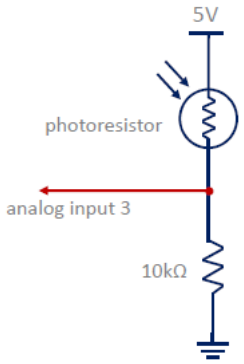
Exam Practice Problems (5 Point Questions)

Below are practice problems for the five-point questions found on the exam. These questions come from past exams as well additional questions created by faculty. Please note that these are just examples of questions and may not cover all concepts that could be asked in the 5-point section on your exam.

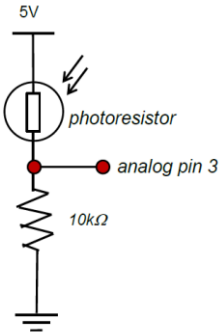
Photoresistors

1. When the photoresistor in the circuit diagram below has a resistance of 15 kΩ, the integer value returned by the analogRead(3) function is closest to ...
    a. LOW
    b. 1023
    c. 0
    d. HIGH
    e. 683
    f. 409
    g. 2
    h. 767
    i. 256
    j. 613.8

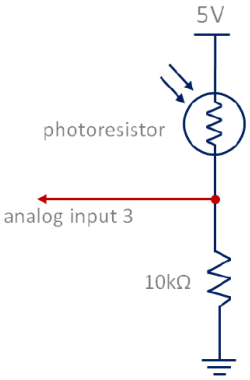


2. The photoresistor circuit used in class is attached to analog input 3 to "measure" the light level. If the light level is such that the resistance of the photoresistor is 2,000 Ω, then the Serial Monitor will show that "val" is closest to . . .
    a. 20
    b. 87
    c. 122
    d. 170
    e. 201
    f. 582
    g. 853

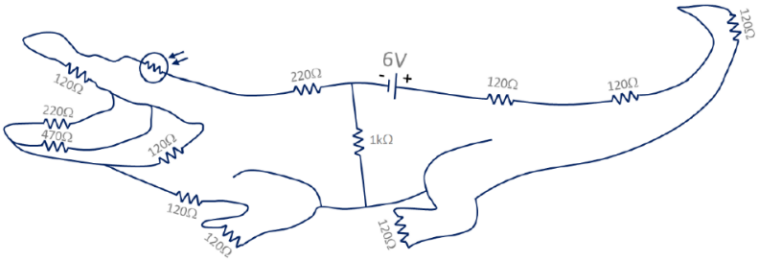
```
1  int analogPin = 3;
2  int val = 0;
3
4  void setup() {
5    Serial.begin(9600);
6  }
7
8  void loop() {
9      val = analogRead(analogPin);
10     Serial.println(val);
11 }
```



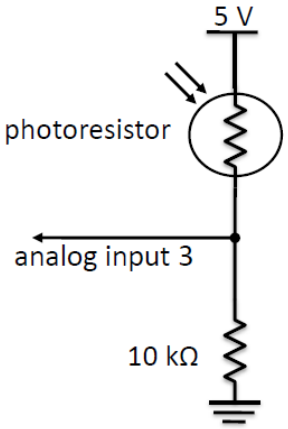
3. When the photoresistor in the circuit diagram below has a resistance of 20kΩ, the integer value returned by the analogRead(3) function will be closest to:
    a. 84
    b. 208
    c. 291
    d. 341
    e. 388
    f. 503
    g. 650
    h. 732
    i. 821
    j. 1011



4. Assuming the resistance of the photoresistor in the problem below is 100Ω, then the power dissipated at the photoresistor is closest to:
    a. 1mW (mW = milliwatt = 0.001 watt)
    b. 1.4mW
    c. 2.0mW
    d. 2.4mW
    e. 2.9mW
    f. 3.3mW
    g. 4.0mW
    h. 6.7mW
    i. 1.2W

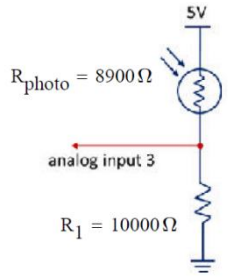


5. When the voltage present at analog input 3 is 3.1 V, the integer value returned by the analogRead(3)function will be closest to…
    a. 84
    b. 208
    c. 291
    d. 341
    e. 388
    f. 503
    g. 634
    h. 732
    i. 821
    j. 1011



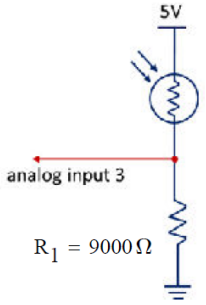
6. Refer to the photoresistor circuit shown. If the analogRead(3) function is used to determine the voltage at analog input 3 and the value returned is "VAL" (given below), the voltage would be closest to:
    a. 645 V
    b. 2.99 V
    c. 5.00 V
    d. 3.15 V
    e. 3.31 V
    f. 1.32×10^5 V
    g. 0.00 V
    h. 3.30 V

VAL = 645



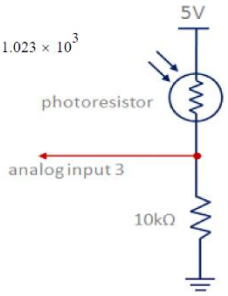
7. Refer to the above photoresistor circuit shown. Assume the voltage at analog input 3 is given below. The resistance value of the photoresistor in this state is closest to:
    a. 1764Ω
    b. 1897Ω
    c. 2023Ω
    d. 2152 Ω
    e. 2280Ω
    f. 2409Ω
    g. 2538Ω
    h. 2667Ω

$V_{analog} = 3.9\,V$

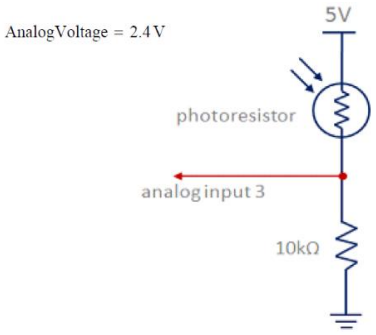


8. If the analogRead(3) function is used to determine the voltage at anlog input 3, and the value returned is "VAL (given below), the voltage would be closest to:
    a. 3.48 V
    b. 3.78 V
    c. 4.09 V
    d. 4.39 V
    e. 4.70 V
    f. 5.00 V
    g. 5.30 V
    h. 5.61 V

$VAL = 1.023 \times 10^3$

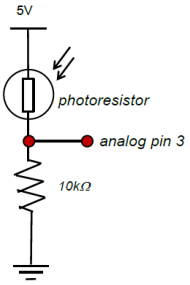


9. Assume the voltage at analog input 3 is as given below. The resistance value of the photoresistor is closest to:
    a. 6880 Ω
    b. 7555 Ω
    c. 8206 Ω
    d. 8865 Ω
    e. 9514 Ω
    f. 10174 Ω
    g. 10833 Ω
    h. 11489 Ω



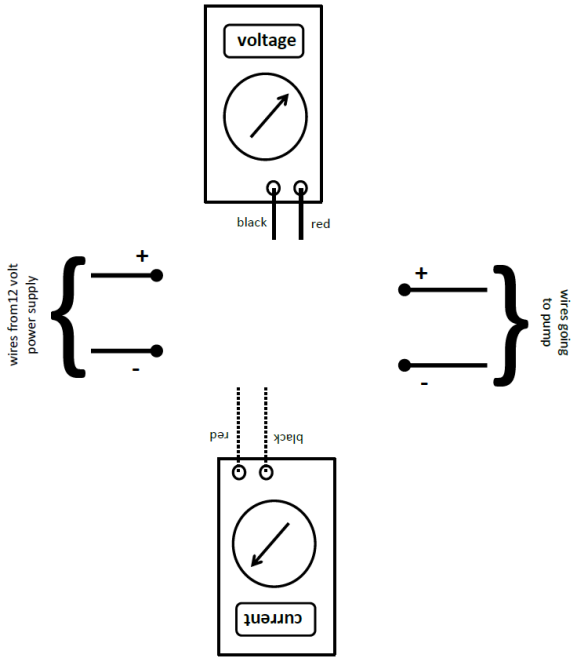
10. The photoresistor circuit used in class is attached to analog input 3 to "measure" the light level. If the light level is such that the resistance of the photoresistor is 3,000Ω, then the Serial Monitor will show that "val" is closest to . . .
    a. 20
    b. 80
    c. 120
    d. 170
    e. 200
    f. 787
    g. 853

```
int analogPin = 3;
int val = 0;

void setup() {
  Serial.begin(9600);
}

void loop() {
   val = analogRead(analogPin);
   Serial.println(val);
}
```

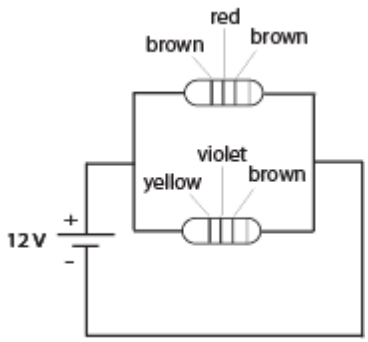


Electricity and Circuitry

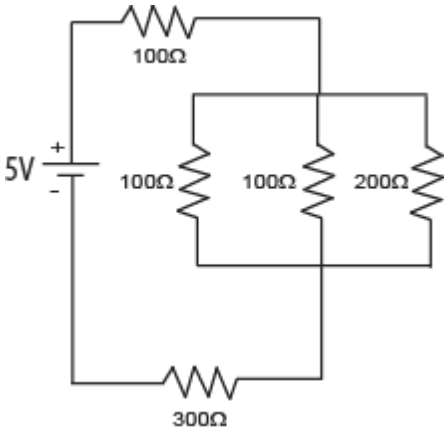
11. Show how two multimeters can be used to measure the current and voltage supplied to a pump from a 12 volt power supply. When showing how the wiring should be completed, use solid lines for voltage measurement and dashed lines for current measurement. Also, draw any remaining wires needed to provide power to the pump using solid lines.



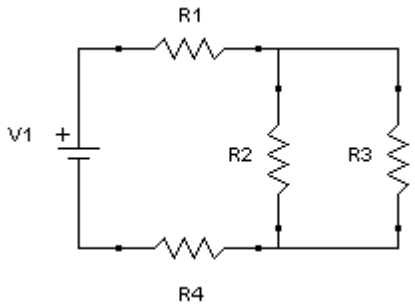
12. The power dissipated at the bottom resistor in the circuit below is closest to . . .
(NOTE: There is a Resistor Color Code Table on the formula sheet)
    a. 0.001W
    b. 0.021W
    c. 0.057W
    d. 0.108W
    e. 0.306W
    f. 0.827W
    g. 4.7W



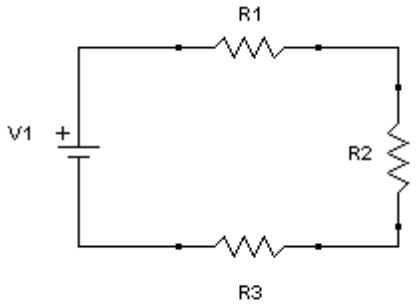
13. The equivalent resistance of the following circuit is closest to . . .
    a. 0.76Ω
    b. 220Ω
    c. 440Ω
    d. 470Ω
    e. 2kΩ
    f. 2780Ω



14. For the circuit below (where V1 = 5V, R1 = 110Ω, R2 = 120Ω, R3 = 240Ω and R4 = 120Ω) the equivalent resistance is closest to …
    a. 310Ω
    b. 390Ω
    c. 410Ω
    d. 450Ω
    e. 690Ω
    f. 110kΩ
    g. 410kΩ



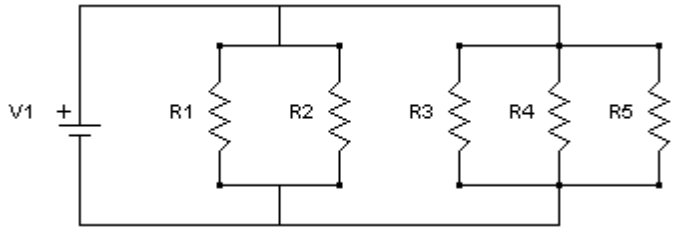
15. For the circuit below (where V1 = 24V, R1 = 100Ω, R2 = 200Ω and R3 = 300Ω) the power dissipated by R2 is closest to …
    a. 0.04W
    b. 0.18W
    c. 0.32W
    d. 0.67W
    e. 1.03W
    f. 1.59W
    g. 2.88W



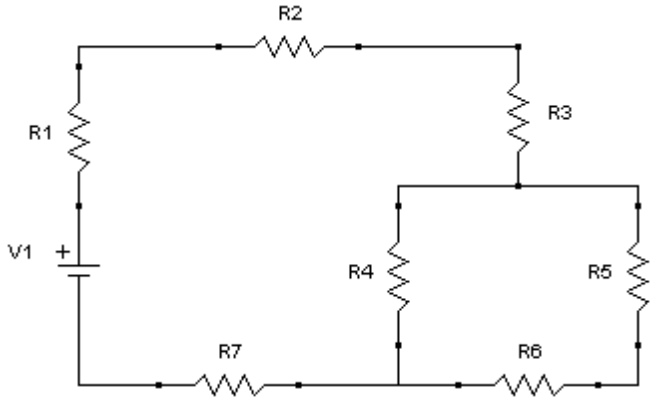
16. For the circuit below (where R1 > R2 > R3 > R4 > R5) the following is true …

    I. The equivalent resistance of R1 & R2 is less than R2.
    II. The current passing through R1 and R2 is always equal to the current passing through R3, R4 and R5.
    III. The equivalent resistance of R3, R4 & R5 is greater than R1.
    IV. The voltage drop across R1 is less than the voltage drop across R3.
    V. The largest amount of current passes through R1 and the smallest amount of current passes through R5.
    VI. The largest amount of current passes through R5 and the smallest amount of current passes through R1.

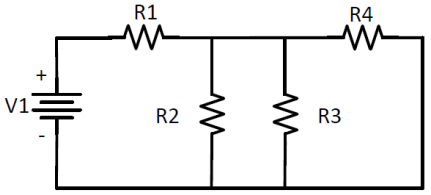
    a. only
    b. I and III
    c. I, II and IV
    d. I and VI
    e. II, IV and V
    f. II and V
    g. II only



17. For the circuit below (where V1 = 12V, VR1 = 3.02V, VR2 = 1.19V, VR3 = 0.38V, VR4 = 4.67V, and VR6 = 2.09V), the voltage drop across R5 is closest to …
    a. 0.65V
    b. 2.58V
    c. 2.74V
    d. 3.02V
    e. 4.67V
    f. 7.41V
    g. Not enough information to determine VR5

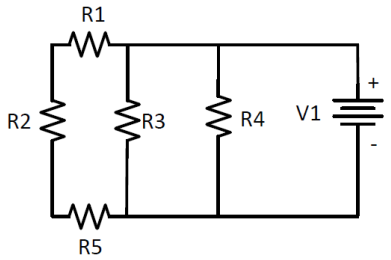


18. The voltage drop across R1 for the circuit shown below is closest to…
    a. 0.823 V
    b. 1.326 V
    c. 8.897 V
    d. 3.857 V
    e. 1.496 V
    f. 5.143 V
    g. 0.082 V
    h. 4.785 V



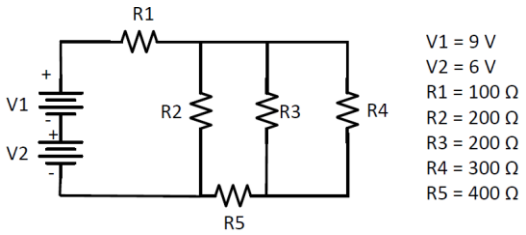
V1 = 9 V
R1 = 100 Ω !
R2 = 200 Ω !
R3 = 200 Ω !
R4 = 300 Ω !

19. The current through R3 for the circuit shown below is closest to…
    a. 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

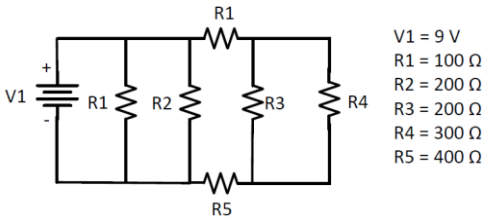


V1 = 5 V
R1 = 100 Ω
R2 = 200 Ω
R3 = 200 Ω
R4 = 300 Ω
R5 = 500 Ω

20. 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

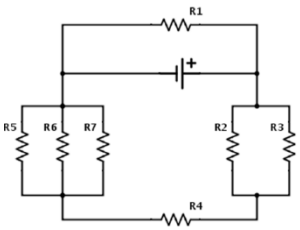


21. The equivalent resistance of all the resistors in the circuit shown below is closest to…
    a. 0.2 Ω
    b. 10.2 Ω
    c. 20.2 Ω
    d. 30.2 Ω
    e. 40.2 Ω
    f. 50.2 Ω
    g. 60.2 Ω
    h. 70.2 Ω
    i. 80.2 Ω



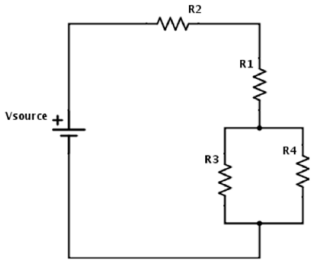
22. A multimeter measures quantities by either hooking its leads so that they are in parallel with a circuit element, e.g. a resistor, or in series with a circuit element. If the leads are placed in series with a circuit element, the multimeter must be measuring:
    a. Capacitance
    b. Current
    c. Power
    d. Resistance
    e. Voltage (AC)
    f. Voltage (DC)

23. The equivalent resistance of the circuit shown below is closest to:
    a. 153.8 Ω
    b. 250.8 Ω
    c. 614.9 Ω
    d. 562.6 Ω
    e. 333.3 Ω
    f. 414.2 Ω
    g. 063.7 Ω
    h. 351.1 Ω



VSource = 9 V
R1 = 400 Ω
R2 = 200 Ω
R3 = 200 Ω
R4 = 50 Ω
R5 = 300 Ω
R6 = 300 Ω
R7 = 300 Ω

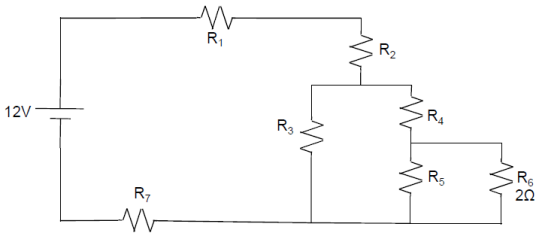
24. The voltage drop across R3 is closest to:
    a. 2.24 V
    b. 7.23 V
    c. 8.18 V
    d. 0.82 V
    e. 4.48 V
    f. 6.84 V
    g. 8.85 V
    h. 9.94 V



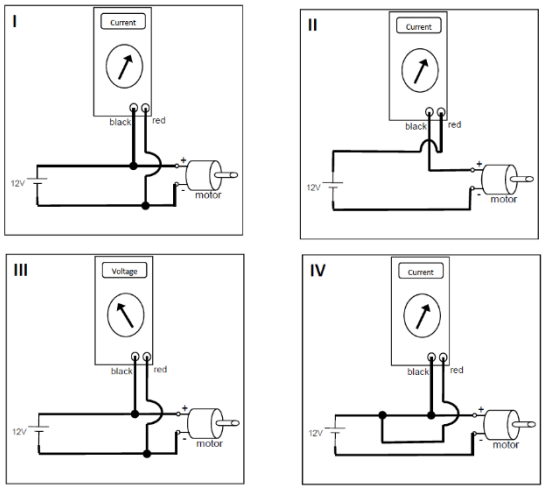
VSource = 9 V

R1 = 50 Ω
R2 = 70 Ω
R3 = 20 Ω
R4 = 30 Ω

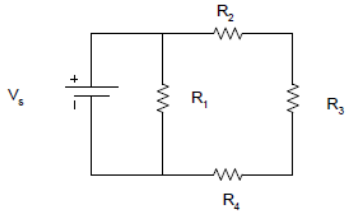
25. If VR1 = 6.02V, VR2 = 1.98, VR7 = 2V, and VR4 = 1V, where the notation VR1 denotes the voltage drop across R1 , then the power dissipated by R6 is closest to…
    a. 0.6 W
    b. 5 W
    c. 0.5 W
    d. 0.8 W
    e. 3 W
    f. 6 W



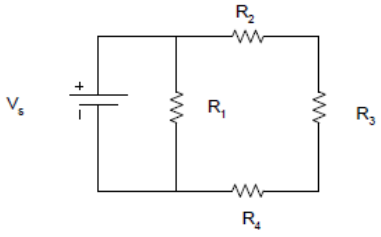
26. The proper way to measure the current through the DC motor is shown in figure …
    a. I
    b. II
    c. III
    d. IV
    e. II and III



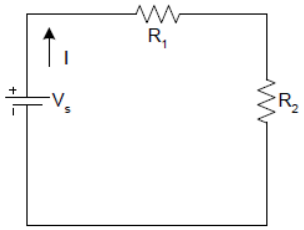
27. Circuit diagram for Multiple Choice Questions 1-2. For this diagram, Vs = 20V, R1 = 50Ω, R2 = 20Ω, R3 = 30Ω, and R4 = 40Ω. The overall equivalent resistance (Req) for the circuit is most nearly:
    a. 140Ω
    b. 32.1Ω
    c. 35.8Ω
    d. None of the above



28. If Req for the circuit is 100Ω and V_s is 20V, then the power generated by the voltage source is most nearly:
    a. 0.5W
    b. 1.0W
    c. 4.0W
    d. 5.0W

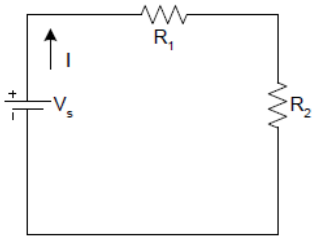


29. For this diagram, Vs = 20V, R1 = 50Ω, and I = 0.2A The power generated by the voltage source is most nearly:



    a. 2W
    b. 4W
    c. 8W
    d. Cannot be determined from the information given.

30. For this diagram, Vs = 20V, R1 = 50Ω, and I = 0.2A The value of R2 is most nearly:



    a. 50Ω
    b. 100Ω
    c. 150Ω
    d. Cannot be determined from the information given.

Linear Regression

31. Consider the data below. Using linear regression and assuming linear behavior, the slope of the best fit line for this data is closest to . . .

x	y
5	2
4	5
2	9

Note: $\sum x = 11$
$\sum y = 16$
$\sum xy = 48$
$\sum x^2 = 45$
$\sum y^2 = 110$

    a. -0.27
    b. -1.51
    c. -2.29
    d. -3.45
    e. 0.27
    f. 1.51
    g. 2.29
    h. 3.45

32. Assume the data below is best modeled using linear regression, the value of m is closest to…

x	y
1	2
50	900
100	2100

    a. 21.20
    b. 34.46
    c. 24.53
    d. 20.58
    e. 30.62

33. Chinch bugs are North American insects that damage grass. They reach high populations in drought-stressed lawns. The following data relates the impact of rainfall on the density of chinch bugs. The slope (m) of the best fit line for the linear regression is closest to …
    a. -11.333
    b. -7.891
    c. -15.031
    d. -12.677
    e. -13.223
    f. 17.049
    g. 6.143

Average rainfall (inches) per month	Number of chinch bugs per square yard	
0.05	40	
0.75	7	
2.2	3	

34. The data below shows the number of engineers on payroll at a growing company. Assuming a linear relationship, the number of engineers the company will employ in the year 2015 is projected to be closest to …
    a. 64
    b. 69
    c. 73
    d. 77
    e. 81
    f. 87

Year	# of Engineers	
1990	15	
2000	33	
2010	59	

35. An engineer calculated the slope (m) to be 13.055, using a linear fit for the following data points. However, she forgot to determine the intercept (b). You determine the intercept to be closest to…
    a. 55.876
    b. -54.675
    c. -42.927
    d. 21.478
    e. -34.521
    f. 25.321
    g. -26.103
    h. 57.983
    i. -52.123

x	y	
0.1	10	
15	50	
30	400	

36. An engineer is growing bio-nanoparticles in a Petri dish. She observed the growth rate of the particles over time. Assuming a linear fit, the value for the slope (m) is closest to…
    a. 211.48
    b. 341.73
    c. 326.54
    d. 395.91
    e. 437.81
    f. 151.47
    g. 212.59
    h. 463.78
    i. 521.25
    j. Not enough information given to solve the problem

Time (hrs)	# of Particles	
0.1	1	
10	240	
100	38000	

37. 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…
    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

Circumference (cm)	Weight (g)	
50	1200	
60	2700	
70	3000	

38. 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…
    a. 0
    b. 29
    c. 46
    d. 64
    e. 85
    f. 90
    g. 97
    h. 106
    i. 115
    j. 137

Week	Patients	
2	46	
5	64	
7	85	

39. NASA has been tracking the average global temperature from 1980 through to today. Given the data provided for 1985-1989, you believe that a straight line will be the best fit. Assuming that the best fit for the data is in fact a straight line, then the best regression equation for the data is (assuming y = Avg. Global Temp and x = Year):
    a. y = 0.042x - 68.158
    b. y = 0.015x - 70.124
    c. y = 0.02x - 80.3
    d. None of the above

Year	Avg. Global Temp
1985	15.17
1986	15.23
1987	15.38
1988	15.41
1989	15.29

40. A linear fit is determined to work best for the data below where m = 1.654. Given this value of "m" and the data below, the value of "b" is closest to …
    a. -3.5
    b. 3.5
    c. -6.0
    d. 6.0
    e. -4.7
    f. 4.7
    g. -5.9
    h. 5.9

x	y
7	17
8	20
11	24

Pumps and Efficiency

41. Water exits a pipe at a velocity of 5 m/s. The water enters a bathtub. When the bathtub is full, the mass of the water in the bathtub is 200 kg. If it takes 10 minutes to fill the tub, the inside diameter of the water pipe at the exit is closest to . . .
    a. 9.2 mm
    b. 12 mm
    c. 13 mm
    d. 14 mm
    e. 15 mm
    f. 20 mm
    g. 25.4 mm

42. A fire truck pump system has an efficiency of 10% and consumes 10 kilowatts of electrical power as it delivers water through a single fire hose. Assume that the water leaves the nozzle of the fire hose at the same elevation as the water supply tank (there is no change in head so that all of the energy is used to increase the velocity of the water). If 800 kg of water is delivered to the fire over a 2 minute period, then the velocity of the water leaving the nozzle is closest to . . .
    a. 5.5 m/s
    b. 7.8 m/s
    c. 12.1 m/s
    d. 17.3 m/s
    e. 32.5 m/s
    f. 51.2 m/s

43. A system pumps water from a valley to an elevation of 4000 meters at the top of a mountain where wise ENGR 120 teachers meditate on robots both day and night. If 1.0 kg of water is collected every 20 seconds at the mountain top and the kinetic energy associated with the velocity of the water at the tube exit can be neglected (just assume v = 0 m/s), then the power (in watts) that would have to be delivered to a pump with an efficiency of 2% is closest to . . .
    a. 1,010 W
    b. 3,280 W
    c. 4,230 W
    d. 50,000 W
    e. 98,100 W

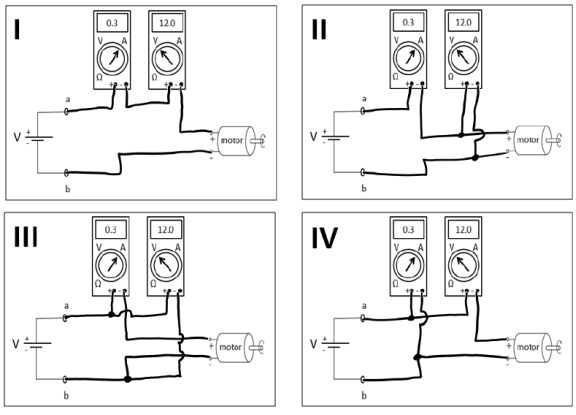
44. Consider the pump experiment completed in ENGR 120. Assume the pump is connected to a smaller tube such that the exit water velocity is 10 m/s for a data point where the measured voltage is 12.8V and the current is 0.4A. If 0.15 kg of water is collected in a container over a 20 second period at an elevation of 45 inches, then the efficiency of the pump is closest to . . .
    a. 1%
    b. 3%
    c. 5%
    d. 7%
    e. 9%
    f. 11%
    g. 20%

45. A farmer uses a nearby creek to irrigate a small plot where he grows rice. He must pump the water from the creek up to the rice paddy (a height difference of 5 feet). Assuming 110kg of water is pumped into the rice paddy every minute at a velocity of 1.3 m/s, determine the power (in watts) that would have to be delivered to the pump assuming an overall pump/piping system efficiency of 15% …
    a. 55W
    b. 84W
    c. 98W
    d. 120W
    e. 164W
    f. 193W
    g. 221W

46. A biodiesel fuel pump with a 15/16 inch diameter nozzle is used to fill an environmentally-friendly bus. If it takes 7 minutes to fill a tank that holds 120kg of biodiesel, the velocity at the fuel pump nozzle exit is closest to…
    a. 0.729 m/s
    b. 1.132 m/s
    c. 1.968 m/s
    d. 2.441 m/s
    e. 2.909 m/s
    f. 3.612 m/s
    g. 3.989 m/s

Density of biodiesel = 880 kg/m3
1 inch = 2.54 cm

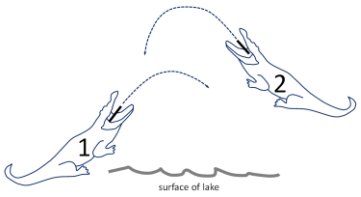
47. Using your experience from the centrifugal water pump testing you did in class (and/or at helpdesk hours), the setup for determining the power input to your pump can be shown by…
    a. I only
    b. II only
    c. III only
    d. IV only
    e. I and IV
    f. II and III
    g. III and IV



48. Uncle Freddie wants to move his cow pasture up to the top of a nearby hill so his cows have a better view. His pasture has a small 10,000-gallon pond that he also wants to move to the top of the hill. The hill is elevated 500 feet above the pasture. Assume the pump that Uncle Freddie has rented is 20% efficient and it does not significantly increase the kinetic energy of the water. The total energy used by the pump is closest to:
    a. 5.66×10^7 J
    b. 6.83×10^7 J
    c. 7.66×10^7 J
    d. 7.83×10^7 J
    e. 2.83×10^8 J
    f. 3.66×10^8 J
    g. 4.86×10^8 J

49. Uncle Freddie wants to move his cow pasture up to the top of a nearby hill so his cows have a better view. His pasture has a small 10,000 gallon pond that he also wants to move to the top of the hill. The hill is elevated 500 feet above the pasture. Assume the pump that Uncle Freddie has rented is 20% efficient and it does not significantly increase the kinetic energy of the water. Also assume that it takes 2 days to pump all of the water and that the current cost of electricity is 10 cents / kW*hour. The cost of the electricity to pump the water is closest to:
    Some conversions: Density of water = $1000 kg/m^3$ 1 foot = 0.305 meter 1 kwh = 1000 W * 1hr = 1000J/s * 1hr
    a. $7,858.00
    b. $1,571.50
    c. $785.80
    d. $157.15
    e. $78.58
    f. $15.71
    g. $7.86
    h. $1.57
    i. $0.79
    j. $0.16

50. Uncle Freddie has created a decorative fountain at the entrance to his alligator farm. A pump delivers water from a lake to exit nozzles in the mouths of two concrete alligators. The exit nozzle for alligator 1 is 4 m above the surface of the lake, and the exit nozzle for alligator 2 is 8 m above the surface of the lake. The DC pump which is 25% efficient draws 1000 W of electric power as it delivers 5 gallons per minute to the exit nozzle of each alligator. If the pipes and nozzles are sized so the exit velocities are the same for both alligators, then the exit velocity is closest to . . .

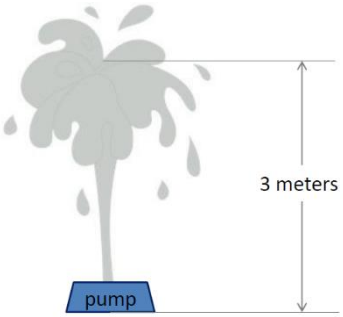


    a. 2 m/s
    b. 5 m/s
    c. 8 m/s
    d. 12 m/s
    e. 26 m/s
    f. 40 m/s
    g. 61 m/s
    h. 87 m/s
    i. 95 m/s
    j. 122 m/s

51. 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%

52. 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

53. 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…

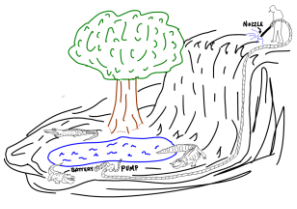


    a. 37.5 J
    b. 142 J
    c. 186 J
    d. 464 J
    e. 557 J
    f. 1393 J
    g. 2322 J

54. 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

55. 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

56. For the tallest water slide at a theme park, a pump must be capable of pumping 1000 L of water per minute up to the top of the slide. The top of the slide is located 80 feet from the pump outlet and the known pump efficiency of the pump is 15%. (Neglect kinetic energy, i.e. v = 0 m/s) The electrical power required to run the pump so the water slide is operational is closest to …
(Hint: 1 MW = 106 W; 1 kW = 103 W)
    a. 1.59 MW
    b. 2.71 kW
    c. 3.99 kW
    d. 5.23 MW
    e. 26.58 kW
    f. 87.17 kW
    g. 26.57 W
    h. 265.79 W
    i. 597.81 W

57. To fill the outdoor swimming pool at the intramural center, Louisiana Tech (with the permission of the Ruston Fire Department) uses a nearby fire hydrant. The fire hose borrowed to fill the pool has a inside diameter of 4 inches. The outdoor pool when filled to the appropriately level contains 540 m^3 of water. It takes roughly all night or 12 hours to fill the pool to the appropriate water level. The velocity of the water leaving the fire hose is closest to …
    a. 0.78 m/s
    b. 5.55 m/s
    c. 1.01 m/s
    d. 4.84 m/s
    e. 2.88 m/s
    f. 7.71 m/s
    g. 1.54 m/s
    h. 9.95 m/s
    i. 7.71 cm/s

58. (5 points) A company worker stands on the 10th floor balcony of an apartment complex cleaning the walls. A total of 200 kg of water is sprayed onto the walls over a 1 hour period, where the exit velocity of the water leaving the spray nozzle is 20 m/s. If the electric motor driving the pumping system draws 25 amps at 20 volts and the height of the balcony is 53 m, then the efficiency of the pumping system is closest to . .
    a. 1%
    b. 2%
    c. 3%
    d. 4%
    e. 6%
    f. 8%
    g. 10%
    h. 15%
    i. 20%

59. Emperor Kuzco wants to move his swimming pool up to the top of a nearby hill so his new getaway can overlook his village. His pool holds 25,000 gallons of water and the hill is elevated 1,000 feet above the village. If it costs Kuzco a total of $47.50 to move the water to his new swimming pool and the pumping system has an efficiency of 15%, how much does electricity cost per kwh? **HINT:** The total electrical energy input to the pumping system is measured in kwh.
    a. $1.27/kwh
    b. $0.13/kwh
    c. $0.04/kwh
    d. $0.09/kwh
    e. $0.23/kwh
    f. $0.29/kwh

1 kwh = 1 kilowatt-hour = 3.6×10^6 J

explanation: $1kwh = 1kW \cdot 1hr \cdot \frac{60\ min}{1\ hr} \cdot \frac{60\ s}{min} = 1{,}000\ W \cdot 3600s = 1000\frac{J}{s} \cdot 3600s = 3{,}600{,}000\ J$

60. The efficiency of an electric drill that produces 1 HP (745.7 Joules/second) when supplied with 10A of current at 115V is most nearly:
    a. 1%
    b. 10%
    c. 65%
    d. 90%

61. A pump requires 1.5kW to raise 5000L of gasoline 10 meters in a half-hour. If the velocity of the gasoline is 5 m/s, and the density of gasoline is 670 kg/m^3, then the efficiency of the pump is most nearly:
    a. 1%
    b. 14%
    c. 20.45%
    d. 35%

Computer based problems from previous exams are found below. Your exam will NOT have a computer portion. However, the content presented in these problems is applicable. Understanding and being able to work these problems will benefit you in your preparation for the exam for both the three and five point questions.

62. Enter and plot the data below using Excel. Considering linear, exponential and power law forms for the equations, find a trendline for the data, showing the best-fit equation for the data as well as r^2. NOTE: You do not need to set up a spreadsheet to compute m, b and r^2 manually.

elevation (km)	pressure (kPa)
1.2	24
4.8	2.7
7.1	0.6
10.3	0.1

63. (*Excel*) Beginning with Aug. 31, 2006, one of your professors has tracked the number of entries contained in the online encyclopedia Wikipedia, and has produced the following table, where Day 0 represents 8/31/06 and Day 434 represents 11/8/07:

    Use linear regression in Microsoft EXCEL (a trendline analysis) to determine whether the best fit for the increasing number of entries is a linear, exponential, or power curve.

Day	# of Entries
0	1,356,724
77	1,486,871
109	1,539,070
190	1,676,896
407	2,044,879
431	2,077,344

64. Write a program to move your robot approximately 2 feet forward at the rate of about 1 in/s. As the robot moves forward, an LED should blink rapidly (0.25 s on; 0.25 s off) when the photo-resistor senses darkness; the LED should blink slowly (0.75 s on; 0.25 s off) when the photo-resistor senses light. Download your program to the robot and demonstrate its operation to the instructor.

65. (*SolidWorks*) Create a part file that represents the part with the dimensions as shown . . . (parts and assemblies such as the pump)

66. Write a program to make the Arduino do the following:
    a. The robot should start in wait state with the LED blinking: 1 second on, 1 second off, 1 second on, 1 second off, … (waiting for one of the whiskers to be pressed or for the photoresistor to be covered).
    b. While a whisker is pressed, the LED should blink ½ second on, ½ second off, ½ second on, ½ second off, …
    c. While a photoresistor is covered with your hand, the LED should blink 0.1 seconds on, 0.1 seconds off, 0.1 seconds on, 0.1 seconds off, …
    d. When the whisker is released and the photoresistor is uncovered, the LED should go back to its original blinking pattern (1 second on, 1 second off, . . .). The entire process should then start over, waiting for a whisker to be pressed or for the photoresistor to be covered. This entire process should be able to continue indefinitely.