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Chapter 1 Physics and Measurement

1. The density of an object is defined as
   a. the volume occupied by each unit of mass.
   b. the amount of mass for each unit of volume.
   c. the weight of each unit of volume.
   d. the amount of the substance that has unit volume and unit mass.
   e. the amount of the substance that contains as many particles as 12 grams of the carbon-12 isotope.

ANSWER: b
POINTS: 1
DIFFICULTY: Easy
REFERENCES: 1.1 Standards of Length, Mass, and Time
HAS VARIABLES: False

2. One mole of the carbon-12 isotope contains 6.022×10^{23} atoms. What volume in m^3 would be needed to store one mole of cube-shaped children's blocks 2.00 cm long on each side?
   a. 4.8×10^{18}
   b. 1.2×10^{22}
   c. 6.0×10^{23}
   d. 1.2×10^{24}
   e. 4.8×10^{24}

ANSWER: a
POINTS: 2
DIFFICULTY: Average
REFERENCES: 1.1 Standards of Length, Mass, and Time
HAS VARIABLES: False

3. John and Linda are arguing about the definition of density. John says an object with a greater mass than another also has a greater density. Linda says it is impossible to compare the densities of the two objects without also knowing their volumes. Which one, if either, is correct?
   a. They are both wrong.
   b. John is correct, but Linda is wrong.
   c. John is wrong, but Linda is correct.
   d. They are both correct.
   e. There is not enough information given to determine who is correct.

ANSWER: c
POINTS: 1
DIFFICULTY: Easy
REFERENCES: 1.1 Standards of Length, Mass, and Time
HAS VARIABLES: False

4. The standard kilogram is a platinum-iridium cylinder 39 mm in height and 39 mm in diameter. What is the density of the material?

ANSWER: 21 464 kg/m^3
POINTS: 2

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DIFFICULTY: Average
REFERENCES: 1.1 Standards of Length, Mass, and Time
HAS VARIABLES: False

5. A 2.00-m by 3.00-m plate of aluminum has a mass of 324 kg. What is the thickness of the plate? (The density of aluminum is 2.70×10^3 kg/m^3.)
ANSWER: 2.00 cm
POINTS: 2
DIFFICULTY: Average
REFERENCES: 1.1 Standards of Length, Mass, and Time
HAS VARIABLES: False

6. What is the mass of air in a room that measures 5.0 m × 8.0 m × 3.0 m? (The density of air is 1/800 that of water).
ANSWER: 150 kg
POINTS: 2
DIFFICULTY: Average
REFERENCES: 1.1 Standards of Length, Mass, and Time
HAS VARIABLES: False

7. The term $\frac{1}{2}\rho v^2$ occurs in Bernoulli's equation, with ρ being the density of a fluid and v its speed. The dimensions of this term are what?

a. $M^{-1}L^5T^2$
b. MLT^2
c. $ML^{-1}T^{-2}$
d. $M^{-1}L^9T^{-2}$
e. $M^{-1}L^3T^{-2}$

ANSWER: c
POINTS: 2
DIFFICULTY: Average
REFERENCES: 1.3 Dimensional Analysis
HAS VARIABLES: False

8. Which of the following quantities has the same dimensions as kinetic energy, $\frac{1}{2}mv^2$?

Note: $[a] = [g] = LT^{-2}$; $[h] = L$ and $[v] = LT^{-1}$.

a. ma
b. mvx
c. mvt
d. mgh
e. mgt

ANSWER: d
POINTS: 2

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DIFFICULTY: Average
REFERENCES: 1.3 Dimensional Analysis
HAS VARIABLES: False

9. The quantity with the same units as force times time, Ft, with dimensions MLT^{-1} is what?

a. mv
b. mvr
c. mv^2r
d. ma
e. $\frac{mv^2}{r}$

ANSWER: a
POINTS: 2
DIFFICULTY: Average
REFERENCES: 1.3 Dimensional Analysis
HAS VARIABLES: False

10. The equation for the change of position of a train starting at $x = 0$ m is given by $x = \frac{1}{2}at^2 + bt^3$. What are the dimensions of b?

a. T^{-3}
b. LT^{-3}
c. LT^{-2}
d. LT^{-1}
e. $L^{-1}T^{-1}$

ANSWER: b
POINTS: 2
DIFFICULTY: Average
REFERENCES: 1.3 Dimensional Analysis
HAS VARIABLES: False

11. Spike claims that dimensional analysis shows that the correct expression for change in velocity, $\vec{\mathbf{v}}_f - \vec{\mathbf{v}}_i$, is $\vec{\mathbf{v}}_f - \vec{\mathbf{v}}_i = \frac{mt}{F}$, where m is mass, t is time, and F is the magnitude of force. Carla says that can't be true because the dimensions of force are $\left[\frac{\mathrm{ML}}{\mathrm{T}^2}\right]$. Which one, if either, is correct?

a. Spike, because $[\vec{\mathbf{v}}] = \left[\frac{\mathrm{ML}}{\mathrm{T}}\right]$.

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b. Spike, because $[\vec{v}] = \left[\frac{T^2}{L}\right]$.

c. Carla, because $[\vec{v}] = \left[\frac{L}{T}\right]$.

d. Carla, because $[\vec{v}] = \left[\frac{L}{MT}\right]$.

e. Spike, because the dimensions of force are $[\vec{F}] = \left[\frac{T^2}{ML}\right]$.

ANSWER: c
POINTS: 2
DIFFICULTY: Average
REFERENCES: 1.3 Dimensional Analysis
HAS VARIABLES: False

12. Which one of the quantities below has dimensions equal to $\left[\frac{ML}{T^2}\right]$?

a. mv
b. mv^2
c. $\frac{mv^2}{r}$
d. mrv
e. $\frac{mv^2}{r^2}$

ANSWER: c
POINTS: 2
DIFFICULTY: Average
REFERENCES: 1.3 Dimensional Analysis
HAS VARIABLES: False

13. Which quantity has dimensions equal to $[MLT^{-1}]$.

a. mr
b. mvr
c. ma
d. mat
e. $\frac{mv^2}{r}$

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ANSWER: d
POINTS: 2
DIFFICULTY: Average
REFERENCES: 1.3 Dimensional Analysis
HAS VARIABLES: False

14. If each frame of a motion picture film is 2 cm high, and 24 frames go by in a second, estimate how many frames are needed to show a two-hour-long movie.

a. 1 400
b. 25 000
c. 50 000
d. 170 000
e. This cannot be determined without knowing how many reels were used.

ANSWER: d
POINTS: 2
DIFFICULTY: Average
REFERENCES: 1.4 Conversion of Units
HAS VARIABLES: False

15. The basic function of a carburetor of an automobile is to atomize the gasoline and mix it with air to promote rapid combustion. As an example, assume that 30 cm^3 of gasoline is atomized into N spherical droplets, each with a radius of 2.0×10^{-5} m. What is the total surface area of these N spherical droplets?

ANSWER: 45 000 cm^2
POINTS: 3
DIFFICULTY: Challenging
REFERENCES: 1.4 Conversion of Units
HAS VARIABLES: False

16. Which of the following products of ratios gives the conversion factor to convert miles per hour $\left(\frac{\text{mi}}{\text{h}}\right)$ to meters per second $\left(\frac{\text{m}}{\text{s}}\right)$?

a. $\frac{5\,280\text{ ft}}{1\text{ mi}} \cdot \frac{12\text{ in.}}{1\text{ ft}} \cdot \frac{1\text{ in.}}{2.54\text{ cm}} \cdot \frac{1\text{ m}}{100\text{ cm}} \cdot \frac{1\text{ h}}{3\,600\text{ s}}$

b. $\frac{5\,280\text{ ft}}{1\text{ mi}} \cdot \frac{12\text{ in.}}{1\text{ ft}} \cdot \frac{2.54\text{ cm}}{1\text{ in.}} \cdot \frac{100\text{ cm}}{1\text{ m}} \cdot \frac{1\text{ h}}{3\,600\text{ s}}$

c. $\frac{1\text{ mi}}{5\,280\text{ ft}} \cdot \frac{1\text{ ft}}{12\text{ in.}} \cdot \frac{1\text{ in.}}{2.54\text{ cm}} \cdot \frac{100\text{ cm}}{1\text{ m}} \cdot \frac{3\,600\text{ s}}{1\text{ h}}$

d. $\frac{5\,280\text{ ft}}{1\text{ mi}} \cdot \frac{12\text{ in.}}{1\text{ ft}} \cdot \frac{2.54\text{ cm}}{1\text{ in.}} \cdot \frac{1\text{ m}}{100\text{ cm}} \cdot \frac{1\text{ h}}{3\,600\text{ s}}$

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e. $\frac{5\ 280\ \text{ft}}{1\ \text{mi}} \cdot \frac{12\ \text{in.}}{1\ \text{ft}} \cdot \frac{2.54\ \text{cm}}{1\ \text{in.}} \cdot \frac{1\ \text{m}}{100\ \text{cm}} \cdot \frac{3\ 600\ \text{s}}{1\ \text{h}}$

ANSWER: d
POINTS: 2
DIFFICULTY: Average
REFERENCES: 1.4 Conversion of Units
HAS VARIABLES: False

17. Which of the following products of ratios gives the conversion factors to convert meters per second $\left(\frac{\text{m}}{\text{s}}\right)$ to miles per hour $\left(\frac{\text{mi}}{\text{h}}\right)$?

a. $\frac{5\ 280\ \text{ft}}{1\ \text{mi}} \cdot \frac{12\ \text{in.}}{1\ \text{ft}} \cdot \frac{2.54\ \text{cm}}{1\ \text{in.}} \cdot \frac{100\ \text{cm}}{1\ \text{m}} \cdot \frac{3\ 600\ \text{s}}{1\ \text{h}}$

b. $\frac{5\ 280\ \text{ft}}{1\ \text{mi}} \cdot \frac{12\ \text{in.}}{1\ \text{ft}} \cdot \frac{1\ \text{in.}}{2.54\ \text{cm}} \cdot \frac{1\ \text{m}}{100\ \text{cm}} \cdot \frac{1\ \text{h}}{3\ 600\ \text{s}}$

c. $\frac{5\ 280\ \text{ft}}{1\ \text{mi}} \cdot \frac{12\ \text{in.}}{1\ \text{ft}} \cdot \frac{2.54\ \text{cm}}{1\ \text{in.}} \cdot \frac{100\ \text{cm}}{1\ \text{m}} \cdot \frac{1\ \text{h}}{3\ 600\ \text{s}}$

d. $\frac{1\ \text{mi}}{5\ 280\ \text{ft}} \cdot \frac{1\ \text{ft}}{12\ \text{in.}} \cdot \frac{1\ \text{in.}}{2.54\ \text{cm}} \cdot \frac{100\ \text{cm}}{1\ \text{m}} \cdot \frac{3\ 600\ \text{s}}{1\ \text{h}}$

e. $\frac{1\ \text{mi}}{5\ 280\ \text{ft}} \cdot \frac{1\ \text{ft}}{12\ \text{in.}} \cdot \frac{1\ \text{in.}}{2.54\ \text{cm}} \cdot \frac{1\ \text{m}}{100\ \text{cm}} \cdot \frac{3\ 600\ \text{s}}{1\ \text{h}}$

ANSWER: d
POINTS: 2
DIFFICULTY: Average
REFERENCES: 1.4 Conversion of Units
HAS VARIABLES: False

18. One U.S. fluid gallon contains a volume of 231 cubic inches. How many liters of gasoline would you have to buy in Canada to fill a 14-gallon tank? (Note: 1 L = 10^3 cm^3.)

a. 53
b. 21
c. 14
d. 8.0
e. 4.0

ANSWER: a
POINTS: 3
DIFFICULTY: Challenging
REFERENCES: 1.4 Conversion of Units
HAS VARIABLES: False

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19. The standard exam page is 8.50 inches by 11.0 inches. What is its area in cm^2?

a. 19.5
b. 36.8
c. 93.5
d. 237
e. 603

ANSWER: e
POINTS: 2
DIFFICULTY: Average
REFERENCES: 1.4 Conversion of Units
HAS VARIABLES: False

20. A standard exam page is 8.5 inches by 11 inches. What is the volume of an exam booklet that is 2.0 mm thick?

a. 1.9×10^4 mm^3.
b. 4.7×10^4 mm^3.
c. 1.2×10^5 mm^3.
d. 3.1×10^5 mm^3.
e. 3.1×10^3 mm^3.

ANSWER: c
POINTS: 3
DIFFICULTY: Challenging
REFERENCES: 1.4 Conversion of Units
HAS VARIABLES: False

21. Which quantity can be converted from the English system to the metric system by the conversion factor $\frac{5\,280\text{ ft}}{1\text{ mi}} \cdot \frac{12\text{ in.}}{1\text{ ft}} \cdot \frac{2.54\text{ cm}}{1\text{ in.}} \cdot \frac{1\text{ m}}{100\text{ cm}} \cdot \frac{1\text{ h}}{3\,600\text{ s}}$?

a. feet per second
b. feet per hour
c. miles per second
d. miles per hour
e. miles per minute

ANSWER: d
POINTS: 2
DIFFICULTY: Average
REFERENCES: 1.4 Conversion of Units
HAS VARIABLES: False

22. If you drove day and night without stopping for one year without exceeding the legal highway speed limit in the United States, the maximum number of miles you could drive would be closest to

a. 8 700.
b. 300 000.
c. 500 000.

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d. 1 000 000.
e. 32 000 000.

ANSWER: c
POINTS: 2
DIFFICULTY: Average
REFERENCES: 1.5 Estimates and Order-of-Magnitude Calculations
HAS VARIABLES: False

23. At the end of a year, a motor car company announces that sales of a pickup truck are down 43% for the year. If sales continue to decrease by 43% in each succeeding year, how long will it take for sales to decrease to zero?

a. 1 year
b. 2 years
c. 3 years
d. 4 years
e. More than four years

ANSWER: e
POINTS: 2
DIFFICULTY: Average
REFERENCES: 1.5 Estimates and Order-of-Magnitude Calculations
HAS VARIABLES: False

24. One number has three significant figures and another number has four significant figures. How many significant figures will their product have?

a. One
b. Three
c. Four
d. Seven
e. Twelve

ANSWER: b
POINTS: 2
DIFFICULTY: Average
REFERENCES: 1.6 Significant Figures
HAS VARIABLES: False

25. A rectangle has a length of 1.323 m and a width of 4.16 m. Using significant figure rules, what is the area of this rectangle?

a. 5.503 68 m^2
b. 5.503 7 m^2
c. 5.504 m^2
d. 5.50 m^2
e. 5.5 m^2

ANSWER: d
POINTS: 2

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DIFFICULTY: Average
REFERENCES: 1.6 Significant Figures
HAS VARIABLES: False

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