

# SOLUTIONS

→ × 10<sup>-</sup>  
← × 10<sup>+</sup>

## Review Questions for Midterm Exam

Use the order of operations to simplify the following expression

1. 
$$\frac{[-8 - (|-4| \times 8 \div 16)] [-15 - (\sqrt{64} \div -2)]}{(43 - 40)^3 - 2^4 \div 4}$$

$$\frac{[-8 - (4 \times 8 \div 16)] [-15 - (8 \div -2)]}{(3)^3 - 16 \div 4}$$

$$\frac{[-8 - (32 \div 16)] [-15 - (-4)]}{27 - 4}$$

$$\frac{[-8 - 2] [-15 + 4]}{23}$$

$$\frac{[-10] [-11]}{23}$$

$$\frac{110}{23}$$

Solve the following expressions

2. 
$$\frac{10^{-23} \times 10^{-16} \times 10^{31}}{10^{17} \times 10^{13} \times 10^{-27}}$$

$$\frac{10^{-23-16+31}}{10^{17+13-27}} = \frac{10^{-8}}{10^3} = \frac{1}{10^{3+8}} = \frac{1}{10^{11}}$$

$$\frac{\left(\frac{10^{16}}{10^{-25}}\right)^{-6}}{\left(\frac{10^{-18}}{10^{22}}\right)^3} = \frac{(10^{16+25})^{-6}}{(10^{-18-22})^3}$$

$$\frac{(10^{41})^{-6}}{(10^{-40})^3} = \frac{10^{-246}}{10^{-120}}$$

$$\frac{1}{10^{126}}$$

3. 
$$\frac{18 \times 12 \times 10^6}{27 \times 10^4 + (8.2 \times 10^2)^3}$$

$$\frac{216 \times 10^6}{27 \times 10^4 + (8.2)^3 \times (10^2)^3}$$

$$\frac{216 \times 10^6}{27 \times 10^4 + 551.368 \times 10^6} = \frac{216 \times 10^6}{0.27 \times 10^4 \cdot 10^2 + 551.368 \times 10^6} = \frac{216 \times 10^6}{551.638 \times 10^6} = 0.3915 \approx 3.9 \times 10^{-11}$$

$$4. \frac{1}{6.280 \times 10^2} + \frac{1}{5160} - \sqrt{9720}$$

$$\frac{1}{6.280} \times \frac{1}{10^2} + \frac{1}{5.160} \times \frac{1}{10^3} - (\sqrt{9.720} \times \sqrt{10^3})$$

$$0.15923 \times 10^{-2} + 0.1938 \times 10^{-3} - 3.1177 \times 31.6227$$

$$0.15923 \times 10^{-2} + 0.01938 \times 10^{-3} \times 10^1 - 98.59009$$

$$0.15923 \times 10^{-2} + 0.01938 \times 10^{-2} - 98.59009 = -98.588$$

$$-9.859 \times 10^1$$

$$5. \frac{1}{\frac{1}{7500} - \frac{1}{5600} + \frac{1}{3300}}$$

$$0.0001333 - 0.00017857 + 0.00030303$$

$$0.00025776 = 3879.577 \Rightarrow 3.880 \times 10^3$$

Convert to the following units, final answers should be in scientific notation

$$6. 0.000417 \text{ A} = \frac{4.17 \times 10^{-4}}{1} \text{ A} = 4.17 \times 10^{-1} \text{ mA} = 4.17 \times 10^2 \text{ } \mu\text{A}$$

$$7. 34.7 \text{ mL/km} = \frac{34.7 \text{ mL}}{1 \text{ km}} = 1.34 \times 10^{-4} \text{ cups/yard} = 8.81 \times 10^{-16} \text{ GL/inch}$$

$$\left( \frac{4.17 \times 10^{-4} \text{ A}}{1} \right) \left( \frac{1 \text{ mA}}{10^{-3} \text{ A}} \right) = \frac{4.17 \times 10^{-4} \text{ mA}}{10^{-3}}$$

$$\left( \frac{4.17 \times 10^{-4} \text{ A}}{1} \right) \left( \frac{1 \text{ } \mu\text{A}}{10^{-6} \text{ A}} \right) = \frac{4.17 \times 10^{-4} \text{ } \mu\text{A}}{10^{-6}}$$

$$\left( \frac{34.7 \text{ mL}}{1 \text{ km}} \right) \left( \frac{1.609 \text{ km}}{1 \text{ mile}} \right) \left( \frac{1 \text{ mile}}{1760 \text{ yds}} \right) \left( \frac{1 \text{ teaspoon}}{4.93 \text{ mL}} \right) \left( \frac{1 \text{ tablespoon}}{3 \text{ teaspoons}} \right) \left( \frac{1 \text{ cup}}{16 \text{ tablespoons}} \right) = \frac{34.7 \times 1.609}{1760 \times 4.93 \times 3 \times 16} = 1.34 \times 10^{-4}$$

$$\left( \frac{34.7 \text{ mL}}{1 \text{ km}} \right) \left( \frac{10^{-3} \text{ L}}{1 \text{ mL}} \right) \left( \frac{1 \text{ GL}}{10^9 \text{ L}} \right) \left( \frac{1.609 \text{ km}}{1 \text{ mile}} \right) \left( \frac{1 \text{ mile}}{5280 \text{ feet}} \right) \left( \frac{1 \text{ foot}}{12 \text{ inches}} \right) = \frac{34.7 \times 1.609 \times 10^{-3}}{12 \times 5280 \times 10^9} = 8.81 \times 10^{-16}$$

Convert the following

| Decimal Number | Scientific Notation    |
|----------------|------------------------|
| 0.000008601    | $8.601 \times 10^{-6}$ |
| 0.0000000571   | $5.71 \times 10^{-7}$  |

9. Fill in the following table by converting the known numbers

| Decimal (Base 10)  | Binary (Base 2)           | Octal (Base 8)    | Hexadecimal (Base 16) |
|--------------------|---------------------------|-------------------|-----------------------|
| 433 <sub>10</sub>  | 110110001 <sub>2</sub>    | 661 <sub>8</sub>  | 1B1 <sub>16</sub>     |
| 38 <sub>10</sub>   | 100110 <sub>2</sub>       | 46 <sub>8</sub>   | 26 <sub>16</sub>      |
| 117 <sub>10</sub>  | 001110101 <sub>2</sub>    | 165 <sub>8</sub>  | 075 <sub>16</sub>     |
| 1004 <sub>10</sub> | 001111101100 <sub>2</sub> | 1754 <sub>8</sub> | 3EC <sub>16</sub>     |

Handwritten conversion steps for decimal to binary:

- 433 (R1):  $2 \overline{) 433}$  → 216 (R1), 4, 03, -2, 13, -12, 1
- 108 (R0):  $2 \overline{) 108}$  → 54 (R0), 10, 08, -8, 0
- 54 (R0):  $2 \overline{) 54}$  → 27 (R0), 4, 14, 14, 0
- 27 (R0):  $2 \overline{) 27}$  → 13 (R1), 2, 07, -6, 1
- 13 (R1):  $2 \overline{) 13}$  → 6 (R1), 12, 1
- 6 (R1):  $2 \overline{) 6}$  → 3 (R0), 6, -6, 0
- 3 (R0):  $2 \overline{) 3}$  → 1 (R1), 2, -2, 0

Binary to octal and hexadecimal conversion:

110110001<sub>2</sub> → 0001 | 1011 | 0001 → 1 | B | 1<sub>16</sub> → 661<sub>8</sub>

26<sub>16</sub> →  $2 \cdot 16^1 + 6 \cdot 16^0$   
 $2 \cdot 16 + 6 \cdot 1 = 38_{10}$

075<sub>16</sub> →  $0 \cdot 16^2 + 7 \cdot 16^1 + 5 \cdot 16^0$   
 $0 + 7 \cdot 16 + 5 \cdot 1 = 117_{10}$

3EC<sub>16</sub> →  $3 \cdot 16^2 + E \cdot 16^1 + C \cdot 16^0$   
 $3 \cdot 256 + 14 \cdot 16 + 12 \cdot 1 = 768 + 224 + 12 = 1004_{10}$

Binary to octal and hexadecimal conversion for 117:

000011010101<sub>2</sub> → 0000 | 0111 | 0101 → 0 | 7 | 5<sub>16</sub> → 165<sub>8</sub>

Binary to hexadecimal conversion for 1004:

001111101100<sub>2</sub> → 0011 | 1110 | 1100 → 3 | E | C → 3EC<sub>16</sub>

$$A=10, B=11, C=12, D=13, E=14, F=15$$

Compute the following in the given base

10.  $71456_8 + 20317_8$

$$\begin{array}{r} 71456_8 \\ + 20317_8 \\ \hline 1917713 \\ - \phantom{1}8 \phantom{1}8 \\ \hline 111775_8 \end{array}$$

11.  $A3B92F_{16} + 83CD0E_{16}$

$$\begin{array}{r} A3B92F_{16} \\ + 83CD0E_{16} \\ \hline 11872422329 \\ - \phantom{1}16 \phantom{16}16 \phantom{16} \\ \hline 12786313 \\ - 127863D_{16} \\ \hline \end{array}$$

12.  $1100011_2 + 1011011_2$

$$\begin{array}{r} 1100011_2 \\ + 1011011_2 \\ \hline 12111132 \\ - \phantom{1}2 \phantom{1}22 \\ \hline 1011110_2 \end{array}$$

13.  $101110_2 \div 101_2$

$$\begin{array}{r} 1001 \text{ (R1)} \\ 101 \overline{) 101110} \\ \underline{-101} \\ 0001 \\ \underline{-000} \\ 011 \\ 000 \\ \underline{-000} \\ 110 \\ \underline{-101} \\ 11 \end{array}$$

14.  $732540_8 - 164273_8$

$$\begin{array}{r} 732540_8 \\ - 164273_8 \\ \hline 546245_8 \end{array}$$

15.  $8C90A3_{16} - 231A79_{16}$

$$\begin{array}{r} 8C90A3_{16} \\ - 231A79_{16} \\ \hline 6976210 \\ - 69762A_{16} \\ \hline \end{array}$$

16.  $1110011_2 - 0101101_2$

$$\begin{array}{r} 1110011_2 \\ - 0101101_2 \\ \hline 1000110_2 \end{array}$$

17.  $1010110_2 \times 1011_2$

$$\begin{array}{r} 1010110 \\ \times 1011 \\ \hline 1010110 \\ 1010110 \\ 1010110 \\ 0000000 \\ + 1010110 \\ \hline 1110110010_2 \end{array}$$

$1101101_2 - 1001010_2$  (Use the one's complement)

$$\begin{array}{r}
 1101101_2 \\
 - 1001010_2 \\
 \hline
 \end{array}
 \xrightarrow{\text{invert}}
 \begin{array}{r}
 1111111 \\
 - 1001010 \\
 \hline
 0110101
 \end{array}
 \rightarrow
 \begin{array}{r}
 1111111 \\
 1101101 \\
 + 0110101 \\
 \hline
 10100010 \\
 + \phantom{10100010} 1 \\
 \hline
 0100011_2
 \end{array}$$

19.  $1010110_2 - 1010001_2$  (Use the two's complement)

$$\begin{array}{r}
 1010110_2 \\
 - 1010001_2 \\
 \hline
 \end{array}
 \xrightarrow{\text{invert}}
 \begin{array}{r}
 1111111 \\
 - 1010001 \\
 \hline
 0101110 \\
 + 1 \\
 \hline
 0101111
 \end{array}
 \rightarrow
 \begin{array}{r}
 1111111 \\
 1010110 \\
 + 0101111 \\
 \hline
 10000101_2
 \end{array}$$

20.  $964805_{10} - 697123_{10}$  (Use the nine's complement)

$$\begin{array}{r}
 964805_{10} \\
 - 697123_{10} \\
 \hline
 \end{array}
 \xrightarrow{\text{invert}}
 \begin{array}{r}
 999999 \\
 - 697123 \\
 \hline
 302876
 \end{array}
 \rightarrow
 \begin{array}{r}
 964805 \\
 + 302876 \\
 \hline
 12676811 \\
 \phantom{12676811} \phantom{11} \\
 \phantom{12676811} \phantom{11} \phantom{11} \\
 \hline
 1267681 \\
 + \phantom{1267681} 1 \\
 \hline
 267682_{10}
 \end{array}$$

21.  $739618_{10} - 428561_{10}$  (Use the ten's complement)

$$\begin{array}{r}
 739618_{10} \\
 - 428561_{10} \\
 \hline
 \end{array}
 \xrightarrow{\text{invert}}
 \begin{array}{r}
 999999 \\
 - 428561 \\
 \hline
 571438 \\
 + 1 \\
 \hline
 571439
 \end{array}
 \rightarrow
 \begin{array}{r}
 739618 \\
 + 571439 \\
 \hline
 131110517 \\
 - 10101010 \\
 \hline
 311057_{10}
 \end{array}$$

Also questions on conversion between percent and decimal, rounding, significant figures, scientific notation, powers of 10...will be in multiple choice format.