ENGR 1020 Freshman Engineering Seminar Initial Assessment Key

# If you wish to use any of the libraries noted below, then you will need to copy and paste the 
# following commands in R first
install.packages("install.load") # install the install.load package
library(install.load) # load the install.load package (library)
install_load("mosaic", "Deriv", "DescTools", "prob", "signal", "pracma") # does not require 
# system dependencies
install_load("mosaic", "Ryacas", "Deriv", "DescTools", "prob", "signal", "pracma", "rSymPy")
# install and load the named packages and all of their dependencies, including the system 
# dependencies (this process may take a while depending on the number of dependencies)

Solve the following problems:

1) \[ \int x^2 + 2x - 2 \, dx \]

\[ \frac{x^3}{3} + x^2 - 2x + C \]

library(mosaic)
antiD(x^2 + 2*x - 2 ~ x)

function (x, C = 0)
1/3 * x^3 + 1 * x^2 - 2 * x + C

library(Ryacas) # requires yacas
x <- Sym("x")
Integrate(x ^ 2 + 2 * x - 2, x)

x^3/3 + x ^ 2 - 2 * x

library(rSymPy) # requires Java, Jython, Python
sympy("integrate(x**2 + 2*x - 2, x)"

[1] "-2*x + x**2 + x**3/3"

2) \[ \frac{d}{dx} (x^2 + 2x - 2) \]

\[ 2x + 2 \]

# base R
simp.exp <- expression(x^2 + 2*x - 2)
(D.sc <- D(simp.exp, "x") )

2 * x + 2
library(Deriv)
f <- function (x) x ^ 2 + 2 * x - 2
Deriv(f)

function (x) 
2 + 2 * x

library(mosaic)
D(x^2 + 2*x - 2 - x)

function (x) 
2 * x + 2

library(Ryacas) # requires yacas
x <- Sym("x")
deriv(x ^ 2 + 2 * x - 2, x)
2*x+2;

library(rSymPy) # requires Java, Jython, Python
sympy("diff(x**2+2*x-2, x, 1)")
[1] "2 + 2*x"

3) If x = 5, then what is \( x^2 + 2x - 2 \)?

x <- 5
x^2 + 2 * x - 2
[1] 33

4) 5, 2, 4, 6, 9.2, 10.0, 100, 7, 2  Please round your answer to the nearest tenth

A) What is the mean of the above data set?

mean(c(5, 2, 4, 6, 9.2, 10.0, 100, 7, 2))
[1] 16.13333

B) What is the median of the above data set?

median(c(5, 2, 4, 6, 9.2, 10.0, 100, 7, 2))
[1] 6

C) What is the mode of the above data set?
5) If you have a standard 54 card deck, what is the probability that you will pick any card from the Hearts suite?

**13/54 or 13/52 (no Jokers)**

```r
library(prob)
cds <- cards(jokers = TRUE, makespace = TRUE) # include the probability column in the cards function and create a data.frame called cds of the cards function
Heart <- subset(cds, suit == "Heart") # subset cds with only the Heart suit
Heartprob <- Prob(Heart) # Calculates the probability
Heartprob
[1] 0.2407407
```

or

```r
library(prob)
cds <- cards(makespace = TRUE) # include the probability column in the cards function and create a data.frame called cds of the cards function
Heart <- subset(cds, suit == "Heart") # subset cds with only the Heart suit
Heartprob <- Prob(Heart) # Calculates the probability
Heartprob
[1] 0.25
```

*6) What is the angle between force \( F \) and the x-axis, where \( F = 30i + 50j - 20k \) newtons?

a) 30°

b) 65.8°

c) 60.9°

d) 12.8°

\[
\begin{align*}
Fx & <- 30 \# 30i \\
Fy & <- 50 \# 50j \\
Fz & <- -20 \# -20k \\
\end{align*}
\]

```r
cos_thetax <- Fx / sqrt(Fx ^ 2 + Fy ^ 2 + Fz ^ 2)
thetarad <- acos(cos_thetax) # radians
theta <- thetarad * (180 / pi) # degrees
theta
[1] 60.87843
```
*7) Solve the equation $x(2x - 3) = 5$ for $x$.

a) $-1$

b) $\frac{5}{2}$

c) $3$

d) both a) and b)

library(signal)
roots(c(2, -3, -5))
[1] -1.0-0i 2.50i

library(pracma)
roots(c(2, -3, -5))
[1] 2.5 -1.0

library(pracma)
fzero(function(x) 2 * x ^ 2 - 3 * x - 5, 2)
$x$
[1] 2.5 = 5/2
$fval$
[1] 0

fzero(function(x) 2 * x ^ 2 - 3 * x - 5, -2)
$x$
[1] -1
$fval$
[1] 0

*8) Solve this system of equations:

$x - y + z = -3$

$2x + y = 1$

$y - 3z = 7$

a <- matrix(c(1, -1, 1, 2, 1, 0, 0, 1, -3), nrow = 3, ncol = 3, byrow = TRUE)
b <- c(-3, 1, 7)
solve(a, b)
[1] 0 1 -2

a) $x = 0, y = -11, z = 2$

b) $x = 0, y = 1, z = -2$
c) \( x = 1, y = -1, z = 0 \)
d) \( x = 0, y = 2, z = -6 \)

*A segment of a spreadsheet is shown below. Use the numbers in the cells to answer the following questions.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20</td>
<td>21</td>
<td>22</td>
<td>23</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>A2^2</td>
<td>B2*A$1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>A3^2</td>
<td>B3*B$1</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>7</td>
<td>A4^2</td>
<td>B4*C$1</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>8</td>
<td>A5^2</td>
<td>B5*D$1</td>
<td></td>
</tr>
</tbody>
</table>

*9) What will be the top to bottom values in column B?

a) 25, 30, 35, 40  
b) **25, 36, 49, 64**  
c) 40, 42, 44, 46  
d) 5, 6, 7, 8

```r
A <- c(20, 5, 6, 7, 8)  
A = 20 5 6 7 8
```

```r
B = 21 25 36 49 64
```

```r
D <- 23
```

```r
C = 22 500 756 1078 1472
```

*10) What will be the top to bottom values in column C?

a) 25, 36, 49, 64  
b) 100, 126, 154, 184  
c) **500, 756, 1078, 1472**  
d) 125, 196, 34, 2

Works Cited