INDIA METEOROLOGICAL DEPARTMENT

QUESTION BANK

OF

ADVANCED METEOROLOGICAL TRAINING COURSE (AMTC)

SEMESTER-I EXAMINATION

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PAPER-II: PHYSICAL METEOROLOGY

PART A

India Meteorological Department
Meteorological Training Institute
Advanced Meteorological Training Course
Semester-I

Paper-II ; Part 'A' : Physical Met.

Q. 1 Fill in the blanks

1. _____ and _____ are the two non radiative components to be considered while computing mean heat balance of earth atmospheric system.
2. _____ is the measure of transparency of the atmosphere and any factor which reduces the same is called _____.
3. According to Kirchoff's law, _____ of an object is equal to _____, with reference to same wavelength and temperature.
4. According to Wien's Law, the wavelength corresponding to the maximum black body radiation ---------- as we increase the temperature of a blackbody. (decreases/increases/does not change).
5. Aitken particles have a radius, r ……...
6. Among dominant aerosol species in the atmosphere the _____ aerosol is the most absorbing in the short-wave range.
7. An unsaturated air parcel becomes saturated at _____ by adiabatic ascent but the parcel temperature and environment temperature becomes equal at _____.
8. Atmosphere is generally transparent to terrestrial radiation in between…….and ….. wavelengths, known as atmospheric window.
9. Attenuation of radiation in the atmosphere is due to absorption and_____.
10. By assuming the sun to be emitting like a blackbody its _____ temperature is determined and for the purpose _____ law is used.
11. Condensation occurring on a solid surface is called _____ whereas same occurring on a liquid surface is called _____.
12. Effective temperature of the sun is obtained using _____ law of radiation whereas colour temperature is obtained using _____ law of radiation.
13. From the Normand's point, descending along the pseudo adiabat to the surface level gives _____ whereas descending along the dry adiabat to the surface level gives _____ .
14. Global radiation is the sum of …….and …….

15. Global Solar radiation is the combination of _____ and _____.
16. Homogeneous nucleation takes place at RH=…….
17. If the ratio of the radius of the scattering particle to the wavelength of incident radiation is small, it is called _____ scattering and if the same is large it is called _____ scattering.
18. In homogenous atmosphere, _____ is considered as a constant and the finite height such an atmosphere has is called _____.
19. In order to obtain mean heat balance of the earth atmospheric systems, _____ and _____ act as supporting mechanism.
20. In Rayleigh scattering, scattering coefficient is inversely proportional to _____.
21. Instrument used for measurement of Visibility is _____.
22. Layer within the troposphere in which temperature increases with altitude is known as _____ and lapse rate is _____ in such layers.
23. Luminous region of sun is called ……
24. Mass of absorbing constitutents contained in a vertical column of unit cross sectional area in the atmosphere is called _____ and _____ is the unit for the same.
25. Maximum intensity for solar radiation is centred around wavelength _____ whereas the same for terrestrial radiation is centred around wavelength _____.
26. Monochromatic brightness at a particular wavelength is the product of _____ and _____.
27. Most of the diffuse short-wave radiation in the atmosphere is due to molecular_____.
28. Pyrheliometer is an instrument for measurement of ……
29. Quantity of solar radiation reaching a unit area of the earth's surface is known as ……
30. Rain drops predominantly grow due to the process of _____.
31. Ration of the radiant flux emitted by a surface to the area of that surface is called _____ and _____ is the unit for the same.
32. The change of day time length with seasons is because of earth's_____.

33. The contrast of threshold for Visibility required for viewing distant large objects such as tall trees or hills, is _____.(2%/5%/10%)
34. The GHGs cause the atmosphere to warm up as a result of _____of longwave radiation.
35. The global radiation is the combination of _____ and _____.
36. The mass of an absorbing or emitting material contained in a vertical column of unit cross-sectional area and extending between two specified levels is called ---------- of the layer.
37. The maximum intensity of solar radiation is centred around wavelength _____ whereas the same for terrestrial radiation is centred around wavelength _____.
38. The maximum intensity of solar radiation is centred around wavelength _____ in solar radiation whereas it is centred around wavelength _____in case of terrestrial radiation.
39. The presence of dissolved impurities _____the saturation vapour pressure at cloud drop surfaces.
40. The Scattering Phase Functionof atmospheric aerosol depends on refractive index and _____ of spherical scattering particles.
41. The troposphere remains approximately in a state of_____equilibrium.
42. Type of scattering by visible light in atmosphere is _____.(Mie/Raleigh/ Mie +Raleigh)
43. Unit of Radiant flux is ……..
44. Using Wein's displacement law _____ temperature of the sum is obtained and its value is about _____.
45. Wave length of light in visible light scatter maximum is _____.
46. Wave length range of visible radiation is …….
47. When intensity of radiation emitted from a point is independent of_____, it is said to be isotropic.
48. When the wavelength of maximum radiance emitted from a black-body shifts to lower wavelengths the temperature of the body _____.
49. Albedo of the surface is defined by ratio of outgoing to incoming solar radiation. Keeping this view, which of the following surface will have highest albedo?

    a)Sand b)Snow c)Forest

50. Given a mixed cloud containing water and ice. Which type of particle (ice v.s. water) will grow more quickly?
    (A) Water droplet (B) Ice particle (C) Both (D) None of the above

Q. 2 State with brief reasons whether the following are true or false

1. Absorption of terrestrial radiation by the atmosphere is maximum in the wavelength from 8μ to 12μ.
2. Air must be super saturated for the cloud to form.
3. An aerosol with SSA(Single Scattering Albedo) of 0.7 is less absorbing than one with value of 0.9.
4. At High humidity >95% and low / Calm winds, visibility decreases with increase in the
5. Blue colour of sky is due to Mie scattering.
6. Cloud is a very good reflector for terrestrial radiation.
7. Condensation on hygroscopic nuclei requires very high amount of super saturation.
8. Continental climates have larger seasonal extremes than coastal ones.
9. Convergence of net flux in a layer leads to radiative cooling of that layer.
10. Divergence of net flux causes heating in a layer.
11. Divergence of net flux leads to radiative cooling.
12. During cloudy conditions, maximum temperature attained will be lesser and the minimum temperature will be higher, as compared to the clear sky conditions.
13. Emittance of earth is more than that of sun.
14. Fog due to radiation cooling will be more likely in case of highly moist air close to surface with dry and aloft.
15. For each latitude, the northern hemisphere summer insolation is greater than that of the southern hemisphere during its summer.
16. For each latitude, the northern hemispheric winter insolation is greater than the southern hemispheric wind insolation.
17. For each latitude, the southern hemisphere summer insolation is lesser than that of the corresponding northern hemisphere latitude in its winter.
18. Forward scatter meter works on the principle of measurement of scattered ligh
19. Greenhouse effect is good for earth’s atmosphere.

20. If the GHGs (Green House Gases) were absent from earth's atmpsphere then its Equivalent Temperrature obtained from Radiative balance at the (TOA) top of atmosphere would remain the same.
21. In a conditionally unstable atmosphere, saturated air parcels will On a tephigram, the area enclosed by the lines representing any cyclic process is proportional to the energy exchange or work done during the process.
22. Maximum absorption of terrestrial radiation is in the wavelength range from 8 to 12μ.
23. Maximum temperature recorded in cloudy condition is less than the maximum temperature recorded in clear sky conditions.
24. Minimum temperature recorded in the clear sky condition is more than the minimum temperature recorded in the cloudy condition.
25. Pyranometers can be made using a polythene dome.
26. Saturated adiabatic lapse rate is less than dry adiabatic lapse rate.
27. Terrestrial radiation is in the form of shortwaves.
28. The amount of solar radiation reaching the earth's surface is very less during cloudy condition as compared to clear sky condition.
29. The hotter the radiating body, the shorter the wavelength of maximum radiation.
30. The terminal velocity of raindrops does not depend on their size.
31. There is a limiting size to which cloud droplets can grow up to, by diffusion alone.
32. Transformation of radiant energy takes place in scattering.
33. Transmissivity of the atmosphere for solar radiation will be very high in polluted air than in clean air.
34. When air is saturated with respect to a flat surface, it is saturated with respect to a curved droplet of water & the droplet grows
35. When the size distributions of aerosols changes in the atmosphere its effect on radiation is an altered angular dependence of the scattered radiation.
36. With the increase in temperature, the maximum energy of emission shifts to longer wavelengths.

Q. 3 Answer the following

1. What is terrestrial radiation? What is the wavelength range for terrestrial radiation? Find out the wavelength corresponding to maximum intensity for terrestrial radiation?

Briefly explain the absorption spectra of water vapour, ozone and carbon dioxide with respect to terrestrial radiation.

2. Explain Simpson's method of terrestrial radiation transfer.
3. Briefly explain the parcel method to determine the stability condition of a parcel of air. How the same can be applied to dry air, unsaturated air and saturated air parcels.
4. What is slice method of stability analysis? How the same is different from parcel method?
5. Briefly explain the absorption features of atmosphere constituents with respect to solar radiation and terrestrial radiation.
6. Explain Simpson's method of terrestrial radiation transfer.
7. Explain the various features of geographical and seasonal distribution of solar radiation for the top of the atmosphere and for the earth's surface.
8. Define a thermodynamic diagram. Mention the characteristic features of a thermodynamic diagram. Hence or otherwise justify whether T-Ø gram can be regarded as a thermodynamic diagram.
9. Obtain the criteria for atmospheric stability using slice method. Discuss under what condition, it becomes similar to that using parcel method
10. What are the major factors by which solar radiation gets depleted in the atmosphere? Briefly explain them.
11. Obtain the mean disposition of solar radiation.
12. What are the long wave components of mean heat balance for the earth atmosphere systems? Briefly explain the same.
13. Explain the process of radiative heating or cooling of an atmospheric layer.
14. What is trasmissivity of an atmospheric layer? Obtain the expression for the same for a particular wavelength.
15. Briefly describe the assumptions made by Simpson for the computation of terrestrial radiation transfer.
16. Obtain the expression for the radiative cooling or heating of an atmospheric layer in terms of net flux.
17. Describe Green house effect and the merits and demerits of the same.
18. Explain the terms of the Kohler's Curve relating them to growth of cloud droplets.
19. Beer's law of atmospheric attenuation of radiation.
20. Draw the ellipse of earth's motion around the sun and mark the four seasons on it. Explain whether are any northern hemisphere and southern hemisphere differences.

21. Define solar constant. What is its value?
22. Calculate the equivalent blackbody temperature of the solar photosphere based on the following information. The flux density of solar radiation reaching the Earth, F_s, is 1368 W m^{-2}. The Earth–sun distance is 1.50 x10^{11} m and the radius of the solar photosphere is 7.00 x 10^8 m.
23. Explain the mean heat balance of earth's atmosphere with neat diagram.
24. Describe different types of atmospheric scattering. What is the role of scattering in atmospheric heat budget?
25. What are the lifting mechanisms responsible for cloud development?
26. What is meant by radiance? Explain the laws of blackbody radiation.
27. Write the equation of radiative transfer in the atmosphere explaining its terms.
28. Write a short note on aerosols and their climatic effects.
29. When an air parcel moves upward and expands adiabatically .
30. Do Temperature and Relative Humidity of the parcel change?
31. Does its saturation vapor pressure changes?
32. When the parcel will be lifted upward moist adiabatically?
33. Why saturation vapor pressure increases with Temperature. If T decreases what happens to saturation vapor pressure and relative humidity?
34. What is lapse rate e.g. dry lapse rate and wet lapse rate? Describe the conditions when an air parcel will experience (a) absolute stability, (b) absolute instability and (c) conditional instability.
35. If at ground Temperature=40 ^{0}C and Dew Point Temperature is =20 ^{0}C; when the lifted air parcel will start forming cloud? Describe what type of aerosols can act as a cloud condensation nuclie and why?
    (a) hygroscopic aerosol, (b) hydrophobic aerosol
36. Name which satellite(s) provides aerosol information:
    (a) MODIS (b) TRMM (c) Cloud
37. Empirical equation for saturation vapor pressure of water over a liquid surface is given by the following equation

$$p_{v,s} = 6.112 \exp\left(\frac{17.67TD}{TD + 243.5}\right)$$

If TD=20 C and T=30C, estimate the partial pressure of water, the saturation vapor pressure of water and the relative humidity. TD is the dew point temperature.

Q. 4 Write short notes on the following.

1. Beer's Law
2. Green House effect
3. Homogeneous atmosphere
4. Latent instability
5. ICAO Standard atmosphere
6. Green House Effect
7. Hydrostatic balance & thickness computation
8. Classification of condensation nuclei.
9. Green House effect.
10. Simpson's assumptions for computation of terrestrial radiation transfer.
11. Write short notes on working principle of Transmissometer.
12. Writ short notes on Forward scaterometer.