

Skillis 1-3

Topic 1A: Mathematical Reasoning

1. Express each of the following in correct scientific notation

a. 0.0000056 5.6×10^{-6}

b. 420000000 4.2×10^8

c. 0.0000254 2.54×10^{-5}

2. Apply your knowledge of mathematical functions using scientific notation to solve:

a)
 $\frac{8 \times 10^8}{2 \times 10^2} = 4 \times 10^6$

b)
 $\frac{8 \times 10^8}{2} = 4 \times 10^8$

c)
 $(3 \times 10^3)(2 \times 10^4) = 6 \times 10^{12}$

3. Which of the following is equivalent to 3.5×10^{-7} ?

A) 350 nm B) 35 μ m

C) 0.00035m

A) $350 \times 10^{-9} \text{ m} = 3.5 \times 10^2 \times 10^{-9} = 3.5 \times 10^{-7}$

B) $35 \times 10^{-6} \text{ m} = 3.5 \times 10^1 \times 10^{-6} = 3.5 \times 10^{-5}$

C) $.00035 \text{ m} = 3.5 \times 10^{-4} \text{ m}$

4. Which of the following is equivalent to 510nm?

A) $5.1 \times 10^{-9} \text{ m}$ B) $5.1 \times 10^{-7} \text{ m}$

C) $5.1 \times 10^{-11} \text{ m}$

A) $510 \text{ nm} = 510 \times 10^{-9} \text{ m} = 5.10 \times 10^2 \times 10^{-9} = 5.1 \times 10^{-7} \text{ m}$

B) $5.1 \times 10^{-7} \text{ m} = 51 \times 10^{-8} \text{ m} = .51 \mu \text{m}$

5. Which of the following is equivalent to 0.000035m

A) $3.5 \times 10^{-5} \text{ m}$

B) 35 μ m

C) 35 mm

2 answers

$3.5 \times 10^{-5} \text{ m}$

6. Use the front of the reference table to find equivalencies or "conversion factors". Pay attention to metric prefixes.

a. How many elementary charges are present in $8.0 \times 10^{10} \text{ C}$? [1 step conversion]

$1 \text{ C} = 6.25 \times 10^{18} \text{ e}$

$8 \times 10^{10} \text{ C} \times \frac{6.25 \times 10^{18} \text{ e}}{1 \text{ C}} = 5 \times 10^{29} \text{ e}$

or $8 \times 10^{10} \text{ C} \times \frac{1 \text{ e}}{1.6 \times 10^{-19} \text{ C}} = 5 \times 10^{29} \text{ e}$

b. How many joules of energy (J) are present in 3.5 universal mass units? [2+ step conversion]

$1 \text{ u} = 9.31 \times 10^2 \text{ MeV} = 9.31 \times 10^2 \times 10^6 \text{ eV} = 9.31 \times 10^8 \text{ eV}$

$1 \text{ eV} = 1.6 \times 10^{-19} \text{ J}$

$? \text{ J} = 3.5 \times \frac{9.31 \times 10^8 \text{ eV}}{1 \text{ u}} \times \frac{1.6 \times 10^{-19} \text{ J}}{1 \text{ eV}} = 52 \times 10^{-11} \text{ J} = 5.2 \times 10^{-10} \text{ J}$

c. Convert the speed of sound at STP into miles per hour. [1 mile = 1.6 kilometers]

Speed of Sound = $3.31 \times 10^2 \text{ m/s}$

$? \frac{\text{mi}}{\text{hr}} = \frac{331 \text{ m}}{\text{s}} \times \frac{1 \text{ km}}{1000 \text{ m}} \times \frac{1 \text{ mi}}{1.6 \text{ km}} \times \frac{3600 \text{ s}}{1 \text{ hrs}}$

$= 744.75 \frac{\text{mi}}{\text{hr}}$

$3.5 \times 10^{-5} \rightarrow 35 \times 10^{-6}$
 $35 \mu \text{m}$

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7. ALGEBRA REVIEW: Using equations from the reference table and the table of variables and units of measurement to determine the acceptable units for each of the following variables

Variable	Symbol	Unit	Symbol
Force	F	Newtons	N
Mass	m	Kilograms	kg
Time	t	Seconds	s
Distance	d	Meters	m
Velocity	v	Meters/second	m/s
Charge	q	Coulombs	C
Current	I	Amperes	A

Example: Determine the units for Impulse (J)
 $J = Ft$ so units are Ns

- a) acceleration (a)

$$a = \frac{\Delta v}{t} = \frac{m/s}{s} = m/s^2$$

- b) kinetic energy (KE)

$$KE = \frac{1}{2}mv^2 = \frac{1}{2}kg \left(\frac{m}{s}\right)^2 = kg \frac{m^2}{s^2}$$

- c) work (W)

$$W = Fd = Nm$$

- d) gravitational field strength (g)

$$g = \frac{F}{m} = \frac{N}{kg}$$

- e) current (I)

$$I = \frac{q}{t} = \frac{C}{s}$$

- f) electric field strength (E)

$$E = \frac{F_e}{q} = \frac{N}{C}$$

8. ALGEBRA REVIEW: Rearrange each of the following equations for the stated variable

- a) Solve in terms of "a" for the equation $F = ma$

$$F = ma \quad a = \frac{F}{m}$$

- b) Solve in terms of "v" for the equation $KE = \frac{1}{2}mv^2$

$$KE = \frac{1}{2}mv^2 \quad v^2 = \frac{2KE}{m} \quad v = \sqrt{\frac{2KE}{m}}$$

- c) Solve in terms of "A" for the equation $R = \frac{\rho L}{A}$

$$A \cdot R = \frac{\rho L}{A} \cdot A \quad A = \frac{\rho L}{R}$$

- d) Solve in terms of "t" for the equation $d = \frac{1}{2}at^2$

$$d = \frac{1}{2}at^2 \quad \frac{2d}{a} = \frac{at^2}{a} \quad t^2 = \frac{2d}{a} \quad t = \sqrt{\frac{2d}{a}}$$

9. The height of a 30-story building is approximately

- A) $1 \times 10^0 m$ B) $1 \times 10^1 m$
 C) $1 \times 10^2 m$ D) $1 \times 10^3 m$

$$1 \text{ story} \approx 3m$$

$$30 \text{ story} \approx 90-100m$$

10. The length of a football field is closest to

- A) 1000 cm = $1000 \times 10^{-2} m = 10m$ B) 1000 dm = $1000 \times 10^{-1} m = 100m$
 C) 1000 km = $1000 \times 10^3 m$ D) 1000 mm = $1000 \times 10^{-3} m = 1m$

$$\text{football field} = 100m$$

11. What is the approximate diameter of an inflated basketball?

- A) $2 \times 10^{-2} m$ 2cm B) $2 \times 10^{-1} m$ 2m or $20 \times 10^{-2} m$ 20cm
 C) $2 \times 10^0 m$ 2m D) $2 \times 10^1 m$ 20m

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12. What is the approximate length of a baseball bat?

- Think m
 A) 10^{-1} m .1m = 10cm (B) 10^0 m 1m
 C) 10^1 m 10m D) 10^2 m 100m

13. The length of a dollar bill is approximately

- Think cm
 A) 1.5×10^{-2} m (.5cm) (B) 1.5×10^{-1} m .15m = 15cm
 C) 1.5×10^1 m 15m D) 1.5×10^2 m 150m

14. What is the approximate width of a person's little finger? Think cm

- A) 1 m 100cm B) 0.1 m 10cm
 (C) 0.01 m 1cm D) 0.001 m .1cm

15. Which measurement of an average classroom door is closest to 1 meter?

- A) thickness -cm B) width 1m
 C) height -2m D) surface area m^2

16. The area of a page in a test booklet is closest to

- A) 0.6 cm^2 (3cm x 2cm) B) 6 cm^2 (2cm x 3cm)
 C) 60 cm^2 (6cm x 10cm) D) 600 cm^2 (30cm x 30cm)

17. A kilogram is equivalent to

- A) 0.454 lbs B) 2.2 lbs
 C) 2.2 grams D) 100 grams

18. 1 m^3 is equal to

- A) 100 cm^3 B) $1 \times 10^6 \text{ cm}^3 = 100\text{cm} \times 100\text{cm} \times 100\text{cm}$
 C) 1 liter D) 1 cm^3

19. The height of an average adult is approximately 1.75

- ~~A) cm~~ (B) m ~~C) mm~~ ~~D) km~~

20. Which is the most likely mass of a high school student?

- A) 1 kg B) 5 kg
 (C) 60 kg D) 250 kg