

**INDIA METEOROLOGICAL
DEPARTMENT
QUESTION BANK
OF
INTEGRATED MET. TRAINING COURSE
(IMTC)**

FINAL EXAMINATION

BASED ON 1-11 BATCHES (2013-2021)

PAPER-II: PHYSICAL MET, MARINE

MET AND ENV.MET

PART A : PHYSICAL METEOROLOGY

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PART A : PHYSICAL METEOROLOGY

Q 1. Fill in the blanks

1. Radiative flux divergence causes _____.
2. Aitken nuclei is having size _____.
3. For _____ temperature satisfies Equation of State for moist air.
4. Potential temperature is _____ for an adiabatic process.
5. Virtual temperature is always _____ than or equal to temperature.
6. In a dry adiabatic process _____ and _____ remains constant.
7. The temperature that a air sample would have when all the water vapour in that is condensed is called _____.
8. _____ and _____ are the units of geopotential.
9. The lines joining equal values of mixing ratio are called _____.
10. Rate of flow of radiant energy is called _____.
11. Mass per unit area of absorbing material along the path of radiation beam is called _____.
12. Ratio of the radiant energy absorbed to that incident upon is called _____ and for a black body its value is equal to _____.
13. On a tephigram, the vertical lines are lines joining equal values of _____.
14. The level at which an unsaturated air parcel becomes saturated by lifting it adiabatically is called _____.
15. The ratio of the mass of water vapour in an air sample to the total mass of air sample is called _____.
16. For an ideal gas, internal energy is function of _____ only.

17. Lapse rate is positive if the temperature _____ with height.
18. Aerosol loading in the atmosphere leads to _____ of optical depth.
19. _____ is the radiation law used to obtain the effective temperature of the Sun.
20. _____ is the temperature that a moist air sample should have for having the same specific volume as that of dry air, at the same pressure.
21. Atmosphere is absolutely unstable if _____ .
22. Clouds forming at the top of mountains with their shape similar to that of lens are called _____.
23. _____ Temperature remains conserved for both dry and moist adiabatic process.
24. Example for hygroscopic nuclei _____.
25. Warm clouds exist where the cloud top temperature is _____ freezing level
26. Relation between equivalent and potential temperature is given by ---- = -----
27. Equation for a mixture of gasses, not reacting chemically, is given by -----
28. Virtual temperature is given by the equation -----
29. The unit of optical depth is
30. The major absorption bands for ozone are centred around _____. When environment lapse rate is greater than dry adiabatic lapse rate, the atmosphere is _____.
31. _____ fog is formed when moist air is transported over a cold surface.
32. Dry air contains roughly (by volume) _____ trace gases.
33. The value of emissivity for blackbody is _____.
34. Terrestrial radiation is the radiation energy emitted by the _____.
35. The atmosphere is generally _____ to terrestrial radiation in the wavelengths.
36. Between about $8\ \mu$ and $12\ \mu$, and this range is often referred to as _____.
37. The _____ law relates to ratio of emitted energy to the absorbed energy.
38. The most common trace gas found in earth's atmosphere is
39. Solid particles and liquid droplets suspended in the air are known as
40. Example for high cloud is
41. Saturation is defined as an equilibrium at which the rate of _____ equal to rate of _____.

42. The amount of heat required to change one kilogram of liquid water to one kilogram of vapor at the same temperature is called _____.
43. In the inversion layer lapse rate will be _____.
44. Air consisting of dry air water vapour called as _____.
45. Planck's Law describes the spectrum of radiation emitted by a black body as a function of _____.
46. Mesosphere have _____ lapse rate.
47. There is sufficient large scale mixing in the _____ to counteract the tendency for gases to separate out according to their respective molecular weights.
48. Ozone is a _____ near the Earth surface and _____ in stratosphere (Beneficial/Harmful)
49. The ratio of the mass of water vapour in an air sample to the total mass of air sample is called _____.
50. _____ is the radiation law used to obtain the effective temperature of the Sun.
51. Moist air is _____ than dry air (denser/lighter).
52. Troposphere have -----lapse rate.

Q 2. True / False with reasoning

1. Satellite derived cloud top temperature is obtained using Wein's displacement law.
2. Equivalent potential temperature remains conserved for both dry and moist processes.
3. Virtual temperature is always higher than or equal to the observed temperature.
4. C_p always less than C_v .
5. Dry adiabatic lapse rate is lesser than the saturated adiabatic lapse rate.
6. If the temperature is increasing with height lapse rate is positive.
7. Wavelength corresponding to the maximum intensity of radiation is directly proportional to the temperature of the emitting object.

8. Density of moist air is less than density of dry air.
9. In a conditionally unstable atmosphere, unsaturated air parcels will be unstable.
10. Adiabatic expansion leads to cooling of thermodynamic system.
11. If the environmental lapse rate is greater than dry adiabatic lapse rate then the atmosphere is absolutely stable.
12. Pseudo adiabatic processes are reversible.
13. Due to orographic ascent, cloud formations and precipitation will be more on the lee side.
14. Blue colour gets scattered more than red colour.
15. Specific heat at constant volume is greater than specific heat at constant pressure.
16. In a conditionally unstable atmosphere, unsaturated air parcels will be stable.
17. Adiabatic process is an isentropic process.
18. Nimbostratus clouds are cold clouds.
19. Due to orographic ascent, cloud formations and precipitation will be more on the leeward side.
20. Pseudo adiabatic processes are reversible.
21. GPM is unit of specific energy.
22. Air must be super saturated for the cloud to form.
23. Blue color of sky is due to Mie scattering.
24. At LCL humidity is 50%.
25. The height of the troposphere is very less over the tropics.
26. Morning and Evening sky appears as orange or red colour due to Mie scattering.
27. Due to orographic ascent, cloud formations and precipitation will be more on the windward side.
28. The wavelength corresponding to the maximum black body radiation increases as we increase the temperature of a blackbody
29. Carbon dioxide and Nitrogen are two important greenhouse gases in the atmosphere.
30. Maximum Solar radiation occurs at 0.48μ .

31. Generally, temperature decreases with height in the Mesosphere
32. The relative volume abundance of the major constituent gases of dry air remains remarkably constant upto about 80 km.
33. The atmosphere absorbs the terrestrial radiation in the wavelengths between about 8 and 12 μ .
34. Mie scattering occurs in clouds.
35. Warm clouds are found above the freezing level.
36. Air must be super saturated for the cloud to form.
37. Super adiabatic environmental lapse rate is conducive for absolute instability
38. Aerosols does not have any role in cloud formation
39. Stratospheric ozone is harmful for human and animal life on earth
40. Cirrus clouds are cold cloud.
41. Monsoon rainfall over India is from cold clouds
42. Blue colour gets scattered more than red color.
43. The effective temperature of the sun is obtained from the Stefan-Boltzmann law.

Q 3- Answer the following questions

1. What is T-Phi Gram? State Normand's Rule . Write some utility of T- Phi gram.
2. What is terrestrial Radiation? Discuss absorption of terrestrial radiation by atmosphere and define atmospheric window. Define albedo of a surface.
3. What is the first law of thermodynamics? Derive an expression for the heat added to the system? Find out the relation between C_p and C_v .
4. Briefly explain the parcel method for determination of static stability of the atmosphere. When the atmosphere can be termed as absolute unstable or absolutely stable?
5. Explain the different methods of formation of fog?
6. What are the desirable properties of a thermodynamic diagram? Briefly mention whether a tephigram meets those requirements?

7. What is Normand's theorem? How the same can be used to find out the wet bulb temperature of any pressure level?
8. What is hydrostatic equilibrium ? Write down the expression for hydrostatic equilibrium and explain the terms.
9. From that, get an expression for thickness of an atmospheric layer
10. Discuss the procedure of obtaining relative humidity, virtual temperature, convective condensation level and latent instability from a Tephigram.
11. Obtain the expression for the specific gas constant of moist air in terms of the specific gas constant of dry air.
12. Briefly explain the concept of virtual temperature.
13. Briefly explain the parcel method to determine the static stability of a parcel of air.
14. Describe the application of parcel method for different types of air parcels to determine their stability criteria.
15. What are condensation nuclei? What are the modes of formation of condensation nuclei? Briefly explain the classification of condensation nuclei.
16. Briefly explain the various processes of vertical motion of moist air resulting into its cooling and formation of clouds by condensation.
17. What are thermodynamic diagrams? What are the desirable properties of a thermodynamic diagram? Explain whether the tephigram meets those requirements.
18. How the tephigram is used to determine the various meteorological parameters important for weather forecasting?
19. How the Tephigram is used to determine the various meteorological parameters important for weather forecasting?
20. What are the desirable properties of a thermodynamic diagram? Briefly mention whether Tephigram meets those requirements?

21. What is Normand's theorem? How the same can be used to find out the wet bulb temperature of any pressure level?
22. What is first law of thermodynamics? Derive an expression for heat added to the system. Find out relation between C_p and C_v .
23. Prove $C_p - C_v = R$ where C_p , C_v , R have their usual connotation.
24. Explain the condition of absolute instability, absolute stability and conditional instability of atmosphere.
25. What are the different lifting mechanisms responsible for cloud development? Explain with neat diagrams
26. What are the desirable properties of a thermodynamic diagram? Briefly mention whether a tephigram meets those requirements? What is Normand's theorem? How the same can be used to find out the LCL?
27. With a neat diagram explain the Beer's law of absorption and scattering.
28. Describe the different lifting mechanisms responsible for cloud development?
29. Describe the different lifting mechanisms responsible for cloud development?
30. What is radiation fog? What are the favourable conditions to form Radiation Fog?
31. What is tephigram? What are the uses of tephigram?
32. What is first law of thermodynamics?
33. What is the role of cloud condensation nuclei in cloud physics?
34. Define albedo of a surface.
35. Name the non-radiative effects in the mean heat balance of the earth-atmospheric system.
36. What is emittance? How it is related with the radiance?
37. Explain mean disposition of solar radiation and the mean heat balance of the earth-tropospheric system.
38. State and explain the laws of radiation.
39. Describe the different lifting mechanisms responsible for cloud development?
40. What are the different types of scattering observed in atmosphere? Explain with diagrams.

41. What are cloud condensation nuclei? What is their role in cloud physics? Classify them based on size and properties.
42. How will you classify different layers in the atmosphere based on the composition of gases?
43. What is meant by greenhouse effect? What is its role in the atmosphere?
44. What are the desirable properties of a thermodynamic diagram? Briefly mention whether a tephigram meets those requirements? What is Normand's theorem? How the same can be used to find out the LCL?
45. Explain the condition of absolute instability, absolute stability and conditional instability of atmosphere.
46. Explain cloud classification with respect to shape location and formation.
47. What is terrestrial Radiation? Discuss absorption of terrestrial radiation by atmosphere and define atmospheric window. Define albedo of a surface.
48. Briefly explain the parcel method to determine the static stability of a parcel of air. (b) Describe the application of parcel method for different types of air parcels to determine their stability criteria.
49. Obtain the expression for the specific gas constant of moist air in terms of the specific gas constant of dry air.
50. Briefly explain the concept of virtual temperature.
51. Explain CCN classification according to size.
52. What is the second law of thermodynamics? What is entropy? Discuss how change in entropy can be measured using Meteorological data?
53. Describe different types of atmospheric scattering. What is the role of scattering in atmospheric heat budget?
54. With neat diagram explain vertical structure of atmosphere .

Q 4. Write short notes of the following.

1. Vertical structure of the atmosphere
2. Beer's law
3. Dew point and wet bulb temperature.

4. Kirchoff's law.
5. Composition of the atmosphere.
6. Adiabatic process of saturated moist air.
7. Condensation nuclei
8. Fog formations due to cooling of moist air.
9. Geopotential and Geopotential meter
10. Reversible and irreversible processes
11. Geopotential and geopotential meter
12. Reversible and irreversible process
13. Tephigram.
14. Describe different types of atmospheric scattering. What is the role of scattering in atmospheric heat budget?
15. Geo potential and Geo potential meter.
16. Define Vapour pressure, Saturation vapour pressure.
17. Describe homogenous and heterogeneous nucleation.
18. What are condensation nuclei? Classify them according to their different properties.
19. Cloud formation mechanism
20. Greenhouse gases.
21. Equivalent Potential temperature.
22. Atmospheric composition
23. Dew point and wet bulb temperature.
24. Write short note on Hydrostatic equilibrium