Q. 1 – Q. 9 carry one mark each & Q. 10 – Q. 22 carry two marks each.

Q.1 The most abundant gas in the atmosphere among inert gases is

(A) Helium (B) Argon (C) Neon (D) Krypton

Q.2 The pair of variables that always exhibit monotonic decrease with height in the atmosphere is

(A) Pressure, Temperature
(B) Pressure, Ozone concentration
(C) Air Density, Pressure
(D) Temperature, Water Vapour

Q.3 Correct order of the maximum vertical extent of atmospheric circulation cells is

(A) Hadley > Ferrel > Polar
(B) Polar > Hadley > Ferrel
(C) Hadley > Polar > Ferrel
(D) Ferrel > Hadley > Polar

Q.4 Analysis of an atmospheric variable shows prominent modes at 5, 40 and 1460 days. These modes correspond respectively to

(A) Tidal, MJO and ENSO
(B) Synoptic, MJO and ENSO
(C) Synoptic, MJO and Decadal
(D) Tidal, Milankhovich and ENSO

Q.5 Atmospheric vertical profile of temperature is measured by radiosonde. Equivalent instruments for measuring ocean temperature profile among the following are:
(**P**) drifting buoy (**Q**) ARGO float (**R**) current mooring (**S**) XBT

(A) **Q, R, S** (B) **Q, S** (C) **R, S** (D) **P, R, S**

Q.6 When deep water sinks in the North Atlantic and moves away from where it formed, it gets

(A) richer in oxygen and nutrients
(B) less acidic and richer in metals
(C) richer in CO_2 and poorer in O_2
(D) richer in CO_2 and O_2

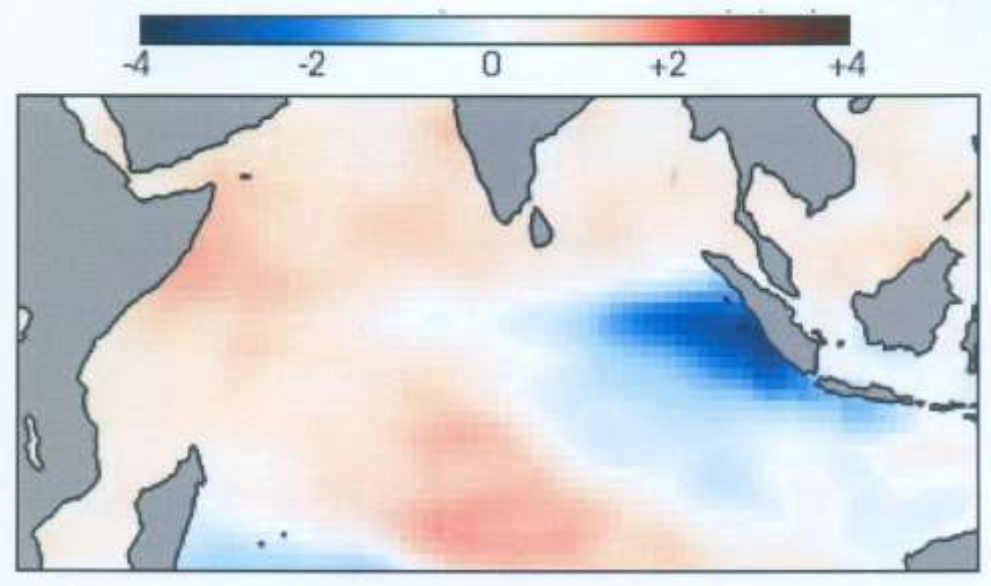
Q.7 The speed of sound in the ocean depends on

(A) temperature alone
(B) temperature and pressure
(C) temperature and salinity
(D) temperature, salinity and pressure

Q.8 In a numerical weather prediction model with a horizontal grid resolution of 50 km, convective cloud processes are parameterized, because

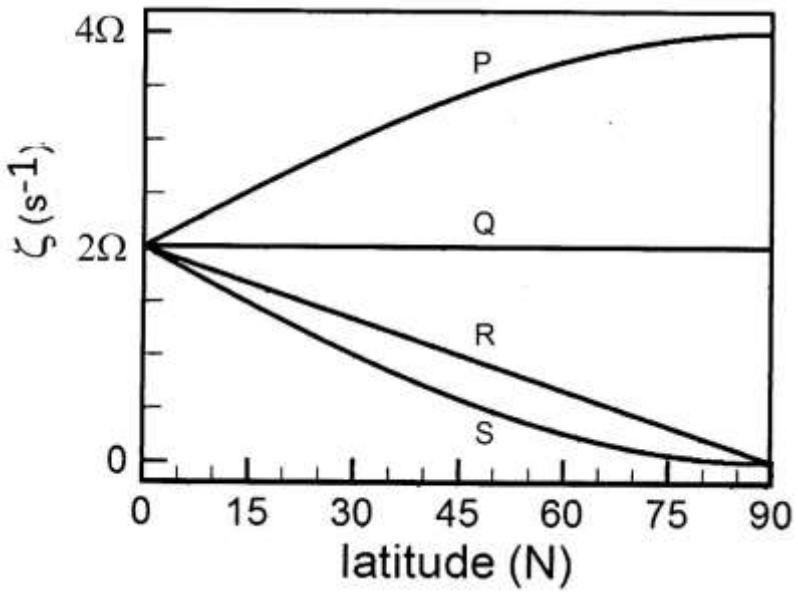
(A) Cloud physics is not known for modelling
(B) Models cannot handle phase change
(C) Cloud size is larger than the grid size
(D) Cloud size is much smaller than the grid size

Q.9 Figure below shows SST anomaly (in °C). It is associated with the phenomenon known as



(A) El Nino
(B) Indian Ocean dipole
(C) La Nina
(D) MJO

Q.10 For an inviscid and barotropic ocean of constant depth (D), a water parcel with initial vorticity 2Ω is displaced from the equator to the north pole. Latitudinal variation of the parcel vorticity (ζ) is well represented by the curve



(A) S (B) Q (C) P (D) R

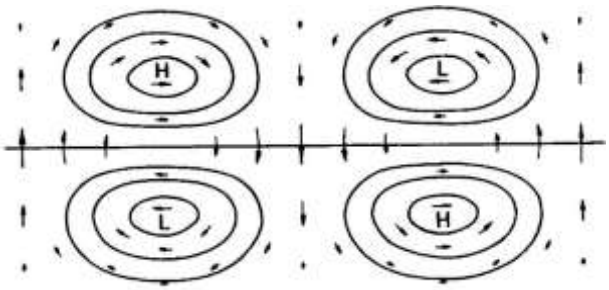
Q.11 A wave progresses up an estuary of decreasing water depth. If friction is neglected, then

(A) wave amplitude decreases and wave length increases
(B) wave amplitude increases and wave length decreases
(C) wave amplitude decreases and wave length decreases
(D) wave amplitude increases and wave length increases

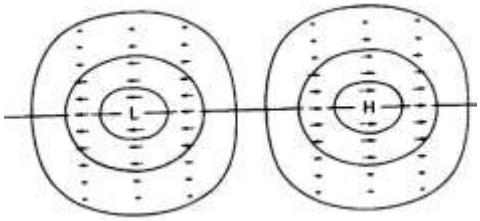
Q.12 In the Ekman flow limit, directions of ocean surface current and the geostrophic wind are

(A) the same
(B) surface current is 45^o to the left of the geostrophic wind
(C) surface current is 45^o to the right of the geostrophic wind
(D) exactly opposite to each other

Q.13



P



Q

P and Q respectively describe flow fields corresponding to

(A) Mid latitude Rossby and Polar gravity waves

(B) Equatorial Rossby and Equatorial Kelvin waves

(C) Midlatitude gravity and Polar Rossby waves

(D) Equatorial Kelvin and Equatorial Rossby waves

Q.14 On the summer solstice day, the maximum incident shortwave radiation at the top of the atmosphere over the equator (up to one decimal place) is _____ W m^{-2}. (Take solar constant as 1368 W m^{-2}).

Q.15 In an isothermal atmosphere having a temperature of 15ºC, the height at which pressure decreases to 1/10 of its value at the surface is _____ km. (Give the answer to two decimal places.) Take g = 9.8 m s^{-2}, gas constant R = 287 J kg^{-1} K^{-1}

Q.16 At 30°N and 700 hPa pressure level, wind field is in gradient balance. If the gradient wind speed is 50 m s^{-1} and radius of curvature of the flow is 50 km, the corresponding geostrophic wind speed is _____ m s^{-1}. (Give the answer to one decimal place.) Take the angular velocity of the Earth as 7.3×10^{-5} s^{-1}

Q.17 In a tropical cyclone over the Pacific Ocean, surface pressure at 500 km from the cyclone centre is 1000 hPa. Surface pressure at the centre is 900 hPa. Sea surface temperature and surface air temperature remain constant at 28°C and 27°C, respectively. Difference in potential temperature between 500 km and cyclone centre is _____ K. (Give the answer to two decimal places.) Take g = 9.8 m s^{-2}, C_p = 1005 J kg^{-1} K^{-1}, gas constant R = 287 J kg^{-1} K^{-1}

Q.18 A cloud forms by the lifting of moist air from the surface with the initial conditions T_o = 30°C, RH = 80% and P_o = 1005 hPa. If the vapour pressure of this parcel at 500 hPa is 6.5 hPa, the liquid water content of the parcel if no precipitation takes place is _____ gm kg^{-1}. (Give the answer to one decimal place.) Saturation vapour pressure of water at 30°C is 42.43 hPa.

Q.19 A numerical model of the atmosphere uses sigma (σ) coordinate system in vertical. At locations P and Q, surface pressures are 1005 hPa and 500 hPa, respectively. Absolute difference in the heights of $\sigma = 0.9$ level between these locations is _____ meters. (Give the answer to one decimal place.) Layer mean temperatures at P and Q are 300 K and 270 K, respectively. (Take g = 9.8 m s^{-2} gas constant R = 287 J kg^{-1} K^{-1})

Q.20 If difference in sea surface elevation is 1 m in 100 km at 30° N latitude, the corresponding geostrophic current is _____ m s^{-1}. (Give the answer to one decimal place.) Take g = 9.8 m s^{-2} and angular velocity of the Earth = 7.3×10^{-5} s^{-1}.

Q.21 If wind speed over ocean surface is 10 m s^{-1}, air-sea interface momentum flux is _____ N m^{-2}. (Give the answer to two decimal places.) Surface air temperature and pressure are 27°C and 1000 hPa, respectively. Take drag coefficient as 0.001 and gas constant R = 287 J kg^{-1} K^{-1}.

Q.22 Let L_x, L_y be length scales in x- and y-directions and corresponding mass transports are M_x and M_y. The ratio of M_x and M_y (to nearest integer) is _____ , if the ratio of L_x and L_y is 10 and vertical velocity is zero.

END OF THE QUESTION PAPER