

ZOO503 ZOOGEOGRAPHY & PALEONTOLOGY

MOST IMPORTANT MCQs FOR FINAL TERM

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Group link: <https://chat.whatsapp.com/BjC6W0jZx8o9yaC2ISh1Gu>

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Dear fellows, as you know that exam of this subject will now entirely objective based. A little effort has been made to facilitate you all. Hope you find it helpful. Underlined words are possible answers that could be made out of the statements. All answers are correct and cross checked with handouts, Google and ChatGPT.

1. Lepidosaurs form the second major diapsid clade.
2. Lepidosaurs include snakes and lizards.
3. Sphenodon, the tuatara of New Zealand is a famous living fossil.
4. First true lizard occurred between Mid and Late Jurassic period.
5. Snakes have mobile skulls and swallow prey animals several times the diameter of the head.
6. Dinosaurs are most important of the new diapsid groups of the Triassic period.
7. First Dinosaurs was modest-sized bipedal carnivore.
8. After the Late Triassic extinction, a new group of herbivorous dinosaurs, the sauropodomorphs, radiated dramatically, some like Plateosaurus.
9. The Theropods include all the carnivorous dinosaurs.
10. In the Jurassic and Cretaceous, the theropods diversified to include many specialized small and large forms, Deinonychus.
11. The theropods and sauropodomorphs share the primitive reptilian hip pattern.
12. Cretaceous Theropod dinosaur is Tyrannosaurus.
13. All other dinosaurs share a unique hip pattern in which the pubis has swung back and runs parallel to the ischium.
14. These dinosaurs are termed as the Ornithischia, all of which were herbivores.
15. Armored Ornithischian Dinosaurs from the Jurassic: Stegosaurus

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16. Armored Ornithischian Dinosaurs from the Cretaceous: Euoplocephalus
17. Armored Ornithischian Dinosaurs from the Cretaceous: Centrosaurus
18. Massospondylus eggs with a complete embryo skeleton inside, measuring some 15 cm in total length.
19. As an adult, Massospondylus would have grown to a length of 5 m.
20. During Mesozoic period several reptile groups became key marine predators.
21. The ichthyosaurs, a fish-shaped animal, adapted to life in the sea, evolved from land-living diaps.
22. Snakes have mobile skulls.
23. Plesiosaurs are second major marine reptile group.
24. The pliosaurs were larger, short necks and large heads and fed mainly on fishes using long neck like a snake.
25. The extraordinary diversity of tetrapod predators in the sea came to an end 65 Ma.
26. During the great Cretaceous-Tertiary mass extinction, dinosaurs and pterosaurs ended followed by the rise of mammals.
27. Archaeopteryx was oldest known bird found in Upper Jurassic sediments in southern Germany in 1861.
28. The skeleton of Archaeopteryx is very like that of Deinonychus.
29. The details of the arm and hindlimb of Archaeopteryx show that birds were small flying theropod dinosaurs.
30. Modern birds appeared in the latest Cretaceous and Early Tertiary period.
31. The perching birds radiated in the Miocene.
32. Confuciusornis from Liaoning, China is an example of Early Cretaceous bird.
33. Primitive forms of small insect eaters arose in the Late Triassic and Early Jurassic.
34. Small insects did not achieve high diversity, due to the dinosaurs.
35. Most basal mammal groups did not outlive the Cretaceous-Tertiary mass extinction.
36. Monotremes are restricted to Australasia, Platypus echidnas and still laying eggs, as the cynodont ancestors.
37. Marsupials and Placentals radiated dramatically in the Tertiary period.
38. Marsupials and Placentals diversified within 10 myr to forms as disparate as bats and rats, monkeys and whales.
39. Mammals uniquely have differentiated teeth, with incisors, canines and cheek teeth.
40. High metabolic rates need lots of nutritious food.
41. Differentiated teeth allows mammals to improve the efficiency of their digestive systems.
42. Females of Subclass Monotremata lay eggs, and newborn young grow in pouch.
43. In Subclass Metatheria, Youngs are born live, but continue development in pouch.

44. In Subclass **Eutheria**, young are born live at an advanced stage, nourished by a placenta.
45. **Early Primates** are one of the oldest of the modern placental mammal groups.
46. The name primate come from **primus**, meaning **first**. Thus, Humans are **primates**.
47. For most of their history, the **primates** were a rare and rather obscure group.
48. **Primates** have **larger** than average brain and good **binocular** vision.
49. **Early primates (Plesiadapis)** were squirrel-like animals that may have climbed trees and fed on fruit, seeds and leaves. E.g The **Paleoceneprimate Plesiadapis**.
50. True monkeys arose in the **Eocene** and they diverged into **two** groups. The New World monkeys of **South America** and The Old-World monkeys of **Africa**, **Asia** and **Europe**.
51. **Marmosets** and spider monkeys, have flat noses and **prehensile** tails used as extra limbs in swinging through the trees.
52. **Marmosets** and spider monkeys belong to **New World Monkeys**.
53. **Macaques** and **Baboons** have narrower projecting noses and **non-prehensile** tails, or no tails at all.
54. **Apes** arose from the **Old-World** monkeys before the end of the **Oligocene**.
55. The **Apes** radiated in **Africa** in the **Miocene**.
56. The **Gibbons** of **Southeast Asia** are the most primitive living apes, having branched off **25– 20 Ma**, followed by the orangutan **20–15 Ma**.
57. Gorillas, chimpanzees and **humans** appear to be very closely related.
58. Gorillas, chimpanzees and humans share many anatomic characters and **>94%** of their DNA is **identical**.
59. Gorillas seem to have diverged first, about **10 Ma**.
60. The ancestors of humans and chimps separated about **8–6 Ma**.
61. In Humans, **Bipedalism** came first than **intelligence**.
62. In the late **Miocene**, Climates became arid and the **East African** rift valley began to open up separating the forests in the west from the arid grasslands in the east.
63. Oldest Human date back to **4 Ma**.
64. Molecular studies estimate of **5 Ma** for the split between humans and chimps.
65. In 2001 and 2002, **two French** teams announced human fossils that were **6 Ma**.
66. It may be that **Sahelanthropus** and **Orrorin** were already bipedal by **6 Ma**.
67. The oldest clear evidence for bipedalism in human tracks in volcanic ash from **Tanzania, 3.75 Ma**.
68. The oldest substantial skeletons, of **Praeanthropus** afarensis dates **3.2 Ma**.
69. The spectacular skull of Sahelanthropus from the upper **Miocene** of **Chad** was over **6 Ma**.
70. The famous skeleton of a female **P. afarensis** from **Ethiopia**, called **Lucy**.
71. Skeleton of **Lucy** was discovered by **Don Johanson** in the **1970s**.
72. Lucy has a rather modern **humanoid pelvis** and **hindlimb**.

73. Lucy's brain is small, only 415 cm³ for a height of 1–1.2 m.
74. Australopithecus continued to evolve in Africa from about 3 to 1.4 Ma.
75. Australopithecus gave rise to small & large robust species reached heights of 1.75 m with brain capacities not exceeding 550 cm³.
76. Homo habilis lived in Africa from 2.4 to 1.5 Ma.
77. Brain capacity of Homo habilis was 630– 700 cm³ in a body and only 1.3 m tall.
78. Homo erectus arose 1.9 Ma in Africa, spread to China, Java and central Europe.
79. Homo erectus had brain size of 830–1100 cm³ in a body up to 1.6 m tall.
80. Homo erectus knew about use of fire for cooking, made tools weapons from stone and bone.
81. Truly modern humans, H. sapiens, may have arisen as much as 400,000 years ago, and certainly by 150,000 years ago, in Africa, evolved from H. erectus.
82. All modern humans arose from a single African ancestor.
83. Modern Humans spread to the Middle East and Europe by 90,000 years ago.
84. The European story includes a phase, from 90,000 to 30,000 years ago, when Neanderthal man occupied much of Europe from Russia to Spain and from Turkey to southern England.
85. Neanderthals had large brains (on average, 1400 cm³), heavy brow ridges and stocky powerful bodies.
86. Modern humans advanced across Europe from the Middle East.
87. A unique small-sized human species, Homo floresiensis emerged 18,000 years ago.
88. Fungi have a long fossil record, perhaps dating back to the end of the Precambrian.
89. Plants moved onto land in the Ordovician and Silurian, a move enabled by the evolution of vascular tissues, waterproof cuticles and stomata, and durable spores.
90. Non-seed-bearing plants arose during the Devonian, but tree-like lycopsids, equisetopsids.
91. Groups such as ferns became established by the Carboniferous.
92. Palynology is the study of fossil pollen and spores.
93. Flowering plants radiated dramatically during the Cretaceous, fully enclosed and protected seeds, flowers and double fertilization.
94. Trace fossils are named on the basis of shape and ornamentation, not on the basis of the supposed maker, environment or stratigraphy.
95. Trace fossils may be produced within a sedimentary layer, or on the surface.
96. The study of trace fossils is called ichnology.
97. German paleontologist Adolf Seilacher established a classification of trace fossils based on behavior.
98. Tracks are sets of discrete footprints, usually formed by arthropods or vertebrates.
99. Trails are continuous traces, usually formed by the whole body, either traveling or resting.

100. **Burrows** are structures formed within soft sediment, either for locomotion, dwelling, protection or feeding, by moving grains out of the way.
101. **Borings** are structures formed in hard substrates, such as limestone, shells or wood, for the purpose of protection, includes bioerosion feeding traces, such as drill holes in shells produced by **gastropods**.
102. **Fecal pellets** and **fecal strings** are small pellets, usually **<10 mm** in length, or strings of excrement.
103. **Coprolites** are discrete fecal masses, usually **>10 mm** in length, and usually the product of **vertebrates**.
104. **Non-fecal pellets** are regurgitation pellets of **birds** and **reptiles**, excavation pellets of crustaceans.
105. Trace fossil genera: **ichnogenera**.
106. Trace fossil species: **ichnospecies**.
107. A plot of species numbers through time must show a pattern of phenomenal increase over the past **3500 myr**.
108. **Exponential** model says that diversity continues to expand without reaching a global carrying capacity.
109. **Logistic model** says that diversity reached a global equilibrium level.
110. It is important not to confuse pattern with process; too often scientists and the public assume such processes as **competition**, **adaptation** and progress without testing for alternatives.
111. Major steps in evolution are well documented by **fossils** and **evolutionary trees**.
112. **Valentine (1969)** plotted the numbers of families of skeletonized shallow marine invertebrates through the **Phanerozoic**.
113. **Raup (1972)** argued that the graph showed more about the sources of error in the fossil record than it did about the true pattern of the diversification of life.
114. There are **three** mathematical models in diversification patterns.
115. The linear model is represented by a **straight line**.
116. The exponential model is presented by an **exponential curve**.
117. The logistic model is showed by **Logistic curve**.
118. **The linear model** represents additive increase, the addition of a fixed number of new species in each unit of time. Such a model has generally been rejected as improbable.
119. If speciation and extinction rates remain roughly **constant**, then there will be regular **doubling** of diversity within fixed units of time. This is **exponential model**.
120. If the **logistic model** is correct, life has diversified in a controlled manner, reaching one or more equilibria, each of which is probably density limited.
121. If the **exponential model** is correct, life has diversified in a **less** controlled manner.
122. Food and space limitations **slow** the rate of increase.

123. The Modern fauna radiated dramatically over the last **100 myr** and shows no sign of reaching an equilibrium level.
124. An evolutionary trend is a **one-way** change in some feature or features.
125. A trend in human evolution has been for **increasing brain** size.
126. A trend is classed as progress if it is assumed that a **larger** brain means **higher** intelligence and so greater evolutionary adaptability.
127. **Hyracotherium** of the **Eocene** was better than the **plains-dwelling**, larger, modern **Equus**.
128. A radiation is when a clade expands relatively **rapidly**.
129. **Patterns** are observations of the appearance and disappearance of **species**.
130. **Processes** are hypotheses that seek to explain the patterns.
131. The replacement of **brachiopods** by bivalves is a famous example of **Biotic Replacements**.
132. Complex organic molecules were synthesized naturally in the **Precambrian** oceans.
133. First living organism **bacteria** occurred **3500 Ma** ago.
134. **Adaptation 2** was carried out with production of **Eukaryotes** and the origin of sex.
135. In marked contrast to the prokaryotes, **eukaryote** cells are usually large, with organelles and membrane bounded nuclei containing the chromosomes.
136. **Adaptation 3** gave rise to **Multicellularity**.
137. Oldest multicellular eukaryotes reported from rocks **1200 Ma** in **Canada**.
138. In **Adaptation 3**, some **400 myr** later true metazoans occurred.
139. During an interval of a few million years in the earliest **Cambrian**, a variety of mineralized skeletons appeared.
140. Predator pressure may have been the main driving force behind the acquisition of hard parts. It lies in **Adaptation 4**.
141. The **Late Precambrian Ediacara** fauna was soft bodied, and it appears likely that predators and scavengers were absent.
142. During the **Early Cambrian**, **Predation** was an important part of the ecosystem.
143. The rapid diversification of armored and protective strategies was a feature of the **Cambrian** radiation.
144. Throughout the **Phanerozoic**, the main reef builders have changed, with major changes punctuated by mass extinctions.
145. The first reefal frameworks appeared during the **Early Cambrian**.
146. **Microbial** life extended a **greenish** scum around the water's edge.
147. **Ordovician** soils suggest that larger plants and animals had moved onto land.
148. Next major expansion of living space on land took place during the **Carboniferous**, with the development of forests.

149. The first tree sized plants occurred in **Late Devonian**.
150. The addition of new stories of vegetation occurred in **Adaptation 8**.
151. Having insect groups to move off the ground in search of edible leaves and fruits, gliding and true flight became inevitable in **Adaptation 8**.
152. Insects arose in the **Early Devonian**, but the first true fliers are **Carboniferous** in age.
153. Flight has arisen more than **30** times among vertebrates.
154. In a biologically-oriented presentation, **John Maynard Smith** and **Eörs Szathmáry** (1997) identified **eight** major steps from the origin of life to human societies with language.
155. The first objects with the properties of multiplication, variation and heredity were probably replicating molecules, similar to **RNA** but perhaps simpler, capable of replication.
156. **Prokaryotes** lack a **nucleus** and have (usually) a single circular chromosome.
157. **Eukaryotes** have a nucleus containing **rod shaped** chromosomes and organelles.
158. **Biogeography** is the study of the distribution of species and ecosystems in geographic space and through geological time.
159. The patterns of species distribution across geographical areas can usually be explained through a combination of historical factors such as: **speciation**, **extinction**, **continental drift**, and **glaciation**.
160. To predict future trends and understand the factors affecting organism distribution, often mathematical models and **GIS** are employed to solve ecological problems that have a spatial aspect to them.
161. **Two** chapters in On the Origin of Species were devoted to geographical distribution.
162. Biogeography and Creation began in the **mid-18th** century.
163. At that time, most people accepted the statements in the **Bible** as the literal truth, that the Earth and all living things that we see today had been created in a **single** series of events.
164. Living world and the planet that it inhabits are continually changing driven by **two** great processes.
165. **Linnaeus**, a **Swedish** naturalist, in **1735** started to name and describe the animals and plants.
166. Georges Buffon was a **French** naturalist.
167. **Georges Buffon** was the first person to realize that “similar environments, found in different regions of the world, contained different groupings of organisms “.
168. Many of the mammals of North America, such as bears, deer, squirrels, hedgehogs and moles, were found also in **Eurasia**. Travelled via Alaska, when climates were warmer.
169. Most of the mammals of South America are quite different from those of Africa, even though they live in similar tropical environments. This is **Buffon’s law**.
170. The concepts of ecological biogeography, botanical regions and island biogeography had, then, all been recognized by the end of the **18th** century.

171. British botanist **Joseph Banks** and the German **Johann Reinhold Forster**, together with his son **Georg Forster** who collected thousands of species of plants, many of them new to science.
172. **Forster** found that **Buffon's Law** applied to plants as well as to animals, and also applied to any region of the world that was separated from others by barriers of geography or climate.
173. There being more plant species closer to the equator and progressively fewer as one move **towards** the **pole**.
174. **Karl Willdenow**, a **German** botanist suggested that, although there had been only one act of creation, it had taken place simultaneously in many places. In each area, the local flora had been able to survive the flood.
175. German naturalist, **Alexander von Humboldt** is regarded as the founder of **plant geography**.
176. **Humboldt** believed that the world was divided into a number of natural regions, each with its own distinctive assemblage of animals and plants.
177. **Augustin de Candolle** of Geneva who, in **1805** together with **Lamarck**, published a map showing **France** divided into **five** floristic regions with different ecological conditions.
178. **Danish** botanist **Joakim Schouw** was the first to classify the world's **flora** and show the results on maps.
179. **Griesbeck** developed more detailed map **The History of Biogeography**.
180. Griesbeck's more detailed, colored map of **1866** was similarly a vegetation map.
181. Leading work on biological and geological subjects had been carried out in **Prussia**.
182. **French** Revolution of **1789** led to a flowering of French science.
183. One of those employed in this new museum was **Jean Baptiste Lamarck**.
184. In **1802**, **Lamarck** suggested that '**Lower**' organisms might also be found earlier in time and that they might gradually change into the '**higher**' forms, due to an inherent tendency of life to improve itself.
185. **Georges Cuvier** found the science of **comparative anatomy**.
186. Cuvier, Lamarck's theory of **continual transformation** was deeply unacceptable.
187. **Geoffroy** suggested evolutionary homologies and links between such widely different animals as fish and cephalopods.
188. Scottish journalist **Robert Chambers** published a book, **Vestiges of the Natural History of Creation** which contained astonishingly ignorant ideas.
189. **Robert Jameson** translated Cuvier's ideas into **English** in **1813**.
190. **Robert Jameson** suggested **Cuvier's** continent-wide catastrophes as the **biblical Flood**.
191. **Cuvier** accepted that **science** and **religion** should not interfere in each other's affair.
192. Young **Charles Darwin** was cautious, secretive and reluctant to publish his ideas by invoking evolution.

193. **Charles Darwin** was interested in geology & natural history, thus, in **1831** joined the crew of a **HMS Beagle**, to act as a companion to the captain and also as a naturalist for 6-year voyage to survey the coasts of South America.
194. **Alfred R. Wallace** was first to publish that closely related species were often also found close to one another geographically.
195. The idea of natural selection was announced by short papers from both **Darwin** and **Wallace**, read at a meeting of the **Linnean Society of London** on **30 June 1858**.
196. Darwin had spent the **40** years after his voyage in detailed research on many other areas of biology that provided evidence for evolution.
197. **Charles Lyell**, a British geologist argued that many lines of evidence suggested that the Earth must be many millions of years old.
198. **Charles Lyell** discovered in the **20th** century, leading to the eventual realization that the Earth is several **billion** years old.
199. **Plate tectonics** is the central paradigm of the earth sciences and Theory of evolution is of the biological sciences.
200. **Adolf Engler (1879)** differentiated between the floras and faunas of the separate continents resulted from their having had separate evolutionary histories.
201. **Engler** was first to make a world map of four major floral regions, or **realms**.
202. The system of plant regions accepted today is very similar to that of **Engler**.
203. **Joseph Hooker** suggested floras of the continents and islands of the Southern Hemisphere, and had suggested that these might be explained partly by the dispersal of floating seeds.
204. **Six** regions were first formalized in **1858** by the British ornithologist **Philip Sclater**.
205. **Alfred Wallace** made his living by collecting bird skins, butterflies and beetles in the **East Indies**, and selling them to naturalists.
206. **Dispersalism** is where a taxon or **two** related taxa are found on either side of a barrier to their spread. This is because they had been able to cross that barrier after it formed.
207. **Joseph Hooker**, found dispersalism quite **unconvincing**.
208. **300** million years ago, **Glossopteris Flora** existed in Africa, Australia, Antarctica, southern South America and, most surprisingly of all, India.
209. German meteorologist, **Alfred Wegener (1912)** presented his **Theory of Continental Drift**.
210. **Wegener** suggested that all of today's continents had originally been part of a single supercontinent, **Pangaea**.
211. According to Wegener, today's landmasses were originally linked together to form a single supercontinent, **Pangaea**.
212. **George Myers** worked on **freshwater fishes**.

213. Walter Matthew wrote his paper 'Climate and Evolution' in 1924.
214. Leon Croizat amassed a vast array of distributional data, representing each biogeographical pattern as a line, or track, connecting its known areas of distribution.
215. Croizat studied the distribution patterns of many unrelated taxa, and for each he drew lines or 'tracks' on the map linking the areas in which they are found.
216. Panbiogeography argued that all of the areas connected by one of these tracks had originally formed a single, continuous area that was inhabited by the groups concerned.
217. Croizat believed that any barriers that exist today within the pattern of distribution of the taxa had appeared after that pattern had come into existence, so that these taxa had never needed to cross them.
218. Croizat published his ideas in the 1950s and 1960s in his 1958 book Panbiogeography.
219. Most of the Croizat's supporters worked in New Zealand.
220. Wegener's theory of continental drift had provided an explanation to Dispersal of Life in early 20th century.
221. Cladistics provides a rigorous methodology for analyzing the patterns of evolutionary relationship between the different members of a group.
222. DNA and Proteins provides confidence in accuracy of reconstructions of the patterns of evolutionary divergence of group under study.
223. Linnaeus made simple observations, recorded, in what type of environment each plant was found.
224. Forster recognized latitudinal gradients of diversity.
225. Candolle (1855) suggested three physiologically different types of plant that resulted from their adaptations to different levels of heat and moisture.
226. V.V. Dokuchaev analyzed the mineralogical and physical attributes of the soils that resulted from the breakdown of different types of rocks.
227. The first clear and simple system of categorizing the different types of vegetation was produced by the German botanists Hermann Wagner and Emil von Sydow in 1888.
228. Clements and Shelford in 1916, were plant formation or, with the addition of its animals, a biome.
229. Tansley in 1935 added the climatic and soil aspects of the complex, calling it an ecosystem, which became the basic unit of ecology.
230. Julius von Sachs was a German botanist and plant physiologist.
231. Plant ecologist Frederic Clements said that communities resemble individual organisms in their degree of internal organization, and may similarly behave as units in their patterns of distribution.
232. The linked concepts of succession and climax was first developed by Henry Cowles.
233. Raymond Lindemann in 1942 put forward a formal account of energy flow in nature.

234. **Raymond's** work was expanded by the work of American ecologists **Howard** and **Eugene Odum**, and named by the British botanist **Arthur Tansley**.
235. **Neutral Theory of Biodiversity** suggests that assemblage of species in a site is entirely a matter of chance.
236. The arrival of a species is a **stochastic** process.
237. **Biogeography** of the oceans is similar to that of the **continents**.
238. **James Dana (1853)** divided the surface waters into several different zones based on **mean minimum temperature**.
239. **Edward Forbes (1856)** published **Five** depth zones and **25** faunal provinces along the coasts of the continents.
240. In **1880**, **Albert Günther** published a book on fishes in which he recognized **10** different regions in the distribution of shore fishes.
241. **Arnold Ortmann** published work based on the distribution of crustaceans such as crabs and lobsters.
242. **Atlas of Zoogeography** was assembled by three British zoologists **John Bartholomew**, **William Clark** and **Pery Grimshaw** in **1911**.
243. **30** maps of the distributions of fishes based on the patterns of distribution of **27** families were made.
244. An Influential Review was carried out by the Swedish worker **Sven Ekman**; German in **1935**, English translation in **1953**. This divided the faunas of the shallow seafloors into **seven** areas.
245. **Sven Ekman** said that **Panama** barrier must have been absent.
246. Phenomenon of '**bipolarity**' is where a species is found on either side of the equatorial regions, but not within them.
247. **Jack Briggs (1974)** used the patterns of endemism of coastal faunas to identify locations where there appears to be a zone of unusually rapid faunal change, and then used this to distinguish **23** zoogeographical regions.
248. The ecology of island faunas and floras is far more fragile than that of the **continents**.
249. **New Guinea** contributes only **3%** of the world's land area and it contains some **10%** of its species of terrestrial organism.
250. **Georg Forster** was the first biologist to identify particular features of island biogeography. Fewer species than the mainland, but that the number of species varies according to the size and ecological diversity of the island.
251. **Candolle** pointed out that the age, climate and degree of isolation of an island, and whether or not it was volcanic, would also affect the diversity of its flora.
252. **Sheer** variety and volume of the works was published by **Alfred Wallace**.

253. **Philip Darlington** (1943) said the larger islands contain a greater number of individuals, and a greater diversity of species, than smaller islands.
254. According to **Philip Darlington**, the species diversity is increasing by a factor of **10** for every doubling of island area.
255. **MacArthur** and **Wilson** revolutionized the study of **island** biogeography, for they led the way in introducing mathematical techniques, and in providing a standard format for analysis and comparison.
256. The Theory of Island Biogeography was published in **1967**, written by two American biologists, the mathematical ecologist **Robert MacArthur** & the taxonomist–biogeographer **Edward Wilson**.
257. **Swedish** worker **Olof Arrhenius** in **1921**, and the Americans **Eugene Munroe** in **1948** and **Frank Preston** in **1962**, had noted the relationship between the area of an island and the number of species that it contains.
258. A species that exists as a series of subspecific forms is termed a **Polytypic** Species.
259. A less variable species that exists in just one form called a **Monotypic** Species.
260. The **Herring Gull** was regarded as polytypic with about a dozen subspecies spread around the entire **Northern** Hemisphere.
261. A dozen subspecies spread around the entire **Northern** Hemisphere. This distribution is termed as **circumboreal**.
262. Where there is gradual change in genetics and form along a gradient, taxonomists refer to a **cline**, and the variation is said to be **clinal**.
263. All chimpanzee subspecies lie to the north or east of the river **Congo**.
264. **Frost** can prove fatal to many tropical plants because the formation of ice within the cells of the plant, followed by melting, disrupts the cell membranes and results in death.
265. **Drought** can cause problems of **desiccation**.
266. A **forest** species may be deterred from crossing an area of grassland; or a marsh organism may fail to travel across dry habitats to reach the next area of wetland.
267. Changes in the pattern of land masses over the surface of the Earth have resulted in the creation of **physical barriers**, sometimes between **closely** related **taxa**.
268. **Sheer** chance in the distribution of organisms.
269. The arrival of a **wind-borne insect** or a **seed** at a particular point in space cannot be predicted with certainty, and the **first** arrival may well be at an advantage over those arriving later.
270. Some plants and animals are confined in their distribution, within the areas in which they evolved; these are said to be **endemic** to that region.

271. The demands that an organism places on its environment in terms of physical and chemical conditions, space and food supply is called **niche**.
272. **Kleptoparasitism** is a form of feeding in which one animal deliberately takes food from another.
273. The **coots** are messy eaters, and it is not difficult for **gadwall** to move in and collect some of the loot.
274. The sum of all the niche requirements under ideal conditions when the species is given unimpeded access to resources is called **Fundamental Niche**.
275. Species perform better in their efficiency of **acquisition**.
276. **Species** may evolve in one region, spread to other locations and then become extinct in all but a restricted area where it survives.
277. In general, there are **two** major factors influencing the degree of endemic in an area.
278. **Isolated** islands and mountains are often rich in **endemics**.
279. The islands of **Australia** for example has long been isolated from outside influences, until the arrival of **European** people with their associated invasive organisms.
280. **Australia** is indeed rich in **endemics**, many of which have a long geological history. This kind of fossil endemism is called **palaeorndemism**.
281. Anything that tends to make it more difficult for a species to live, grow or reproduce in its environment is called **limiting factor** for the species in that environment.
282. Any regular change in physical or chemical conditions through space thus creates a sequence of replacement of one species by another, among both animals and plants. This is known as **zonation**.
283. When two species are attempting to tap a resource in the same way, and when that resource is in short supply, the two are said to be in **competition**.
284. When a species is prevented from occupying an area by the presence of another species in this way, it is termed **competitive exclusion**.
285. An organism may find considerable advantage in avoiding competition with other species or other members of its own species. This is termed as **Reducing Competition**.
286. Many bats are night active insectivores, avoiding competition for prey with insectivorous birds during the day, and also avoiding the predatory attention of day active hawks and falcons, described as **temporal separation**.
287. **Spatial Separation** suggests that each species must be adapted to live within the fixed set of physical conditions of its particular microhabitat.
288. Species is preyed upon too heavily, and the predators can always turn to alternative food species if the numbers of their usual prey should be reduced by climatic or other influences. This is termed **prey switching**.

289. **Parasites** reduce the rate of growth of populations because of their **negative** influence on general fitness, survival and fecundity.
290. The presence of predators is likely to **increase** rather than reduce the numbers of species present.
291. Predators **broaden** the distribution of species.
292. The removal of certain species could create effects far in excess of what may originally have been expected. Influential species of this kind are known as **keystone species**.
293. The loss of a **keystone** species can cause an **avalanche** of **local** extinctions.
294. Environmental conditions alter with seasons, especially in the **higher** latitudes, and some animals alter their distribution patterns in concert with the seasons. This is called **migration**.
295. **Microscopic plankton** are capable of changing the depth at which they live, depending on conditions, and this can be regarded as a form of vertical migration.
296. **Birds** are among the most mobile of animals, and many species resort to migration in order to maximize food supply, especially during the **breeding** season.
297. Most extraordinary of all migrant birds, is the **Arctic tern (Sterna paradisaea)** which, nests in the Arctic and travels to the **Antarctic** during the northern hemisphere winter.
298. **Success** of a species can be measured by its **geographical** distribution.
299. The flightless birds, such as the **Great Auk** and the **Dodo**, are examples of extinct species.
300. Ecological Imperialism is greatly assisted by **humans**.
301. **Ecological imperialism** is a term sometimes used to describe the wave of biological invasions that has occurred in the wake of human invasions, by either accidental transport or deliberate introduction.
302. Species rarely occur as single populations; usually they occur in a mixture of different species, and such an assemblage is termed a **community**.
303. The term **guild** is used for animals that play a particular role in the community, such as plant sucking insects or insectivorous birds.
304. species tolerating one another, or becoming dependent on one another is called **Co-evolution**.
305. **Phytosociology** is a discipline of vegetation science summarized by the views of the two American ecologists, **Frederic Clements** and **Henry Gleason** who began the discussion in the **1910s** and **1920s**.
306. **Clements** regarded the plant community as an organic entity in which the **positive** interactions and interdependencies between plant species led to their being found in distinct associations that were frequently repeated in nature.
307. **Gleason** suggested **Individualistic Concept** pointing out that no two species have quite the same needs.
308. There are **two** models of vegetation.

309. **Hydrological Cycle** plays a major role in both delivering and removing elements to and from ecosystems.
310. **Redundant Species Hypothesis** suggests that removal of certain species from an ecosystem would have little or no effect on the functioning of that ecosystem.
311. Certain species play key roles in the ecosystem, and when they are lost there is a sudden drop in the capacity of the ecosystem to function. This is sometimes referred to as the **Rivet Hypothesis**.
312. **Rivet hypothesis**, in which certain species are critical in supporting ecosystem function.
313. British ecologist **Charles Elton** first proposed (in **1950s**) that a more complex and richer ecosystem should also be more stable, less prone to violent fluctuations such as those caused by **epidemic disease** or pest outbreaks.
314. Animal life included in descriptions and definitions and they are called **biomes**.
315. **Raunchier** analyzed the flora of different parts of the world into component functional types and found that each region had its own distinctive biological spectrum.
316. **Ian Woodward** proposed **11** types of classification of vegetation.
317. Climate varies with **latitude**.
318. In the **high** latitudes, energy is spread over a wide area; thus, polar climates are generally **cold**.
319. As the angle of incidence of the sun's rays approaches **90°**, the area over which the energy is spread becomes smaller, so that there is an **increase** heating effect.
320. The precise latitude that receives sunlight at **90°** at noon varies during the year; it is at the **equator** during March and September, at the **Tropic of Cancer** (23°28'N) during June and at the **Tropic of Capricorn** (23°28'S) during December.
321. Air moves towards the pole & gradually cools & increases in density until it descends, where it forms a subtropical region of high pressure, known as the **Horse Latitudes**.
322. Air either moves toward the equator or else moves poleward. This simplified and idealized picture is complicated by the **Coriolis effect**.
323. Coriolis Effect was analyzed by **French** mathematician, **Gaspard Coriolis**.
324. The winds moving toward the equator in both hemispheres are deflected and consequently blow from east to west. The **trade winds**, found in both the Northern and Southern Hemispheres, meet in the region of the equator, and this is known as the **Intertropical Convergence Zone** or **(ITCZ)**.
325. In the Northern Hemisphere summer, strong southerly winds are generated in the **Indian Ocean**, carrying warm, moist air into India and East Africa.
326. These '**trade winds**' bring the monsoon rains to these regions.
327. Due to the spherical shape of the Earth, **polar** regions receive **less** solar energy per unit area than the **equatorial** regions.
328. **Metapopulation** are known as **fragmented population**.

329. Approximately **1.8 million** species of organism have been described.
330. Of the bacteria, only about **4000** species have so far been described.
331. Many species may have been described and named twice, or even more times known as **Alias problem**.
332. The biologist **Edward O. Wilson** has calculated that the loss of species from the tropical forest area alone could currently be as high as **6000** species per year.
333. Regions with the highest **evapotranspiration** are able to support the **highest** diversity of tree species.
334. **Evolution** is the process by which new species are generated.
335. **Angiosperms** have always been most abundant in the **low-latitude** or **(tropical)** regions.
336. **Metabolic Theory** suggests that in an environment where energy is abundant and temperature is consistently high, such as the tropics, metabolic rates in organisms tend to be **faster**.
337. **Ultraviolet Radiation** is generally greater in the tropics, and this can increase mutation rates.
338. Regions with **high** diversity exhibit a **faster** rate of diversification.
339. **Jonathan Davies** & his colleagues from I. College London and from **Kew Gardens** said that accumulation of species was indeed faster in regions of high biomass. Either of speciation being rapid, or of extinction rates being lower
340. **Energy-biomass** model remains the most robust explanation currently available for latitudinal gradients in diversity.
341. Greater extinction rates in the higher latitudes are the instability of climatic conditions over the past **2 million** years.
342. Earth's Climate is constantly changing and considerably **colder** over the past **2 million** years.
343. High latitude organisms have **broadier** geographical ranges than those from the **low** latitudes.
344. General feature of biogeography was first pointed out by **E.H. Rapoport** in the **1970s**, and named as **Rapoport's rule**.
345. **Klaus Rohde** of Armidale, Australia, considers that **Rapoport's rule** is of local application only and cannot be applied in the **tropical** regions.
346. **James Brown** of the of **New Mexico** has coined the term **macroecology** to cover this approach to biogeographical and ecological research.
347. The **Amazon** basin contains approximately **90,000** flowering plant species, whereas equivalent areas in Africa and in South East Asia contain only about **40,000** each.
348. There appear to be certain areas of the world that are exceptionally rich in species, termed **biodiversity hotspots** by the conservationist **Norman Myers**.
349. Norman Myers originally proposed **10** hotspots.

350. The location of **25** of the hottest spots for biodiversity on Earth based on a consideration of many of the better-known groups of organisms.
351. All the land surface area of the hotspots together comprises only about **1.4%** of the Earth's terrestrial total.
352. All than land surface area of the hotspots contains about **44%** of the world's vascular plants and **35%** of the vertebrates from the four main groups.
353. **Stuart Pimm** & **Peter Raven**, a research conservationists calculated that even if the **25** hotspots were given protection the likely extinction rate of species would be about **18%**.
354. If protection is delayed, as high as **40%** of the extinction rate would occur.
355. The idea that continents could fragment and move across the face of the planet was first suggested by the **German meteorologist Alfred Wegener** in **1912**.
356. The ocean floors move as well as the continents, the study of their movements is known as **plate tectonics** rather than **continental drift**.
357. The different plates may also move past one another at regions known as **transform faults**.
358. In the **1960s**, new discoveries revealed the motive force.
359. All this evidence for the theory of plate tectonics was so overwhelmingly convincing that it quickly gained general acceptance by biogeographers during the **1960s**.
360. Lines within the oceans show the positions of spreading ridges.
361. **Dotted lines** indicate the positions of **trenches**.
362. Lines within the continents show the divisions between the **different plates**.
363. **Arrows** indicate the directions and proportionate speeds of movement of the **plates**.
364. The Antarctic plate is rotating **clockwise**.
365. **Harry Hess (1962)**, an American geophysicist suggested that the Volcanic chains were spreading ridges, where new seafloor is being formed.
366. The two continents, South America and Africa were originally part of a single continent, **Gondwana**.
367. The two continents, South America and Africa moved apart, separated by the new **South Atlantic Ocean**.
368. The surface of the Earth, known as the **lithosphere**, is occupied by a number of areas known as **tectonic plates**, which may contain continents and parts of oceans, or may consist only of ocean floor.
369. In the middle of the **Paleozoic**, **400 mya**, a large landmass that we call **Euramerica**, lay across the equator.

370. Joined by a number of smaller fragments including north China, south China, Tibet, Indochina and South East Asia that had split off from the northern edge of Gondwana and moved northward and merged into single world continent, called **Pangaea**.
371. **Gondwana** separated from the northern landmass, now made up of North America and Eurasia, that we call **Laurasia**.
372. The new ocean between the two landmasses is known as the **Tethys Ocean**.
373. **Continental Islands** were the first type of island, originally a part of a nearby continent, but it became separated from it by rising sea levels or by tectonic processes that split them away from an adjacent continent.
374. Of **Volcanic Island Arc**, the most obvious are the Kurile and Aleutian Island arcs that lie along the edge of the Pacific.
375. **Volcanic Island Hotspots** are other islands form as a result of the activity of what geologists call hotspots.
376. An initially interbreeding population that splits into two or more distinct species sharing a common range is an example of **Sympatry**.
377. **Allopatric speciation**, also referred to as **geographic speciation**, is a mode of speciation that occurs when biological populations of the same species become isolated from each other.
378. The **species** is a group of natural populations whose members can all breed together to produce fertile offspring.
379. Separate floras and/or fish faunas can be distinguished in the northerly placed **Siberian continent**, the equatorially placed **Euramerican continent**, Kazakhstan, northern Africa and Australia.
380. The **coalescence** of the different continental fragments to form **Pangaea** led to climatic changes. In general, the world became steadily warmer and drier during the **Triassic**.
381. **Candolle** (1820) & **Engler** (1879) used the patterns of distribution of flowering plants.
382. **Sclater** (1858) working on birds, & **Wallace** in **1860–1876**, working on mammals, defined the system of zoogeographical regions.
383. The comparatively small northern movement of South America led to its connection with Northern America about **3 mya**.
384. Further east, New Zealand separated from Australia **84 mya**, followed by the small continental fragment we call **New Caledonia** around **80–65 mya**.
385. **India–Madagascar** parted from **Antarctica** about **132 mya**, while the split between India and Madagascar took place **90–85 mya**.
386. **Seaway** gradually extended clockwise around Africa, to form in turn the southern South Atlantic about **135 mya**, and the northern South Atlantic about **105 mya**.

387. Africa became united with the northern continents during the Mid Miocene, 16–10 mya it was probably from Africa that tropical flowering plants dispersed to the tropics of southern Asia.
388. Africa contains the best known & most distinctive of Old-World tropical mammal fauna.
389. Placentals are made up of the elephants, hyracoids (conies), aquatic sirenians (sea cows), elephant shrews, armadillos, Cape golden moles, insectivorous tenrecs and extinct embrithopods; they have been placed together in a superorder, Afrotheria that is endemic to Africa.
390. About 19 mya in the Miocene, a firm land connection with Eurasia took place in what is now the Middle East.
391. The seaway was finally broken near the beginning of the Late Miocene, 12 mya, by rising mountains in Arabia, Turkey and the Middle East. It was at this time that the early horse Hipparion, which had evolved in North America, appeared in both Eurasia and Africa.
392. The elephant originated in Africa in the Eocene, migrated into Eurasia in the Early Miocene and migrated back later in the Miocene.
393. The ancestors of the mammoths and modern Asian elephant probably evolved in Africa 4 to 5 mya and migrated back into Eurasia 2 million years later.
394. Area of 587,000 km², Madagascar is second only to New Guinea in size.
395. Madagascar reached its present position relative to Africa by 121 mya; it separated from India about 88 mya. Became an island, while India continued its journey toward Asia.
396. After its separation from Madagascar, India was isolated from direct contact with other land masses during its long journey northward to collide with southern Asia that probably took place less than 35 mya.
397. Ali and Aitchison believe that oceanic islands and now submerged oceanic plateau could have provided stepping stones for organisms to disperse between it and other parts of East Gondwana in the Late Cretaceous and Early Paleocene.
398. There were once islands on the 5000 km long Ninety east Ridge, so named because it approximately parallels that longitude today. Now eroded away, in the Paleocene to Late Oligocene.
399. The mammal fauna of India in the Cretaceous and Paleocene is unknown, but it must have been quickly colonized by the placental mammals of Asia after its collision with that continent.
400. About 3 mya, an increase in aridity, related to the uplift of the Himalayan Mountains to new heights, led to the northern parts of the Indian subcontinent becoming much drier and also led to an increase in the numbers of grazing mammals such as horses, antelope and camels, and of elephants.
401. By the Middle and Late Cretaceous, Gondwana had lost both India and Africa and retained only a narrow connection with South America, so that Antarctica–Australia was the most substantial remnant of the old supercontinent.

402. In the early Cenozoic, songbirds (oscines) started their diversification.
403. The Oscines then dispersed to Asia in the Eocene, where their descendants started the worldwide radiation that today comprises nearly half of all living species of bird.
404. Australia only started to move rapidly northward 46 mya, in the Eocene.
405. By the Early Oligocene, around 35 mya, it had separated sufficiently far from Antarctica for the deep-water Antarctic Circumpolar Current of cooler water and associated westerly winds to become established.
406. Arboreal possum families radiated in the Eocene in Nothofagus forests.
407. The early marsupial herbivores, kangaroos and wallabies appeared after the Erebean grassland ecosystem appeared in the Pliocene.
408. Apart from humans and the aerial bats, only the rats spread naturally as far as Australia, 50 species now form 50% of the diversity of the Australian land mammal fauna.
409. Human beings probably arrived 60,000 to 40,000 years ago and brought the domestic dog about 3500 years ago.
410. Dingo was the ancestor of domestic dogs.
411. Geological studies show that New Caledonia is the smallest (about 1600 km²) surviving fragment of Gondwana.
412. Gondwana rifted away from Australia in the Late Cretaceous 80–65 mya and reaching its present position 1500 km east of it 50 mya.
413. Biogeographers have investigated the history of the angiosperm family Sapotaceae and found that it resulted from nine colonization of the island between 3.3 and 4.2 mya, dates that are about 40 million years after the rifting of New Caledonia from Australia.
414. New Guinea and Australia were the most important sources of the arrivals, those from Pacific islands arriving only more recently, 27–24 mya.
415. Total area of New Zealand is 270,000 km² which makes it far larger than any other Pacific oceanic island.
416. When New Zealand first separated from Gondwana in the Late Cretaceous, about 82 mya, it was part of a Mini continent known as Zealandia almost half the size of Australia.
417. This small landmass drifted northeastward to its present position, separated from Australia by the Tasman Sea, 1400 km wide.
418. Most of it sank below sea level 30–25 mya, during the Oligocene, and it is possible that all of it was submerged at this time.
419. The New Zealand flora is highly endemic at the species level (86% of its less than 2500 species are endemic), but with no endemic families, perhaps because as yet there has not been sufficient time for their evolution to have taken place.

420. Though superficially similar in their geographical position, poised between two continents the islands of the Caribbean do not present the same fascinating problems as the islands of Wallacea because they do not lie between continents with totally different faunas and floras.
421. 1300 native species of freshwater or terrestrial vertebrate in the islands, of which 75% are endemic contain 672 species of amphibian and reptile, which belong to about 75 different evolutionary lineages.
422. Of these 75 different evolutionary lineages, 49 are related to South American taxa, and only four to North American taxa (the origins of the remaining 22 lineages are Africa, Central America or uncertain).
423. The mammal fauna of South America today is characterized by a few marsupials and a diversity of edentate placental mammals known as the Xenarthra that are hardly known elsewhere.
424. In the Late Cretaceous, South America had a mammal fauna of strange marsupials and of ungulate placentals quite unlike anything known elsewhere in the world.
425. Much of Europe was, until about 30 mya, covered by a shallow epicontinental sea, so that the area was an archipelago of islands of varying size, rather like the East Indies today.
426. The biogeographical importance of the climate of the Bering region can be seen in its influence on faunal exchange between North America and Eurasia.
427. Ice Ages are relatively rare events in the Earth's 4.6 billion years of history.
428. During the most recent Ice Age, the movement of Antarctica into its position over the South Pole led to the development of a Southern Polar Ice Cap 42 mya.
429. Rearrangements of the Northern Hemisphere land masses have subsequently resulted in the isolation of the Arctic Ocean so that it received relatively little influence from warm-water currents, leading to it becoming frozen some 3 to 5 million years ago.
430. The presence of two massive polar ice caps increased the albedo, or reflectivity, of the Earth, for whereas the Earth as a whole reflects about 40% of the energy that falls on it, the ice caps reflect about 80%.
431. Milankovich constructed a model based on the fact that the Earth's orbit around the sun is elliptical and that the shape of the ellipse changes in space in a regular fashion, from more circular to strongly elliptical.
432. It takes about 96,000 years to complete a cycle of this change in orbital shape.
433. A second source of variation is produced by the tilt of the Earth's axis relative to the sun, which again affects the impact of seasonal changes, with a cycle duration of about 42,000 years.
434. The third consideration is a wobble of the Earth's axis around its basic tilt angle, which shows a cycle of about 21,000 years.

435. The **Pleistocene** was a time of climatic instability, which had considerable impact on the distribution patterns of organisms over the face of the Earth.
436. One of the species that evolved Quaternary time was, **Homo sapiens**.
437. As Human had an even greater impact on the biogeography of the Earth than even the Ice Ages, it has therefore been suggested that this period of time should be known as the '**Anthropocene**'.
438. The primates of the New World and the Old World became separated from each other some **40 (mya)**, and it is the Old-World branch that is ancestral to humans.
439. Humans were closely related to the great apes, which include the **orangutan Pongo**, and especially to the Gorilla and the chimpanzees Pan.
440. The separation of the human ancestral branch from the **great apes** taken place about **7 mya**.
441. The group of human ancestors and **great apes** is jointly known as **Hominids**.
442. We can study the fossil record of other, larger and more common mammal groups, such as the **hyaenids** and the **proboscideans** associated with hominids.
443. It is very likely that hominids followed similar changing patterns of distribution in the **Miocene**.
444. In 2002, **Michel Brunet** and his fellow researchers discovered **six** fossil bones (a cranium and some lower jaws) that had **hominin** similarities.
445. **Michel Brunet** and his fellows were assigned to a new genus on the human line of evolution and called **Sahelanthropus tchadensis**.
446. **Archaic Hominins** were the earliest finds in Tanzania and Ethiopia and dated from around **4 mya**.
447. **Megadont Hominins** is a short-lived side-line of hominin evolution lived in East Africa **2.3–1.4 mya**.
448. **Homo habilis** is a species that lived nearly **2 mya**.
449. A new hominin, **Homo ergaster**, appeared around **1.9 mya**, closely followed **Homo erectus**.
450. Homo erectus left Africa about **1.7 mya**, and had spread into eastern Asia by **100,000** years later.
451. **Homo heidelbergensis** lived between **600,000** and **100,000** years ago.
452. Appearance of Homo neanderthalensis about **200,000** years ago with evidence of Homo sapiens appearing later, in **160,000**-year-old deposits from **Ethiopia**.
453. **H. neanderthalensis** and **H. sapiens** co-existed in Europe and Asia Minor **40,000 to 35,000** years ago.
454. Even before the last glaciation had begun, **H. sapiens** was spreading into the Middle East and also further south into the **African** continent.
455. By the middle of the **glaciation**, our ancestors had reached the Asian interior and north of the **Caspian Sea**.
456. Australia became populated by about **50,000 ya**, and humans had reached northern Europe and eastern Asia by the time the glaciation was at its peak, **20,000ya**.

457. The sea levels at the time of spread were lower, perhaps by around 100 m.
458. A human skeleton dated to 13,000–12,000 ya, found in Mexico, that shows a mixture of Asian and Native American features.
459. Traces of human occupation about 15,500 ya north of Austin in Texas, at Monte Verde in southern Chile about 14,000ya.
460. Human bones dated to about 13000 ya found in the Channel Islands off California also suggest that some, at least, of the early Americans may have arrived by boat.
461. New World must have taken place before the major advance of the last glaciation about 22,000 years ago.
462. R.A. Rogers revealed three distinct groups of Native American languages centered on the three ice-free refugial areas of North America during the height of the last glaciation.
463. The spread of the human species during the last glaciation was accompanied by the extinction of many species of large mammals, known as the megafauna – first in Australia, then in Eurasia and finally in North America.
464. It was long assumed that these extinctions were the result of the climatic changes, but the American anthropologist Paul Martin suggested that humans may have been the culprits.
465. Paul Martin pointed out that most of the animals that became extinct were large herbivorous mammals or flightless birds, weighing over 50 kg body weight.
466. Martin suggests that 35 genera of large mammal (55 species) became extinct in North America at the end of the last (Wisconsin) glaciation.
467. Dale Guthrie of the University of Alaska has obtained radiocarbon dates for the Late Pleistocene and Early Holocene remains of many large mammal fossils from Alaska and the Yukon Territory.

It is highly recommended and advisable NOT to rely on this file alone.

For obtaining maximum marks, it is necessary to go through handouts/pptx/online material or any relevant material found.

Regards:

Sir Mughal