

## CHAPTER 8 UNITS, PREFIXES AND ENGINEERING NOTATION

### EXERCISE 34 Page 62

1. State the SI unit of volume.

The SI unit of volume is cubic metres,  $\text{m}^3$

2. State the SI unit of capacitance.

The SI unit of capacitance is the farad, F

3. State the SI unit of area.

The SI unit of area is square metres,  $\text{m}^2$

4. State the SI unit of velocity.

The SI unit of velocity is metres per second, m/s

5. State the SI unit of density.

The SI unit of density is kilograms per cubic metres,  $\text{kg}/\text{m}^3$

6. State the SI unit of energy.

The SI unit of energy is the joule, J

7. State the SI unit of charge.

The SI unit of charge is the coulomb, C

8. State the SI unit of power.

The SI unit of power is the watt, W

**9.** State the SI unit of angle.

The SI unit of angle is the radian, rad, or degrees, °

**10.** State the SI unit of electric potential.

The SI unit of electric potential is the volt, V

**11.** State which quantity has the unit kg.

Mass has units of kg

**12.** State which quantity has the unit symbol  $\Omega$ .

Electrical resistance has the unit symbol,  $\Omega$

**13.** State which quantity has the unit Hz.

Frequency has the unit hertz, Hz

**14.** State which quantity has the unit  $\text{m/s}^2$ .

Acceleration has the unit of  $\text{m/s}^2$

**15.** State which quantity has the unit symbol A.

Electric current has the unit symbol, A (i.e. amperes)

**16.** State which quantity has the unit symbol H.

Inductance has the unit symbol, H (i.e. henry)

**17.** State which quantity has the unit symbol m.

Length has the unit symbol, m (i.e. metres)

**18.** State which quantity has the unit symbol K.

Thermodynamic temperature has the unit symbol, K (i.e. Kelvin)

**19.** State which quantity has the unit Pa.

Pressure has the unit symbol, Pa (i.e. Pascal)

**20.** State which quantity has the unit rad/s.

Angular velocity has the unit symbol, rad/s (i.e. radians per second)

**21.** What does the prefix G mean?

Giga has the symbol G, which means  $\times 10^9$

**22.** What is the symbol and meaning of the prefix milli?

Milli has the symbol m and means  $\times 10^{-3}$

**23.** What does the prefix p mean?

Pico has the symbol p and means  $\times 10^{-12}$

**24.** What is the symbol and meaning of the prefix mega?

Mega has the symbol M and means  $\times 10^6$

### EXERCISE 35 Page 65

1. Express in standard form: (a) 73.9      (b) 28.4      (c) 197.62

(a)  $73.9 = 7.39 \times 10^1 = 7.39 \times 10$

(b)  $28.4 = 2.84 \times 10^1 = 2.84 \times 10$

(c)  $197.62 = 1.9762 \times 10^2$

2. Express in standard form: (a) 2748      (b) 33 170      (c) 274 218

(a)  $2748 = 2.748 \times 10^3$

(b)  $33\,170 = 3.317 \times 10^4$

(c)  $274\,218 = 2.74218 \times 10^5$

3. Express in standard form: (a) 0.2401      (b) 0.0174      (c) 0.00923

(a)  $0.2401 = 2.401 \times 10^{-1}$

(b)  $0.0174 = 1.74 \times 10^{-2}$

(c)  $0.00923 = 9.23 \times 10^{-3}$

4. Express in standard form: (a) 1702.3      (b) 10.04      (c) 0.0109

(a)  $1702.3 = 1.7023 \times 10^3$

(b)  $10.04 = 1.004 \times 10^1$

(c)  $0.0109 = 1.09 \times 10^{-2}$

5. Express in standard form: (a)  $\frac{1}{2}$       (b)  $11\frac{7}{8}$       (c)  $130\frac{3}{5}$       (d)  $\frac{1}{32}$

(a)  $\frac{1}{2} = 0.5 = 5 \times 10^{-1}$

(b)  $11\frac{7}{8} = 11.875 = 1.1875 \times 10$

(c)  $130\frac{3}{5} = 130.6 = 1.306 \times 10^2$

(d)  $\frac{1}{32} = 0.03125 = 3.125 \times 10^{-2}$

**6.** Express the numbers given as integers or decimal fractions:

(a)  $1.01 \times 10^3$    (b)  $9.327 \times 10^2$    (c)  $5.41 \times 10^4$    (d)  $7 \times 10^0$

(a)  $1.01 \times 10^3 = 1010$

(b)  $9.327 \times 10^2 = 932.7$

(c)  $5.41 \times 10^4 = 54\,100$

(d)  $7 \times 10^0 = 7 \times 1 = 7$

**7.** Express the numbers given as integers or decimal fractions:

(a)  $3.89 \times 10^{-2}$    (b)  $6.741 \times 10^{-1}$    (c)  $8 \times 10^{-3}$

(a)  $3.89 \times 10^{-2} = 0.0389$

(b)  $6.741 \times 10^{-1} = 0.6741$

(c)  $8 \times 10^{-3} = 0.008$

**8.** Evaluate, stating the answers in standard form:

(a)  $(4.5 \times 10^{-2})(3 \times 10^3)$    (b)  $2 \times (5.5 \times 10^4)$

(a)  $(4.5 \times 10^{-2})(3 \times 10^3) = 4.5 \times 3 \times 10^{-2+3} = 13.5 \times 10^1 = 135 = 1.35 \times 10^2$

(b)  $2 \times (5.5 \times 10^4) = 11 \times 10^4 = 110000 = 1.1 \times 10^5$

9. Evaluate, stating the answers in standard form:

(a)  $\frac{6 \times 10^{-3}}{3 \times 10^{-5}}$       (b)  $\frac{(2.4 \times 10^3)(3 \times 10^{-2})}{(4.8 \times 10^4)}$

(a)  $\frac{6 \times 10^{-3}}{3 \times 10^{-5}} = 2 \times 10^{-3-(-5)} = 2 \times 10^2$

(b)  $\frac{(2.4 \times 10^3)(3 \times 10^{-2})}{(4.8 \times 10^4)} = \frac{2.4 \times 3}{4.8} \times 10^{3-2-4} = \frac{3}{2} \times 10^{-3} = 1.5 \times 10^{-3}$

10. Write the following statements in standard form.

(a) The density of aluminium is  $2710 \text{ kg m}^{-3}$

(b) Poisson's ratio for gold is 0.44

(c) The impedance of free space is  $376.73 \Omega$

(d) The electron rest energy is 0.511 MeV

(e) Proton charge–mass ratio is  $95\,789\,700 \text{ C kg}^{-1}$

(f) The normal volume of a perfect gas is  $0.02241 \text{ m}^3 \text{ mol}^{-1}$

(a) The density of aluminium is  $2710 \text{ kg m}^{-3} = 2.71 \times 10^3 \text{ kg m}^{-3}$  in standard form

(b) Poisson's ratio for gold is  $0.44 = 4.4 \times 10^{-1}$  in standard form

(c) The impedance of free space is  $376.73 \Omega = 3.7673 \times 10^2 \Omega$  in standard form

(d) The electron rest energy is  $0.511 \text{ MeV} = 5.11 \times 10^{-1} \text{ MeV}$  in standard form

(e) Proton charge–mass ratio is  $95\,789\,700 \text{ C kg}^{-1} = 9.57897 \times 10^7 \text{ C kg}^{-1}$  in standard form

(f) The normal volume of a perfect gas is  $0.02241 \text{ m}^3 \text{ mol}^{-1} = 2.241 \times 10^{-2} \text{ m}^3 \text{ mol}^{-1}$  in standard form

### EXERCISE 36 Page 67

1. Express 60 000 Pa in engineering notation in prefix form.

$$60\,000\text{ Pa} = 60 \times 10^3\text{ Pa} = 60\text{ kPa}$$

2. Express 0.00015 W in engineering notation in prefix form.

$$0.00015\text{ W} = 150 \times 10^{-6}\text{ W} = 150\ \mu\text{W}\text{ or } 0.15\text{ mW}$$

3. Express  $5 \times 10^7$  V in engineering notation in prefix form

$$5 \times 10^7\text{ V} = 50 \times 10^6\text{ V} = 50\text{ MV}$$

4. Express  $5.5 \times 10^{-8}$  F in engineering notation in prefix form.

$$5.5 \times 10^{-8}\text{ F} = 55 \times 10^{-9}\text{ F} = 55\text{ nF}$$

5. Express 100 000 W in engineering notation in prefix form.

$$100\,000\text{ W} = 100 \times 10^3\text{ W} = 100\text{ kW}$$

6. Express 0.00054 A in engineering notation in prefix form.

$$0.00054\text{ A} = 0.54 \times 10^{-3}\text{ A} = 0.54\text{ mA}\text{ or } 540 \times 10^{-6}\text{ A} = 540\ \mu\text{A}$$

7. Express  $15 \times 10^5$   $\Omega$  in engineering notation in prefix form

$$15 \times 10^5\ \Omega = 1\,500\,000\ \Omega = 1.5 \times 10^6\ \Omega = 1.5\text{ M}\Omega$$

8. Express  $225 \times 10^{-4}$  V in engineering notation in prefix form.

$$225 \times 10^{-4}\text{ V} = 0.0225\text{ V} = 22.5 \times 10^{-3}\text{ V} = 22.5\text{ mV}$$

9. Express 35 000 000 000 Hz in engineering notation in prefix form.

$$35\,000\,000\,000\text{ Hz} = 35 \times 10^9\text{ Hz} = 35\text{ GHz}$$

10. Express  $1.5 \times 10^{-11}$  F in engineering notation in prefix form.

$$1.5 \times 10^{-11}\text{ F} = 15 \times 10^{-12}\text{ F} = 15\text{ pF}$$

11. Express 0.000017 A in engineering notation in prefix form.

$$0.000017\text{ A} = 17 \times 10^{-6}\text{ A} = 17\text{ }\mu\text{A}$$

12. Express 46 200  $\Omega$  in engineering notation in prefix form.

$$46\,200\ \Omega = 46.2 \times 10^3\ \Omega = 46.2\text{ k}\Omega$$

13. Rewrite 0.003 mA in  $\mu\text{A}$ .

$$0.003\text{ mA} = 0.003 \times 10^{-3}\text{ A} = 0.000003\text{ A} = 3 \times 10^{-6} = 3\text{ }\mu\text{A}$$

14. Rewrite 2025 kHz as MHz.

$$2025\text{ kHz} = 2\,025\,000\text{ Hz} = 2.025 \times 10^6\text{ Hz} = 2.025\text{ MHz}$$

15. Rewrite  $5 \times 10^4$  N in kN.

$$5 \times 10^4\text{ N} = 50\,000\text{ N} = 50 \times 10^3\text{ N} = 50\text{ kN}$$

16. Rewrite 300 pF in nF.

$$300\text{ pF} = 300 \times 10^{-12}\text{ F} = 0.0000000003\text{ F} = 0.3 \times 10^{-9}\text{ F} = 0.3\text{ nF}$$

**17.** Rewrite 6250 cm in metres.

$$6250 \text{ cm} = \frac{6250 \text{ cm}}{100 \text{ cm/m}} = 62.50 \text{ m}$$

**18.** Rewrite 34.6 g in kg.

$$34.6 \text{ g} = \frac{34.6 \text{ g}}{1000 \text{ g/kg}} = 0.0346 \text{ kg}$$

**19.** Evaluate:  $4.5 \times 10^{-7} \times 3 \times 10^4$  in engineering notation.

$$4.5 \times 10^{-7} \times 3 \times 10^4 = 4.5 \times 3 \times 10^{-7+4} = 13.5 \times 10^{-3}$$

**20.** Evaluate  $\frac{(1.6 \times 10^{-5})(25 \times 10^3)}{(100 \times 10^{-6})}$  in engineering notation.

$$\frac{(1.6 \times 10^{-5})(25 \times 10^3)}{(100 \times 10^{-6})} = \frac{1.6 \times 25}{100} \times 10^{-5+3-(-6)} = \frac{1.6}{4} \times 10^4 = 0.4 \times 10000 = 4000 = 4 \times 10^3$$

**21.** The distance from Earth to the moon is around  $3.8 \times 10^8$  m. State the distance in kilometres.

$$\text{Distance} = 3.8 \times 10^8 \text{ m} = \frac{3.8 \times 10^8}{10^3} = 3.8 \times 10^5 \text{ km}$$

**22.** The radius of a hydrogen atom is  $0.53 \times 10^{-10}$  m. State the radius in nanometres.

$$\text{Radius} = 0.53 \times 10^{-10} \text{ m} = \frac{0.53}{10^{10}} \text{ m} = \frac{0.53 \text{ m}}{10^{10}} \times 10^9 \text{ nm/m} = 0.053 \text{ nm}$$

**23.** The tensile stress acting on a rod is 5 600 000 Pa. Write this value in engineering notation.

$$\text{Tensile stress} = 5\,600\,000 \text{ Pa} = 5.6 \times 10^6 = 5.6 \text{ MPa}$$

**24.** The expansion of a rod is 0.0043 m. Write this in engineering notation.

$$\text{Expansion} = 0.0043 \text{ m} = 4.3 \times 10^{-3} \text{ m} = 4.3 \text{ mm}$$

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