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24MS091

Class test-ES1201 Earth System Processes

Time-1 hour Max Marks-18

All questions are compulsory. Marks for each question has been indicated. Each correct answer earns two marks. Calculator is permitted. Please write only in the space provided for each question.

1. What information about time do we get about supernova explosions and meteorite accretion from the presence of excess ^{26}Mg produced from ^{26}Al? [3]

2. If half life of U^{235} is 0.7 Ga and assuming age of the earth is 4.9 Ga, what percentage of the heat production is going on today (of the initial production at 4.9 Ga)- [2]

3. Taking a grain radius, a, of 1 mm, Φ of 0.1 (10% volume melt), $\Delta\rho$ of 3500 kg m^{-3}, g of 9.8 m s^{-2} (the acceleration due to gravity on Earth) and a viscosity, η of 0.005 kg m^{-1} s^{-1}, calculate the migration velocity of Fe–Ni metal (give your answer in kilometers per year). (Note: 1 year= 3.2 x 10^7 seconds) [4]

4. Calculate the ε182W value for the following data from a laboratory in which the same meteorite has a measured 182W/184W ratio of 0.864523 and a standard representative of the BSE has a measured 182W/184W ratio of 0.864696. [2]

5. A planetesimal mass of 10^{20} kg impacts the Earth with a velocity of 20,000 m/s. Calculate the rise in temperature on the Earth, assuming that the heat generated by the impact spreads rapidly and uniformly throughout Earth. Take the total mass of the Earth to be 6×10^{24} kg, and the average specific heat capacity of the Earth to be 750 J kg) –1 K–1. (Note: 1 J = 1 kg $m^2 s^{-2}$) [2]

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6. Explain the model that explains the uniform abundance of highly siderophile elements in mantle rocks by a neat diagram if required. [5]