Materials Science 2017 Answer Key

1. +1 for correct calculation of force, F = mass $\times$ g, g = 9.81

   +1 for correct calculation of area, A = $\pi \times (\frac{0.000280m}{2})^2$

   +2 for correct calculation of stress, Stress = F/A

   +2 for correct calculation of strain, Strain = Change in length/Starting length

2. +1 for correct axes labels and units

   +2 for proper plotting of data

   +1 for trend line

   +2 for correct Modulus = stress/strain aka slope

3. +3 for complete observation of each liquid (+1 each)

   +3 for correctness of observations (+1 each)

4. +3 points for all correct unknowns (max +1 if 2 unknowns are correct)

   +3 points for solid reasoning using intermolecular forces or hydrophobicity and backing statements with data, even if unknowns are wrong. For example:

   Unknown #4 was water because it took the longest amount of time to evaporate, which indicates stronger intermolecular forces. Water has stronger hydrogen bonding than isopropyl alcohol.

5. Full points for saying that both volume and surface area increase, and that surface area increases at a slower rate than volume.

   Only one point for getting one part correct.

6. C

7. A

8. Pascal seconds (Also acceptable: $Pa \times s$, $\frac{N \times s}{m^2}$, $\frac{kg}{m}/s$)

9. Full points for clearly comparing the relative movement of liquid in a fixed amount of time, or comparing the relative speed of the steel ball in a fixed volume of liquids.

   E.g. Graduated cylinder is filled with a liquid, steel ball is placed in cylinder, and time for the ball to reach the bottom is recorded. Repeat for all liquids, same volume. Compare results.

   1 point for mentioning time and displacement, but no mentioning of fixing either of them.

   0 points for not mentioning time, distance travelled, or comparisons.

10. Polymer
11. Composite
12. Metal
13. Ceramic
14. Ceramic
15. Polymer
16. E
17. D
18. A
19. B
20. D
21. C
22. A
23. B
24. False
25. C

26. +3 for correct answer: 2.889 Å

    +2 for adequate work, which could be:

    A diagram showing the relative position of the silver atoms

    hypotenuse = $\sqrt{2(4.086\ \text{Å})^2} = 5.778\ \text{Å}$

    distance $= \frac{hypotenuse}{2} = \frac{5.778}{2} = 2.889\ \text{Å}$

27. +2 for correct answer: 1.444 Å

    +1 for showing dividing 2.889 by 2 or dividing 5.778 by 4.

    If answer is incorrect due to incorrect answer in 27, maximum of 2 points is awarded (1 for correct answer, 1 for calculation)

28. E

29. +2 for correct answer: 1.590×10^{-22} grams

    +1 for decent work

    Sample work: Volume = $(3.306\ \text{Å})^3 = 36.13\ \text{Å}^3 = 3.613 \times 10^{-23}\ cm^3$

    $$3.613 \times 10^{-23}\ cm^3 \times 4.401\ g/cm^3 = 1.590 \times 10^{-22} g$$

30. Temperature and Pressure are above critical points, it is in neither a liquid or gas state, must be in a closed system.

    Full points are awarded for getting at least two characteristics, 1 point otherwise.

31. C

32. False

*Note: for calculation questions, dock one point if significant figures are off