1.67×10^{-27} kg. If we assume that the sun is mostly composed of hydrogen, how many atoms are there in the sun?

- A. 1.2×10^{56} atoms
- B. 3.4×10^{56} atoms
- C. 1.2×10^{57} atoms
- D. 2.4×10^{57} atoms

37. The information on a one-gallon paint can is that the coverage, when properly applied, is 450 ft^2 . One gallon is 231 in^3 . What is the average thickness of the paint in such an application?

- A. 0.003 6 in
- B. 0.009 0 in
- C. 0.043 in
- D. 0.051 in

38. Assume everyone in the United States consumes one soft drink in an aluminum can every two days. If there are 270 million Americans, how many tons of aluminum need to be recycled each year if each can weighs $1/16$ pound and one ton = 2000 pounds?

- A. 750 000 tons
- B. 1.5 million tons
- C. 1.75 million tons
- D. 3 million tons

39. A physics class in a large lecture hall has 150 students. The total mass of the students is about ____ kg.

- A. 10^2
- B. 10^3
- C. 10^4
- D. 10^5

40. An apartment has 1100 ft^2 of floor space. What is the approximate volume of the apartment?

- A. 10^3 ft^3
- B. 10^4 ft^3
- C. 10^5 ft^3
- D. 10^6 ft^3

41. Which point is nearest the x -axis?

- A. (-3, 4)
- B. (4, 5)
- C. (-5, 3)
- D. (5, -2)

42. Each edge of a cube has a length of 25.4 cm. What is the length of a diagonal of the cube going through the center of the cube?

- A. 25.4 in
- B. 17.3 in
- C. 14.4 in
- D. 10.0 in

43. If point A is located at coordinates (5, 3) and point B is located at coordinates (-3, 9), what is the distance from A to B if the units of the coordinated system are meters?

- A. 14 m
- B. 10 m
- C. 8 m
- D. 17 m

44. A high fountain of water is in the center of a circular pool of water. You walk the circumference of the pool and measure it to be 150 meters. You then stand at the edge of the pool and use a protractor to gauge the angle of elevation of the top of the fountain. It is 55° . How high is the fountain?

- A. 17 m
- B. 23 m
- C. 29 m
- D. 34 m

45. A right triangle has sides 5.0 m, 12 m, and 13 m. The smallest angle of this triangle is nearest:

- A. 21° .
- B. 23° .
- C. 43° .
- D. Not attainable since this is not a right triangle.

46. If $j = 90^\circ - q$, what is the value of $\sin^2 j + \sin^2 q$?

- A. 0
- B. 1
- C. -1
- D. The answer depends on q.

47. A triangle has sides of length 7.0 cm and 25 cm. If the triangle is a right triangle, which of the following could be the length of the third side?

- A. 18 cm
- B. 24 cm
- C. 27 cm
- D. 32 cm

48. A train slowly climbs a 500-m mountain track which is at an angle of 10.0° with respect to the horizontal. How much altitude does it gain?

- A. 86.8 m
- B. 88.2 m
- C. 341 m
- D. 492 m

49. Note the expression: $y = x^2$. Which statement is most consistent with this expression?

- A. If y doubles, then x quadruples.
- B. y is greater than x .
- C. If x doubles, then y doubles.
- D. If x doubles, then y quadruples.

50. Note the expression: $y = A/x^3$. Which statement is most consistent with this expression?

- A. y is less than A .
- B. If x is halved, y is multiplied by eight.
- C. If x is doubled, y is multiplied by a factor of 8.
- D. y is greater than x .

51. For which of the values below is $x > x^3$?

- A. $x = -1.5$
- B. $x = 0$
- C. $x = 1.0$
- D. $x = 1.5$

52. Modern electroplaters can cover a surface area of 60.0 m^2 with one troy ounce of gold (volume = 1.611 cm^3). What is the thickness of the electroplated gold?

- A. $2.68 \times 10^{-8} \text{ m}$
- B. $1.34 \times 10^{-9} \text{ m}$
- C. $1.67 \times 10^{-6} \text{ m}$
- D. $3.33 \times 10^{-7} \text{ m}$

53. The basic function of an automobile's carburetor is to atomize the gasoline and mix it with air to promote rapid combustion. Assume that 30 cm^3 of gasoline is atomized into N spherical droplets. Each droplet has a radius of $2.0 \times 10^{-5} \text{ m}$. Find the total surface area of these N spherical droplets.

- A. $2\,100 \text{ cm}^2$
- B. $15\,000 \text{ cm}^2$
- C. $18\,000 \text{ cm}^2$
- D. $45\,000 \text{ cm}^2$

54. A circle has an area of 2.0 m^2 . A second circle has double the radius of the first. The area of the second circle is _____ times that of the first.

- A. 0.50
- B. 2.0
- C. 4.0
- D. 8.0

55. Doubling the radius of a sphere results in increasing its volume by a factor of

- A. 2
- B. 4
- C. 8
- D. 8 p

56. A room in a house has a floor area of 120 ft^2 . Which of the following is most likely the approximate volume of the room?

- A. 3 m^3
- B. 30 m^3
- C. 300 m^3
- D. $3\,000 \text{ m}^3$

57. When SI units are plugged into an equation, it is found that the units balance. Which of the following can we expect to be true for this equation?

- A. The equation will be dimensionally correct.
- B. The equation will be dimensionally correct except sometimes in cases when the right hand side of the equation has more than one term.
- C. The equation will not be dimensionally correct.
- D. All constants of proportionality will be correct.

58. How long has it been that scientists have accepted that the nucleus of the atom consists of neutrons and protons? Think of your answers in terms of order of magnitude.

- A. about a decade
- B. about a century
- C. about a thousand years
- D. since Aristotle

59. Consider the sine of any angle between 30° and 40° . If the angle were doubled, what would happen to the sine of the angle?

- A. It would double.
- B. It would more than double.
- C. It would increase but be less than double.
- D. In different cases, it could do any of the above.

60. There are other ways of expressing uncertainty besides significant figures. For example, suppose a quantity is known to have a value between 20.4 and 20.0, and our best estimate of the value is midrange at 20.2. We could write the number as 20.2 ± 0.2 and say that the number has a 1% uncertainty. We would also say it has 3 significant figures. If we square a number with 1% uncertainty (i.e., 2 parts in about 200) and 3 significant figures, what results?

- A. A number with 1% uncertainty and 3 significant figures.
- B. A number with 2% uncertainty and 3 significant figures.
- C. A number with 2% uncertainty and 2 significant figures.
- D. A number with 1% uncertainty and 2 significant figures.

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 - C.** 10^{-12} , 10^{-9} , and 10^9
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- A. v/t^2
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- C. v^2/t
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11. Which expression is dimensionally consistent with an expression that would yield a value for time^{-1} ? (v is velocity, x is distance, and t is time)

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- C. 1.75 million tons
- D. 3 million tons

39. A physics class in a large lecture hall has 150 students. The total mass of the students is about ____ kg.

- A. 10^2
- B. 10^3
- C.** 10^4
- D. 10^5

40. An apartment has 1100 ft^2 of floor space. What is the approximate volume of the apartment?

- A. 10^3 ft^3
- B.** 10^4 ft^3
- C. 10^5 ft^3
- D. 10^6 ft^3

41. Which point is nearest the x -axis?

- A. (-3, 4)
- B. (4, 5)
- C. (-5, 3)
- D.** (5, -2)

42. Each edge of a cube has a length of 25.4 cm. What is the length of a diagonal of the cube going through the center of the cube?

- A. 25.4 in
- B.** 17.3 in
- C. 14.4 in
- D. 10.0 in

43. If point A is located at coordinates (5, 3) and point B is located at coordinates (-3, 9), what is the distance from A to B if the units of the coordinated system are meters?

- A. 14 m
- B. 10 m**
- C. 8 m
- D. 17 m

44. A high fountain of water is in the center of a circular pool of water. You walk the circumference of the pool and measure it to be 150 meters. You then stand at the edge of the pool and use a protractor to gauge the angle of elevation of the top of the fountain. It is 55° . How high is the fountain?

- A. 17 m
- B. 23 m
- C. 29 m
- D. 34 m**

45. A right triangle has sides 5.0 m, 12 m, and 13 m. The smallest angle of this triangle is nearest:

- A. 21° .
- B. 23° .**
- C. 43° .
- D. Not attainable since this is not a right triangle.

46. If $j = 90^\circ - q$, what is the value of $\sin^2 j + \sin^2 q$?

- A. 0
- B. 1**
- C. -1
- D. The answer depends on q.

47. A triangle has sides of length 7.0 cm and 25 cm. If the triangle is a right triangle, which of the following could be the length of the third side?

- A. 18 cm
- B. 24 cm**
- C. 27 cm
- D. 32 cm

48. A train slowly climbs a 500-m mountain track which is at an angle of 10.0° with respect to the horizontal. How much altitude does it gain?

- A.** 86.8 m
- B. 88.2 m
- C. 341 m
- D. 492 m

49. Note the expression: $y = x^2$. Which statement is most consistent with this expression?

- A. If y doubles, then x quadruples.
- B. y is greater than x .
- C. If x doubles, then y doubles.
- D.** If x doubles, then y quadruples.

50. Note the expression: $y = A/x^3$. Which statement is most consistent with this expression?

- A. y is less than A .
- B.** If x is halved, y is multiplied by eight.
- C. If x is doubled, y is multiplied by a factor of 8.
- D. y is greater than x .

51. For which of the values below is $x > x^3$?

- A.** $x = -1.5$
- B. $x = 0$
- C. $x = 1.0$
- D. $x = 1.5$

52. Modern electroplaters can cover a surface area of 60.0 m^2 with one troy ounce of gold (volume = 1.611 cm^3). What is the thickness of the electroplated gold?

- A.** $2.68 \times 10^{-8} \text{ m}$
- B. $1.34 \times 10^{-9} \text{ m}$
- C. $1.67 \times 10^{-6} \text{ m}$
- D. $3.33 \times 10^{-7} \text{ m}$

53. The basic function of an automobile's carburetor is to atomize the gasoline and mix it with air to promote rapid combustion. Assume that 30 cm^3 of gasoline is atomized into N spherical droplets. Each droplet has a radius of $2.0 \times 10^{-5} \text{ m}$. Find the total surface area of these N spherical droplets.

- A. $2\,100 \text{ cm}^2$
- B. $15\,000 \text{ cm}^2$
- C. $18\,000 \text{ cm}^2$
- D.** $45\,000 \text{ cm}^2$

54. A circle has an area of 2.0 m^2 . A second circle has double the radius of the first. The area of the second circle is _____ times that of the first.

- A. 0.50
- B. 2.0
- C. 4.0**
- D. 8.0

55. Doubling the radius of a sphere results in increasing its volume by a factor of

- A. 2
- B. 4
- C. 8**
- D. 8 p

56. A room in a house has a floor area of 120 ft^2 . Which of the following is most likely the approximate volume of the room?

- A. 3 m^3
- B. 30 m^3**
- C. 300 m^3
- D. $3\,000 \text{ m}^3$

57. When SI units are plugged into an equation, it is found that the units balance. Which of the following can we expect to be true for this equation?

- A.** The equation will be dimensionally correct.
- B. The equation will be dimensionally correct except sometimes in cases when the right hand side of the equation has more than one term.
- C. The equation will not be dimensionally correct.
- D. All constants of proportionality will be correct.

58. How long has it been that scientists have accepted that the nucleus of the atom consists of neutrons and protons? Think of your answers in terms of order of magnitude.

- A. about a decade
- B.** about a century
- C. about a thousand years
- D. since Aristotle

59. Consider the sine of any angle between 30° and 40° . If the angle were doubled, what would happen to the sine of the angle?

- A. It would double.
- B. It would more than double.
- C.** It would increase but be less than double.
- D. In different cases, it could do any of the above.

60. There are other ways of expressing uncertainty besides significant figures. For example, suppose a quantity is known to have a value between 20.4 and 20.0, and our best estimate of the value is midrange at 20.2. We could write the number as 20.2 ± 0.2 and say that the number has a 1% uncertainty. We would also say it has 3 significant figures. If we square a number with 1% uncertainty (i.e., 2 parts in about 200) and 3 significant figures, what results?

- A. A number with 1% uncertainty and 3 significant figures.
- B.** A number with 2% uncertainty and 3 significant figures.
- C. A number with 2% uncertainty and 2 significant figures.
- D. A number with 1% uncertainty and 2 significant figures.