Problem 1

(2 points) If a resistor has color stripes of brown, green and orange, then the resistance is closest to...

a. 15 Ω
b. 152 Ω
c. 215 Ω
Answer: f
d. 1500 Ω
e. 5100 Ω
f. 15000 Ω
g. 21500 Ω
Problem 2
(2 points) Which of the units below is equivalent to a Joule of energy?

a. \( \frac{\text{kg}}{\text{s}} \)

b. \( \frac{\text{kg} \cdot \text{m}}{\text{s}} \)

c. \( \frac{\text{kg} \cdot \text{m}}{\text{s}^2} \)

d. \( \frac{\text{kg} \cdot \text{m}^2}{\text{s}^2} \)

e. \( \frac{\text{kg} \cdot \text{m}^3}{\text{s}} \)

Answer: d
Problem 3
(2 points) The body of the pump is made of what material?

a. nitrogen
b. PVC
c. HDPE
d. bronze
e. acrylic
f. polyester
g. UHMWPE
h. kryptonite
i. teflon

Answer: b
Problem 4
(2 points) The large drill bits (1 inch and 1.25 inch) used to make the impeller cavity in the pump body are commonly called...

a. #44 bits
b. Q bits
c. N bits
d. bacon bits
e. end mills
f. Forstner bits
g. jobber bits
h. flat-bottomed, rotational cutting implements

Answer: f
Problem 5
(2 points) Consider the three plots below. If linear regression is used to determine the best-fit line to this data, then which form of the equation is likely be work best?

a. linear
b. sinusoidal
c. power
d. exponential
e. utopian
f. tight
g. polyester

Answer: c
Problem 6
(2 points) The unit of electric potential is the Volt. The basic units which define the Volt are...

a. $\frac{\text{meter}^3}{\text{second}}$

b. $\frac{\text{Joule}}{\text{Coulomb}}$

c. $\frac{\text{Joule}}{\text{second}}$

d. $\frac{\text{electrons}}{\text{m}^3}$

e. $\frac{\text{electrons}}{\text{ohm}}$

f. $\frac{\text{Coulomb}}{\text{second}}$

g. $\frac{\text{electrons}}{\text{bushel}}$

Answer: b
Problem 7
(2 points) A cylindrical container 1-inch in diameter and 2-inches tall is filled with water. The volume of the water in the container is closest to...

a. 0.026 L  
b. 0.054 L  
c. 0.075 L  
d. 0.103 L  
e. 0.371 L  
f. 0.987 L  
g. 1.57 L  
h. 1.94 L  
i. 8.71 L

Answer: a
Problem 8
(2 points) If you wanted to make an LED flash on and off repeatedly using the Arduino (the way we did early in ENGR 120, where we had an LED and a resistor in series on the breadboard), you would need one wire going from your breadboard back to GND. Where on the Arduino would you hook up the other wire?

a. A  
 b. B  
 c. C  
 d. D  
 e. E  
 f. F

Answer: f
Problem 9
(2 points) Which of the statements below is true?

a. potential energy has units of Joules per second
b. kinetic energy has units of Joules per hour
c. potential energy and kinetic energy both have units of Joules
d. electrical energy has units of Coulombs/second
e. the force exerted by a gram of water is one Newton
f. the fundamental unit of electrical charge is the “sparky”
g. a force multiplied by a distance is a horsepower

Answer: c
Problem 10
(2 points) Consider the Arduino code below. When this for statement is executed, x will take on different values. The smallest value of $X$ that will be printed to the serial monitor is...

a. -65535 
b. -32767 
c. 0 
d. 5 
e. 6 
f. 21 
g. 22 
h. 225 
i. 32767 
j. 65535 

for (int x=22; x>5; x--)
{
  Serial.println(x);
}

Answer: e
Problem 11
(5 points) The voltage drop across R1 for the circuit shown below is closest to...

a. 0.823 V  
b. 1.326 V  
c. 8.897 V  
d. 3.857 V  
e. 1.496 V  
f. 5.143 V  
g. 0.082 V  
h. 4.785 V

V1 = 9 V  
R1 = 100 Ω  
R2 = 200 Ω  
R3 = 200 Ω  
R4 = 300 Ω

Answer: f
Problem 12
(5 points) The current through R3 for the circuit shown below is closest to...

a. 0.015 A
b. 0.025 A
c. 0.035 A
d. 0.045 A
e. 0.055 A
f. 0.065 A
g. 0.075 A
h. 0.085 A
i. 0.095 A

Answer: b

V1 = 5 V
R1 = 100 Ω
R2 = 200 Ω
R3 = 200 Ω
R4 = 300 Ω
R5 = 500 Ω
Problem 13
(5 points) The power dissipated by R2 for the circuit shown below is closest to...

a. 0.093 W  

b. 0.193 W  

c. 0.293 W  

d. 0.393 W  

e. 0.593 W  

f. 0.793 W  

g. 0.893 W  

h. 0.993 W  

Answer: d
Problem 14
(5 points) The equivalent resistance of all the resistors in the circuit shown below is closest to...

a. 0.2 Ω  
b. 10.2 Ω  
c. 20.2 Ω  
d. 30.2 Ω  
e. 40.2 Ω  
f. 50.2 Ω  
g. 60.2 Ω  
h. 70.2 Ω  
i. 80.2 Ω

V1 = 9 V
R1 = 100 Ω
R2 = 200 Ω
R3 = 200 Ω
R4 = 300 Ω
R5 = 400 Ω

Answer: g
Problem 15
(5 points) A multimeter measures quantities by either hooking its leads so that they are in parallel with a circuit element, e.g. a resistor, or in series with a circuit element. If the leads are placed in series with a circuit element, the multimeter must be measuring:

a. Capacitance
b. Current
c. Power
d. Resistance
e. Voltage (AC)
f. Voltage (DC)

Answer: b
Problem 16
(5 points) You have recently installed a pool next to your home and are filling it with water from a nearby pond. The water is pumped from the pond up to the pool which is 3 feet higher (elevation difference). Assuming 60 kg of water is pumped into the pool every minute at a velocity of 2.0 m/s and the power (in watts) delivered to the pump is 16.9 W, then the efficiency (%) of the pump/piping system is closest to...

a. 2%
b. 11%
c. 29%
d. 42%
e. 65%
f. 87%
g. 93%

Answer: e
Problem 17
(5 points) A garden hose is used to fill a 20 gallon bucket. The inner diameter of the hose is 1 inch. If the average velocity in the hose is 4.9 ft/s, the time it will take to fill the bucket with water is closest to...

a. 305 s
b. 100 s
c. 49 s
d. 30 s
e. 17 s
f. 6 s
g. 4 s

Answer: b
Problem 18

(5 points) Using your experience from the centrifugal water pump testing you did in class (and/or at helpdesk hours), the setup for determining the power input to your pump can be shown by ...

a. I only
b. II only
c. III only
d. IV only
e. I and IV
f. II and III
g. III and IV

Answer: f
Problem 19
(5 points) You are building a water fountain in your front yard using a small water pump. The pump sprays the water to an average height of 3 meters above the pump, and you measure that the pump flow rate is 5 gallons of water per minute. The velocity at the peak can be neglected, i.e. assume $v=0$ m/s. Assuming the pump is 40% efficient, the Joules of energy input used by the pump in a minute is closest to...

a. 37.5 J  
b. 142 J  
c. 186 J  
d. 464 J  
e. 557 J  
f. 1393 J  
g. 2322 J

Answer: f
Problem 20
(5 points) A walk-in medical clinic wants to use their history of walk-in patients to predict the number of patients they expect to see in a few weeks. Given the information in the table, and assuming that a linear fit will give them the best result, then the number of patients expected in Week 10 is closest to...

<table>
<thead>
<tr>
<th>Week</th>
<th>Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>46</td>
</tr>
<tr>
<td>5</td>
<td>64</td>
</tr>
<tr>
<td>7</td>
<td>85</td>
</tr>
</tbody>
</table>

a. 0
b. 29
c. 46
d. 64
e. 85
f. 90
g. 97
h. 106
i. 115
j. 137

Answer: h
Problem 21
(5 points) An engineer calculated the slope (m) to be 0.1234, using an exponential fit \( y = b \cdot e^{mx} \) for the following data points. However, she forgot to determine the intercept (b). Also using an exponential fit, you find the intercept to be closest to...

a. -42.9  
b. 0  
c. 0.1234  
d. 2.21  
e. 3.275  
f. 9.15  
g. 42.9  
h. 52  
i. 72.123

<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>10</td>
</tr>
<tr>
<td>15</td>
<td>50</td>
</tr>
<tr>
<td>30</td>
<td>400</td>
</tr>
</tbody>
</table>

Answer: f
Problem 22
(5 points) An engineer is growing bio-nanoparticles in a Petri dish. She observed the growth rate of the particles over time. Assuming that a Power fit \( y = b \cdot x^m \) is the best fit for the data, the value for the slope (m) is closest to...

a. 1.48
b. 1.73
c. 2.54
d. 3.97
e. 7.81
f. 15.47
g. 21.59
h. 46.78
i. 52.25
j. Not enough information given to solve the problem

<table>
<thead>
<tr>
<th>Time (hrs)</th>
<th># of Particles</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>240</td>
</tr>
<tr>
<td>100</td>
<td>38000</td>
</tr>
</tbody>
</table>

Answer: a
Problem 23
(5 points) Around Halloween, an engineer wondered if there is a linear correlation between the circumference of pumpkins (measured in cm) and their weight (measured in grams). He assumed that circumference is the independent variable, and took the measurements shown in the table. To determine how good the linear fit was, he calculated the coefficient of determination ($r^2$) and found that it was closest to...

<table>
<thead>
<tr>
<th>Circumference (cm)</th>
<th>Weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>1200</td>
</tr>
<tr>
<td>60</td>
<td>2700</td>
</tr>
<tr>
<td>70</td>
<td>3000</td>
</tr>
</tbody>
</table>

a. 0.500
b. 0.7231
c. 0.8710
d. 0.9114
e. 0.9333
f. 0.9750
g. 0.9832
h. 0.9995
i. Not enough information given to solve the problem

Answer: c
Problem 24
(5 points) Identify the following data points on the unlabeled semi-logarithmic graph paper below for the Price of a Company’s Stock per Share vs the Year. (NOTE: The graph below is not labeled completely, however, you have enough information to identify the correct data points given what you were taught about semi-logarithmic graph paper.)

<table>
<thead>
<tr>
<th>Year</th>
<th>Price of Stock per share ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0.40</td>
</tr>
<tr>
<td>4</td>
<td>1.80</td>
</tr>
<tr>
<td>6</td>
<td>1.00</td>
</tr>
</tbody>
</table>

The data in the table above best correspond to points...

a. 1, 4 & 8
b. 2, 6 & 7
c. 3, 5 & 9
d. 1, 4 & 7
e. 2, 5 & 8
f. 3, 4 & 9
g. 1, 5 & 7
h. 2, 6 & 9
i. 3, 6 & 8

Answer: e
Problem 25
(5 points) A system pumps water from a valley to an elevation of 6000 m at the top of a mountain where wise engineering professors meditate. To help them relax, a fountain is there where 1 kg of water is collected every 10 s and the velocity of the water flowing in this fountain is 2 m/s. Assuming an overall efficiency of 30% and a cost of $0.09 per kilowatt-hour, then the cost to operate this fountain per hour is closest to...

a. $0.01/hr  
b. $0.23/hr  
c. $0.99/hr  
d. $1.77/hr  
e. $5.98/hr  
f. $63.45/hr  
g. $112.53/hr  
h. $345.78/hr  
i. $1923.88/hr

Answer: d
Problem 26
(5 points) A worker is pressure washing a deck 4.7 meters above an alligator pond. The pressure washer produces a 10 liter per minute stream of water through a nozzle with an orifice diameter of 2.5 millimeters. A 12V battery supplies power to an electrically powered centrifugal pump that draws water from the pond. Assuming a 50% efficient system, the amount of electrical current that the battery must supply is closest to...

a. 12.79 A  
b. 17.29 A  
c. 21.97 A  
d. 27.91 A  
e. 29.71 A  
f. 71.29 A  
g. 79.12 A  
h. 92.71 A  
i. 97.21 A

Answer: b