Each of the questions or incomplete statements below is followed by four suggested answers of completions. Select the one that is best in each case.

1. A circular ring of radius R and mass M can rotate in the vertical plane about a horizontal axis passing through its centre and perpendicular to its plane. A bullet of mass m, moving with speed v tangentially to the (initially stationary) ring, gets embedded in it. The resulting angular velocity of rotation of the ring is

   (a) $\dfrac{Mv}{R(m+M)}$
   (b) $\dfrac{mv}{R(m+M)}$
   (c) $\dfrac{(m+\frac{M}{2})v}{Rm}$
   (d) $\dfrac{(m+M)v}{Rm}$

2. The approximate quantum number n for a circular orbit of diameter 0.0001 mm in a Hydrogen atom is

   (a) 31
   (b) 30
   (c) 35
   (d) 20

3. A very small planet is orbiting a star. If the planet's minimum and maximum distances from the star and the planet's maximum orbital speed are known, which of the following *cannot* be calculated?

   (a) Mass of the planet (b) Mass of the star (c) Minimum speed of the planet (d) Eccentricity of the orbit of the planet

4. An effective resistance of 50 Ω with a current-carrying capacity of 4 A is required. If only 100 Ω resistors each having a current carrying capacity of 1 A are available, the minimum number of such resistors required to construct the effective resistance is

   (a) 2
   (b) 8
   (c) 12
   (d) 16

5. A monochromatic light ray in air (refractive index=1) enters a glass prism (refractive index=1.5). Now, in the glass prism

   (a) both wavelength and frequency of light are smaller than that in air.
   (b) the wavelength is the same, but frequency is smaller than that in air.
   (c) the frequency is the same, but wavelength is smaller than that in air.
   (d) both the wavelength and the frequency are the same as in air.

6. Assuming that Helium gas is at a temperature T Kelvin, the de Broglie wavelength of He molecules (of mass m) is

   (a) $\sqrt{h/(3mk_BT}$
   (b) $h/\sqrt{(2mk_BT}$
   (c) $h/\sqrt{(3mk_BT}$
   (d) $2h/\sqrt{(mk_BT}$

7. In an experiment, a system of ideal gas is taken from state A to state B via an isobaric process. It is then taken from state B to C via an isothermal process. In another experiment, the same system is taken from state A to D via an isochoric process and is then taken from state D to C via an isobaric process. Which of these statements is true?

   (a) The total work done is the same in both cases because the initial and final states are the same.
   (b) The net change of heat is the same in both cases because the initial and the final states are the same.
   (c) The total work done is the same for both cases but the net change of heat is different.
   (d) The total change in internal energy is the same in both cases but the total work done is different.