

ANSWERS TO UNIT II : INTRODUCTION TO CHEMISTRY

1. (a) unknown amount = cost in dollars or # of dollars
initial amount = 100 g
conversion factor = \$50/g, or 1 g/\$50
- (b) unknown amount = # of disks
initial amount = \$36.00
conversion factor = \$6.00/10 disks, or 10 disks/\$6.00
- (c) unknown amount = volume in millilitres or # of millilitres
initial amount = 20 g
conversion factor = 0.35 g/mL, or 1 mL/0.35 g
- (d) unknown amount = # of kiwi fruit
initial amount = \$5
conversion factor = 3 kiwi fruit/\$1, or \$1/3 kiwi fruit
- (e) unknown amount = # of bims
initial amount = 30 tuds
conversion factor = 4 bims/5 tuds, or 5 tuds/4 bims
- (f) unknown amount = # of goats
initial amount = 10 cows
conversion factor = 2 cows/7 goats, or 7 goats/2 cows
- (g) unknown amount = mass of oxygen or # of grams
initial amount = 5.5 moles
conversion factor = 32 g/mole, or 1 mole/32 g
- (h) unknown amount = # of sulphur molecules
initial amount = 104 sulphur atoms
conversion factor = 8 sulphur atoms/1 sulphur molecule, or 1 sulphur molecule/8 sulphur atoms
- (i) unknown amount = length of time or # of seconds
initial amount = 200 coulombs
conversion factor = 35 coulombs/s, or 1 s/35 coulombs
- (j) unknown amount = temperature increase or # of °C
initial amount = 100 kJ
conversion factor = 4.18 kJ/1°C, or 1°C/4.18 kJ

2. (a) # of atoms = $5.5 \text{ mol} \times \frac{6.02 \times 10^{23} \text{ atoms}}{1 \text{ mol}} = 3.3 \times 10^{24} \text{ atoms}$
- (b) # of moles = $25.0 \text{ L} \times \frac{1 \text{ mol}}{22.4 \text{ L}} = 1.12 \text{ mol}$
- (c) # of moles = $7.0 \text{ g} \times \frac{1 \text{ mol}}{28 \text{ g}} = 0.25 \text{ mol}$
- (d) # of seconds = $200.0 \text{ coulombs} \times \frac{1 \text{ s}}{35 \text{ coulombs}} = 5.7 \text{ s}$
- (e) # of atmospheres = $4 \times 10^{-8} \text{ kPa} \times \frac{1 \text{ atm}}{101.3 \text{ kPa}} = 4 \times 10^{-10} \text{ atmospheres}$
- (f) # of kilograms = $3.20 \times 10^4 \text{ troy ounce} \times \frac{0.0311 \text{ kg}}{1 \text{ troy ounce}} = 995 \text{ kg}$
- (g) # of milliseconds = $5.0 \times 10^{-4} \text{ s} \times \frac{1 \text{ ms}}{10^{-3} \text{ s}} = 0.50 \text{ ms}$
- (h) # of moles = $15 \text{ 100 kJ} \times \frac{1 \text{ mol}}{5450 \text{ kJ}} = 2.77 \text{ mol}$

- (i) # of millimetres = $0.05 \text{ micron} \times \frac{10^{-3} \text{ mm}}{1 \text{ micron}} = 5 \times 10^{-5} \text{ mm}$
- (j) # of litres = $0.0358 \text{ mol} \times \frac{1 \text{ L}}{11.7 \text{ mol}} = 0.00306 \text{ L}$
3. # of kilopascals = $27.0 \text{ inches} \times \frac{0.0334 \text{ atm}}{1 \text{ inch}} \times \frac{101.3 \text{ kPa}}{1 \text{ atm}} = 91.4 \text{ kPa}$
4. (a) amount of heat = $3.1 \times 10^{13} \text{ m}^3 \times \frac{917 \text{ kg}}{1 \text{ m}^3} \times \frac{334 \text{ kJ}}{1 \text{ kg}} = 9.5 \times 10^{18} \text{ kJ}$
- (b) # of kilograms = $9.5 \times 10^{18} \text{ kJ} \times \frac{1 \text{ kg}}{1.51 \times 10^4 \text{ kJ}} = 6.3 \times 10^{14} \text{ kg}$
5. # of tonnes = $\$350 \times \frac{1 \text{ kg}}{\$0.980} \times \frac{1 \text{ t}}{1000 \text{ kg}} = 0.357 \text{ t}$
6. # of carats = $177 \text{ mL} \times \frac{3.51 \text{ g}}{1 \text{ mL}} \times \frac{1 \text{ carat}}{0.200 \text{ g}} = 3110 \text{ carats}$
7. (a) # of kilometres = $0.25 \text{ h} \times \frac{120 \text{ km}}{\text{h}} = 30 \text{ km}$
- (b) # of kilometres = $12 \text{ min} \times \frac{1 \text{ h}}{60 \text{ min}} \times \frac{120 \text{ km}}{1 \text{ h}} = 24 \text{ km}$
8. (a) # of dollars = $3 \text{ doz} \times \frac{\$8.40}{1 \text{ doz}} = \$25.20$
- (b) # of hamburgers = $5 \text{ doz} \times \frac{\$8.40}{1 \text{ doz}} \times \frac{1 \text{ hamburger}}{\$1.50} = 28 \text{ hamburgers}$
- (c) # of beakers = $\$13.30 \times \frac{1 \text{ doz}}{\$8.40} \times \frac{12 \text{ beakers}}{1 \text{ doz}} = 19 \text{ beakers}$
9. # of chickens = $1 \text{ gift} \times \frac{2 \text{ horses}}{1 \text{ gift}} \times \frac{5 \text{ cows}}{3 \text{ horses}} \times \frac{4 \text{ hogs}}{1 \text{ cow}} \times \frac{4 \text{ goats}}{3 \text{ hogs}} \times \frac{9 \text{ chickens}}{1 \text{ goat}} = 160 \text{ chickens}$
10. # of centimetres = $5 \text{ yard} \times \frac{3 \text{ feet}}{1 \text{ yard}} \times \frac{12 \text{ inches}}{1 \text{ foot}} \times \frac{1 \text{ cm}}{0.3937 \text{ inch}} = 457.2 \text{ cm}$
11. (a) 2.5 cm ; $2.5 \times 10^{-2} \text{ m}$ (d) 5.1 dg ; $5.1 \times 10^{-1} \text{ g}$
 (b) 1.3 kg ; $1.3 \times 10^3 \text{ g}$ (e) 0.25 ML ; $0.25 \times 10^6 \text{ L}$ (or $2.5 \times 10^5 \text{ L}$)
 (c) 25.2 mmol ; $25.2 \times 10^{-3} \text{ mol}$ (or $2.52 \times 10^{-2} \text{ mol}$) (f) 6.38 μg ; $6.38 \times 10^{-6} \text{ g}$
12. (a) 2.5 millimetres ; $2.5 \times 10^{-3} \text{ m}$ (d) 4 megatonnes ; $4 \times 10^6 \text{ t}$
 (b) 6.5 decilitres ; $6.5 \times 10^{-1} \text{ L}$ (e) 9.94 centigrams ; $9.94 \times 10^{-2} \text{ g}$
 (c) 1.9 kilomoles ; $1.9 \times 10^3 \text{ mol}$ (f) 1.25 microseconds ; $1.25 \times 10^{-6} \text{ s}$
13. (a) 4.5 mmol ; 4.5 millimoles (d) 2.68 dg ; 2.68 decigrams
 (b) 1.6 km ; 1.6 kilometres (e) 8.85 Mt ; 8.85 megatonnes
 (c) 0.50 μL ; 0.50 microlitre (f) 7.25 cm ; 7.25 centimetres
14. (a) 50 mL
 (b) $22.5 \times 10^3 \text{ kg}$ (or $2.25 \times 10^4 \text{ kg}$)
 (c) $0.125 \times 10^3 \text{ L}$ (or $1.25 \times 10^2 \text{ L}$)
15. (a) $1 \text{ kg} = 10^3 \text{ g}$ (d) $1 \text{ dm} = 10^{-1} \text{ m}$ (g) $1 \text{ kL} = 10^3 \text{ L}$ (j) $1 \text{ cL} = 10^{-2} \text{ L}$
 (b) $1 \text{ Mm} = 10^6 \text{ m}$ (e) $1 \text{ cs} = 10^{-2} \text{ s}$ (h) $1 \mu\text{s} = 10^{-6} \text{ s}$ (k) $1 \text{ dmol} = 10^{-1} \text{ mol}$
 (c) $1 \mu\text{L} = 10^{-6} \text{ L}$ (f) $1 \text{ mmol} = 10^{-3} \text{ mol}$ (i) $1 \text{ Mg} = 10^6 \text{ g}$ (l) $1 \text{ mg} = 10^{-3} \text{ g}$

16. (a) # of milligrams = $0.25 \text{ Mg} \times \frac{10^6 \text{ g}}{1 \text{ Mg}} \times \frac{1 \text{ mg}}{10^{-3} \text{ g}} = 2.5 \times 10^8 \text{ mg}$
- (b) # of centiseconds = $10 \mu\text{s} \times \frac{10^{-6} \text{ s}}{1 \mu\text{s}} \times \frac{1 \text{ cs}}{10^{-2} \text{ s}} = 1 \times 10^{-3} \text{ cs}$
- (c) # of millimetres = $15.8 \text{ cm} \times \frac{10^{-2} \text{ m}}{1 \text{ cm}} \times \frac{1 \text{ mm}}{10^{-3} \text{ m}} = 158 \text{ mm}$
- (d) # of kilograms = $250 \text{ mg} \times \frac{10^{-3} \text{ g}}{1 \text{ mg}} \times \frac{1 \text{ kg}}{10^3 \text{ g}} = 2.5 \times 10^{-4} \text{ kg}$
- (e) # of decilitres = $0.5 \text{ kL} \times \frac{10^3 \text{ L}}{1 \text{ kL}} \times \frac{1 \text{ dL}}{10^{-1} \text{ L}} = 5 \times 10^3 \text{ dL}$
17. (a) # of milliseconds = $3 \text{ s} \times \frac{1 \text{ ms}}{10^{-3} \text{ s}} = 3 \times 10^3 \text{ ms}$
- (b) # of litres = $50.0 \text{ mL} \times \frac{10^{-3} \text{ L}}{1 \text{ mL}} = 5.0 \times 10^{-2} \text{ L}$
- (c) # of microlitres = $2 \text{ L} \times \frac{1 \mu\text{L}}{10^{-6} \text{ L}} = 2 \times 10^6 \mu\text{L}$
- (d) # of grams = $25 \text{ kg} \times \frac{10^3 \text{ g}}{1 \text{ kg}} = 2.5 \times 10^4 \text{ g}$
- (e) # of metres = $3 \text{ Mm} \times \frac{10^6 \text{ m}}{1 \text{ Mm}} = 3 \times 10^6 \text{ m}$
- (f) # of decilitres = $2 \text{ L} \times \frac{1 \text{ dL}}{10^{-1} \text{ L}} = 2 \times 10^1 \text{ dL}$
- (g) # of milliseconds = $7 \mu\text{s} \times \frac{10^{-6} \text{ s}}{1 \mu\text{s}} \times \frac{1 \text{ ms}}{10^{-3} \text{ s}} = 7 \times 10^{-3} \text{ ms}$
- (h) # of milligrams = $51 \text{ kg} \times \frac{10^3 \text{ g}}{1 \text{ kg}} \times \frac{1 \text{ mg}}{10^{-3} \text{ g}} = 5.1 \times 10^7 \text{ mg}$
- (i) # of kilolitres = $3125 \mu\text{L} \times \frac{10^{-6} \text{ L}}{1 \mu\text{L}} \times \frac{1 \text{ kL}}{10^3 \text{ L}} = 3.125 \times 10^{-6} \text{ kL}$
- (j) # of centigrams = $1.7 \mu\text{g} \times \frac{10^{-6} \text{ g}}{1 \mu\text{g}} \times \frac{1 \text{ cg}}{10^{-2} \text{ g}} = 1.7 \times 10^{-4} \text{ cg}$
- (k) # of seconds = $1 \text{ yr} \times \frac{365 \text{ d}}{1 \text{ y}} \times \frac{24 \text{ h}}{1 \text{ d}} \times \frac{60 \text{ min}}{1 \text{ h}} \times \frac{60 \text{ s}}{1 \text{ min}} = 3.15 \times 10^7 \text{ s}$
- (l) # of $\frac{\text{grams}}{\text{litre}} = \frac{1 \text{ mg}}{\text{dL}} \times \frac{10^{-3} \text{ g}}{1 \text{ mg}} \times \frac{1 \text{ dL}}{10^{-1} \text{ L}} = 1 \times 10^{-2} \frac{\text{g}}{\text{L}}$
- (m) # of $\frac{\text{kilometres}}{\text{second}} = \frac{1 \text{ cm}}{\mu\text{s}} \times \frac{10^{-2} \text{ m}}{1 \text{ cm}} \times \frac{1 \text{ km}}{10^3 \text{ m}} \times \frac{1 \mu\text{s}}{10^{-6} \text{ s}} = 1 \times 10^1 \frac{\text{km}}{\text{s}}$
- (n) # of $\frac{\text{decigrams}}{\text{litre}} = \frac{1 \text{ cg}}{\text{mL}} \times \frac{10^{-2} \text{ g}}{1 \text{ cg}} \times \frac{1 \text{ dg}}{10^{-1} \text{ g}} \times \frac{1 \text{ mL}}{10^{-3} \text{ L}} = 1 \times 10^2 \frac{\text{dg}}{\text{L}}$
- (o) # of $\frac{\text{mg}}{\text{s}} = \frac{5 \text{ cg}}{\text{ds}} \times \frac{10^{-2} \text{ g}}{\text{cg}} \times \frac{1 \text{ mg}}{10^{-3} \text{ g}} \times \frac{\text{ds}}{10^{-1} \text{ s}} = 5 \times 10^2 \frac{\text{mg}}{\text{s}}$

18. (a) # of metres = $8.3 \text{ min} \times \frac{60 \text{ s}}{1 \text{ min}} \times \frac{3.00 \times 10^8 \text{ m}}{1 \text{ s}} = 1.5 \times 10^{11} \text{ m}$
- (b) # of seconds = $3.8 \times 10^5 \text{ km} \times \frac{10^3 \text{ m}}{1 \text{ km}} \times \frac{1 \text{ s}}{3.00 \times 10^8 \text{ m}} = 1.3 \text{ s}$
- (c) # of minutes = $7.83 \times 10^7 \text{ km} \times \frac{10^3 \text{ m}}{1 \text{ km}} \times \frac{1 \text{ s}}{3.00 \times 10^8 \text{ m}} \times \frac{1 \text{ min}}{60 \text{ s}} = 4.35 \text{ min}$
19. # of $\frac{\text{kg}}{\text{m}^3} = \frac{9.0 \text{ lb}}{\text{in}^3} \times \frac{1 \text{ kg}}{2.2 \text{ lb}} \times \left(\frac{39 \text{ in}}{1 \text{ m}}\right)^3 = 2.4 \times 10^5 \frac{\text{kg}}{\text{m}^3}$
20. (a) # of dollars = $90.0 \text{ kg} \times \frac{\$9.80}{10 \text{ kg}} = \$88.2$
- (b) # of dollars = $6.00 \text{ t} \times \frac{10^3 \text{ kg}}{1 \text{ t}} \times \frac{\$9.80}{10 \text{ kg}} = \$5880$
21. (a) # of centimetres = $20.0 \text{ inch} \times \frac{2.54 \text{ cm}}{1 \text{ inch}} = 50.8 \text{ cm}$
- (b) # of metres = $36 \text{ inch} \times \frac{2.54 \text{ cm}}{1 \text{ inch}} \times \frac{10^{-2} \text{ m}}{1 \text{ cm}} = 0.914 \text{ m}$
22. # of centigrams = $90 \mu\text{g} \times \frac{10^{-6} \text{ g}}{1 \mu\text{g}} \times \frac{1 \text{ cg}}{10^{-2} \text{ g}} = 9 \times 10^{-3} \text{ cg}$
23. (a) # of hours = $450 \text{ km} \times \frac{1 \text{ h}}{105 \text{ km}} = 4.3 \text{ h}$
- (b) # of seconds = $2.0 \times 10^2 \text{ m} \times \frac{1 \text{ km}}{10^3 \text{ m}} \times \frac{1 \text{ h}}{105 \text{ km}} \times \frac{60 \text{ min}}{1 \text{ h}} \times \frac{60 \text{ s}}{1 \text{ min}} = 6.9 \text{ s}$
- (c) # of kilometres = $10.0 \text{ min} \times \frac{1 \text{ h}}{60 \text{ min}} \times \frac{105 \text{ km}}{1 \text{ h}} = 17.5 \text{ km}$
- (d) # of centimetres = $1.00 \text{ ms} \times \frac{10^{-3} \text{ s}}{1 \text{ ms}} \times \frac{1 \text{ min}}{60 \text{ s}} \times \frac{1 \text{ h}}{60 \text{ min}} \times \frac{105 \text{ km}}{1 \text{ h}} \times \frac{10^3 \text{ m}}{1 \text{ km}} \times \frac{1 \text{ cm}}{10^{-2} \text{ m}} = 2.92 \text{ cm}$
24. (a) # of kilograms = $7.00 \text{ L} \times \frac{5.50 \text{ kg}}{1 \text{ L}} = 38.5 \text{ kg}$
- (b) # of litres = $22 \text{ kg} \times \frac{1 \text{ L}}{5.50 \text{ kg}} = 4.0 \text{ L}$
- (c) # of grams = $5.00 \text{ mL} \times \frac{10^{-3} \text{ L}}{1 \text{ mL}} \times \frac{5.50 \text{ kg}}{\text{L}} \times \frac{10^3 \text{ g}}{1 \text{ kg}} = 27.5 \text{ g}$
25. (a) # of grams = $10.0 \text{ kJ} \times \frac{1.00 \text{ g}}{0.334 \text{ kJ}} = 29.9 \text{ g}$
- (b) # of kilojoules = $50.0 \text{ g} \times \frac{0.334 \text{ kJ}}{1.00 \text{ g}} = 16.7 \text{ kJ}$
- (c) # of joules = $2.00 \text{ kg} \times \frac{10^3 \text{ g}}{1 \text{ kg}} \times \frac{0.334 \text{ kJ}}{1.00 \text{ g}} \times \frac{1000 \text{ J}}{1 \text{ kJ}} = 6.68 \times 10^5 \text{ J}$