**Material Science Answer Packet**

**Mentor 2017**

**SCHOOL NAME\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_TEAM # \_\_\_\_\_\_\_\_\_\_\_\_\_**

Participant’s (1) Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Participant’s (2) Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

T1: (0 pts) Who is shown in the picture on the front of the test packet?

**Sir George Gabriel Stokes**

 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

#1: (14 pts) T6:



T2: (0 pts) What device is shown on the front of the test packet? Wilhelmy Plate apparatus

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

#2: (1 pt each)

|  |  |  |  |
| --- | --- | --- | --- |
| i. | A | v. | D |
| ii. | B | vi. | B |
| iii. | E | vii. | C |
| iv. | C | viii. | D |

#3: (3pts) T5

#4: (1pt) T4 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

#5: (1pt) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

#6: (3pts) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

#7: (1 pt each) (T3) Any order:

|  |  |  |  |
| --- | --- | --- | --- |
| Ductile | Malleable | Conductor | Has luster (shiny) |

#8: (1 pt each)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  A. | 30 | B. | 20W-40 | C. | 10W-40 |
| D. | 10W | E. | 5W-30 | F. | 5W-20 |

Multiple Choice 9-48: (1pt each)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 9. | B | 19. | B | 29. | A | 39. | D |
| 10. | C | 20. | A | 30. | B | 40. | D |
| 11. | A | 21. | B | 31. | C | 41. | C |
| 12. | B | 22. | A | 32. | C | 42. | C |
| 13. | C | 23. | D | 33. | D | 43. | C |
| 14. | A | 24. | B | 34. | B | 44. | C |
| 15. | C | 25. | B | 35. | D | 45. | D |
| 16. | B | 26. | B | 36. | B | 46. | C |
| 17. | C | 27. | B | 37. | B | 47. | D |
| 18. | C | 28. | B | 38. | B | 48. | D |

49. (2pts) Zero

50. (3pts) (Show Work) 1,700m

51. (3pts) (Show Work) 43,400 N

52. (2pts) The calculation was done assuming the bone was solid.

53. (3pts) (Show work) **374,000 N**

#54: (1 pt each)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| A. | 101 | B. | 110 | C. | 011 |
| D. | 101 | E. | 1-10 | F. | 01-1 |
| G. | 100 | H. | 010 | I. | 001 |
| J. | -100 | K. | 0-10 | L. | 00-1 |

55. (1pt)

56. (1pt)

57. (1pt)

58. (2pts) T10

59. (2pts)

60. (2pts)

Multiple Choice 61-92: (1pt each)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 61. | D  | 69. | E | 77. | C | 85. | C |
| 62. | C | 70. | B | 78. | C | 86. | A |
| 63. | C | 71. | A | 79. | B | 87. | D |
| 64. | A | 72. | D | 80. | A | 88. | B |
| 65. | C | 73. | D | 81. | A | 89. | C |
| 66. | A | 74. | A | 82. | C | 90. | C |
| 67. | C | 75. | B | 83. | E | 91. | C |
| 68. | C | 76. | A | 84. | B | 92. | W |

93. (2pts each) T9

a) (200) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (211) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b) (T6)

94. (1 pt each)

 O-O \_\_\_\_\_\_\_\_\_\_\_\_\_\_ Al-F\_\_\_\_\_\_\_\_\_\_\_\_\_\_

N-O \_\_\_\_\_\_\_\_\_\_\_\_\_\_ H-C \_\_\_\_\_\_\_\_\_\_\_\_\_\_ H-O \_\_\_\_\_\_\_\_\_\_\_\_\_\_

95. Show work (3 pts) T8

96. (2pts)

97. (1pt each) T7

a)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ b)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

c)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ d)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Lab #1) Part A- Data Table (10 pts)

 **Look for sig figs and units. Masses, Forces (using m\*g), Area (pi\*r^2), Lo and delta L.**

 **Stress = F/A and Strain=delta L/Lo**

Lab #1) Part A- Graph. (5pts)

 **Graph should have a title, labeled x and y axis with units, plotted data points, and trendline.**

Lab #1) Part B- Young’s modulus \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (5 pts)

 (Show Work)

**Slope of best fit line.**

Lab #1) Part C- Percent error\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_% (3 pts)

**Correct answer based on slope of graph (in units of N/m2) to the accepted value given.**

Lab #1) Part D – (2 pts)

**Something about plastic vs. elastic or how releasing the masses in a way that may stretch the nylon inconsistently.**

Lab #2) Part A - Data Table (10 pts)

**Look for sig figs and units. Multiple distances and times. Diameter of BB.**

Lab #2) Part B - Graph (5 pts)

**Graph should have a title, labeled x and y axis with units, plotted data points, and trendline.**

Lab #2) Part B - kinematic viscosity \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cSt (8 pts)

 **Slope of graph is the speed.**

**Kinematic viscosity = (2/9)\*g\*r^2\*(7.90-1.44)/(1.44\*speed)**

**Answer will be in St and needs to be converted to cSt by multiplying by 100.**

Lab #2) Part D – (2 pts)

 **It assumes a temperature of 100oC to give the range of kinematic viscosities.**

Lab #3A: radius of Al atom \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (15 pts)

 **Something like this:**



Lab #3B) Part A - (2 pts each)

 a\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ b\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 c\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ d\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Lab #3B) Part B- rational (3 pts)

**The contact angle. The least hydrophilic will have a large contact angle. It becomes more hydrophilic as this angle becomes smaller.**

Lab #3B) Part C- two reasons (2 pts each)

**Absorption, evaporation, or wicking are acceptable**. (2 of these are needed)