1. Junctional epidermolysis bullosa (JEB) is an autosomal recessive genetic disorder characterized by fragility of the skin and mucous membranes, manifest by blistering with little or no trauma. Mutations in genes encoding basement membrane proteins, such as *LAMB3*, have been reported to cause JEB. It has also been well documented that JEB patients have hypoplastic enamel with irregular surface and pitting defects. Please describe in detail the 3 major developmental stages of normal enamel formation and indicate which stage of and how this developmental process is affected in JEB cases. (20%)

2. The tongue is a unique muscular organ that has nerve innervation from cranial nerves V, VII, IX, and XII. Please describe in detail the developmental process of tongue formation and explain the embryonic origin of these nerve innervations. (20%)

3. Dental pulp stem cells (DPSCs) are multipotent stem cells found in dental pulp. Aside from their odontogenic potential, these cells have been shown able to differentiate into a variety of other cells, such as chondrocytes, myocytes, and neurons. Pleases specify the embryonic origin of DPSCs to explain this multipotency. Also, please describe in detail which cells, tissues, and organs in our whole body are derived from this embryonic origin. (20%)

4. The mechanisms of tooth eruption are not fully understood yet. Several theories have been proposed.
   (a) Please describe the 4 major theories of eruptive mechanisms. (10%)
   (b) From the above theories, please name one that seems the most plausible to you and design experiments using animal models to demonstrate if it is necessary and/or sufficient for tooth eruption. Please specify your hypothesis, specific aims of research, materials & methods, and expected results. (30%)

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