MATERIALS SCIENCE

CYFALLS INVITATIONAL

October 22, 2016

Testing Time: 50 minutes

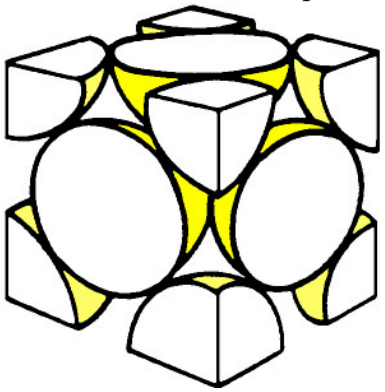
Permitted Materials: FIVE sheets of notes, calculators

School Number: _____

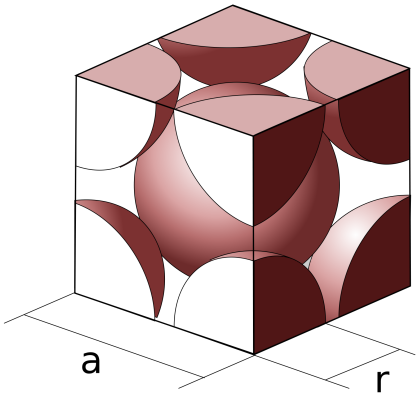
Names: _____

Note: *All questions are short answer*

1. Each element has a unique atomic number, equal to the number of _____ in its nucleus
2. Water's high boiling point is due to the strength of its _____ bonds
3. How many electrons can fit in the 3d suborbital?
4. Which of the intermolecular forces is the weakest?
5. Which of the four atoms has the lowest first ionization energy: Ge, Ca, S, Si?
6. What subatomic particles contribute to an atom's atomic mass?
7. What is electron affinity?
8. Give the full electron configuration for scandium
9. In the equation for Gibbs Free Energy, what does the letter H stand for?
10. Youngs Modulus is the ratio of what two quantities?
11. The relationship between which two energy units was first verified by the Joule experiment?
12. Let a and b be two vectors. Consider the lattice formed by vectors of the form $r = k_1 a + k_2 b$ where $k_1, k_2 \in \mathbb{Z}$. If the angle between a and b is 60 degrees, what polygon shape does the lattice form?
13. Bloch waves are the propagation of what medium?
14. How many atoms does a Buckminsterfullerene contain?
15. The unit cell below represents what type of configuration?



16. What about this one?



17. $SiHBr_3$ has a higher boiling point than $SiHCl_3$ because:

18. A material exhibits polymorphism if what?

19. The total mass of ions in a unit cell of crystalline KBr. Considering that the density of KBr at STP is 2.75 $\frac{g}{cm^3}$, calculate the length of the unit cell in Angstroms .

20. What is a half-metal?

21. When mechanical stress is applied to quartz, it produces an electric charge. What is the name of this effect?

22. The meissner effect describes the behavior of magnetic fields in what type of material?

23. If a material is not crystalline, it is _____

24. What happens when a metal reaches its Curie temperature?

25. An FCC unit cell has atomic radius P. Find the cells volume in terms of P.

26. What force does anisotropy energy direct along certain axes?

27. A quasicrystal is a structure which is ordered but not _____

28. What is the CGS unit of viscosity?

29. Most room-temperature crystalline electrical insulators are of what color?

30. When it freezes, water expands by what percent?

31. Below the λ point, helium switches between which two states of matter?

32. Which two elements have the highest boiling points?

33. What term describes the property changes of clay when it becomes saturated with water?

34. Name the Pearson symbol used to denote triclinic crystals.

35. Rydberg atoms have electrons characterized by a large quantum value. What is this value?

36. What is the APF of a hexagonal close-packed unit cell?

37. If a particle does not obey the Pauli exclusion principle, what principle does it follow?

38. How does passivation affect the durability of most materials?

39. What is the key difference between lasers and masers?

40. What common material is the primary constituent of LiTraCon?

41. State the defining characteristic of block copolymers.

42. What is the symmetry operation given by the Schoenflies symbol C_{34}?

43. How do Miller indices relate to Weiss indices?

44. Between 1000 and 2000 degrees Fahrenheit, what is the correlation between temperature and thermal conductivity in graphite?

45. What liquid has the highest heat capacity at STP?

46. What is the element with the highest atomic number that can be commonly found in most buildings? (Hint: it's used in smoke detectors)

47. A solid-state reaction occurs in the absence of what crucial chemical substance?

48. The average occupation number of fermions is described using what model?

49. What distinguishes thermosetting plastics from thermoplastics?

——— *End of Examination* ———