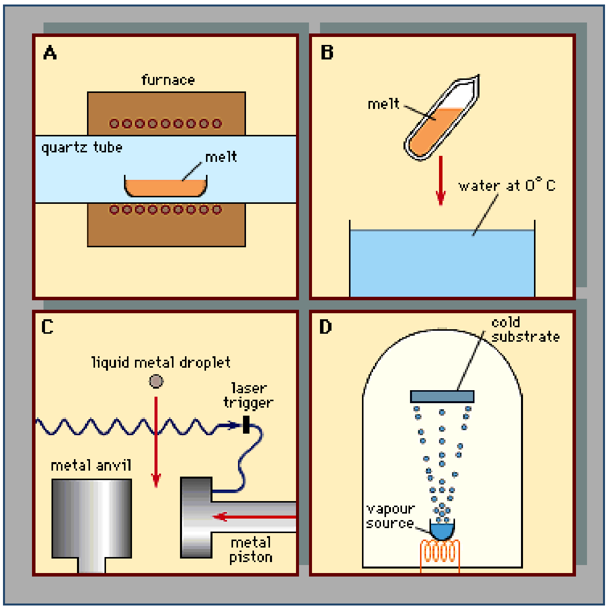
"Amorphous Materials"

Class # ___________ Name ______________

1. Fill in the blank. (10 points)



Four techniques for preparing ( ) solids are illustrated in Figure A-D. These techniques are not fundamentally different from those used for preparing ( ) solids; the key is simply to ( ) the sample quickly enough to form the glass, rather than slowly enough to form the crystal. The quench rate ( ) greatly from left to right in the figure.

Preparation of ( ) requires a quite rapid quench. The technique shown in Figure 4C, called ( ), can quench a droplet of a molten metal roughly 1,000° C in one millisecond, producing a ( ) of metal that is an amorphous solid. In enormous contrast to this, the ( ) that forms the rigid ribbed disk of the Hale telescope of the Palomar Observatory near San Diego, Calif., was prepared by cooling (over a comparable temperature drop) during a time interval of eight months. The great difference in the quench rates needed for arriving at the amorphous solid state (the quench rates here differ by a factor of 3×10^{10}) is a dramatic demonstration of the difference in the glass-forming tendency of silicate glasses (very ( )) and metallic glasses (very ( )).

In the gold-silicon system, at compositions far from the ( ), glasses cannot be formed by melt quenching—even by the rapid splat-quench technique. Amorphous solids can still be prepared by dispensing with the ( ) phase completely and constructing a thin solid film in atom-by-atom fashion from the ( ) phase. ( ) shows the simplest of these vapor-condensation techniques. A vapor stream, formed within a vacuum chamber by ( ) of a sample of the material to be deposited, impinges on the surface of a cold substrate. The atoms condense on the cold surface and, under a range of conditions (usually a ( ) rate of deposition and a ( ) substrate temperature), an amorphous solid is formed as a thin film. Pure silicon can be prepared as an amorphous solid in this manner. Variations of the method include using an electron beam to vaporize the source or using the plasma-induced decomposition of a molecular species. The latter technique is used to deposit amorphous silicon from gaseous ( ).

Numerous other methods exist for preparing amorphous solids, and new methods are continually invented. In ( ), a jet of molten metal is propelled against the moving surface of a cold, rotating copper cylinder. A solid film of metallic glass is spun off as a continuous ( ) at a speed that can exceed a kilometre per minute. In ( ), a brief intense laser pulse melts a tiny spot, which is swiftly quenched by the surrounding material into a glass. In ( ), small molecules in a liquid solution chemically link up with each other, forming a disordered network. It is possible to take a crystalline solid and convert it into an amorphous solid by bombarding it with high-kinetic-energy ions. Under certain conditions of composition and temperature, ( ) (mixing on an atomic scale) between crystalline layers can produce an amorphous phase.

sphere/ thin film/ ribbon/ plate/ bulk/ Figure A/ Figure D/ Si/ Au-Si/ SiH_4/ eutectic/ peritectic/ melting/ solid/ liquid/ gas/ crystalline/ crystal/ amorphous/ metallic glass/ silicate glass/ interdiffusion/ migration/ quench/ cooling/ increases/ decreases/ droplet quenching/ splat quenching/ melt-spinning/ strip casting/ sputtering/ thermal evaporation/ irradiation/ laser glazing/ sol-gel synthesis/ high/ low/

*** Suggestion for class or request for personal conversation:**

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