**Material Science Answer Packet**

**Mentor 2017**

**SCHOOL NAME\_\_\_\_\_\_\_\_\_\_\_\_\_KEY KEY KEY KEY KEY\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_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 \_\_\_\_\_\_**viscous flow**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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

#6: (3pts) \_\_\_\_\_**This is a Strain vs. Stress graph and thus it looks different since most the the time the axis are the other way around**. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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

#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) ***“-1” will likely be written as a 1 with a bar over top of it.***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 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) **Distance between planes**

56. (1pt) **0.74**

57. (1pt) **12**

58. (2pts) T10 **3.615 \* 10^-10m**

59. (2pts) **1.531 \* 10^19 atoms/m^2**

60. (2pts)  **3.912 \* 10^9 atoms/m**

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) \_\_\_**0.135nm or 1.35\*10-10m** \_\_\_ (211) \_\_\_**0.111nm or 1.11\*10-10m** \_\_\_\_\_\_

**For (200) spacing = 0.1452nm/(2\*sin 32.5)**

**For (211) spacing = 0.1452nm/(2\*sin 41.0)**

 **(2 sig figs will be accepted)**

b) (T6) **0.270nm or 2.70\*10-10m (2 sig figs will be accepted)**

 **=spacing \* (h2+k2+l2)0.5**

94. (1 pt each)

 O-O \_\_\_Covalen\_\_\_\_\_\_ Al-F\_\_\_Ionic\_\_\_\_\_\_\_

N-O \_\_\_\_Covalent\_\_\_\_\_ H-C \_\_\_\_Covalent\_\_\_\_\_\_ H-O \_\_\_Polar Covalent\_\_\_

95. Show work (3 pts) T8 **31%**

% = [1 - e ^-(0.25)(4.0 - 2.5)] times 100
% = [1 - 0.69]times 100
% = 31%

96. (2pts) **0.155-0.225**

97. (1pt each) T7

a)\_\_\_\_\_\_\_ **cubic close packed** \_\_\_\_\_\_\_\_\_\_ b)\_\_\_\_\_\_\_ **hexagonal close packed** \_\_\_\_\_\_\_\_\_

c)\_\_\_\_\_\_\_ **face centered cubic** \_\_\_\_\_\_\_\_\_ d)\_\_\_\_\_\_ **body centered cubic** \_\_\_\_\_\_\_

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)