

**ASL310 (Fundamentals of Atmosphere and Ocean)**  
**Marks 40**  
**Major**

**Time 2 hr**

**Answer scripts will be shown on 25<sup>th</sup> and 28<sup>th</sup> Nov**

**Instructions:** You can consult only your own original lecture notes and photocopies of slides & textbooks. Exchange of lecture notes is not allowed. State all assumptions clearly. All abbreviations carry usual meanings. Use the thermodynamic diagram as required.

$R^* = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ ;  $C_p = 1004 \text{ J K}^{-1} \text{ kg}^{-1}$ ;  $C_v = 717 \text{ J K}^{-1} \text{ kg}^{-1}$ ;  $R_d = 287 \text{ J kg}^{-1} \text{ K}^{-1}$ ;  $R_v = 461.51 \text{ J kg}^{-1} \text{ K}^{-1}$ ;  $L_v = 2.5 \times 10^6 \text{ J kg}^{-1}$ ;  $\sigma = 5.67 \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4}$ ;  $M_w = 18.016$ ; Wien's constant =  $2897.9 \text{ K } \mu\text{m}$ .

**Read the questions carefully.**

1. Write 'True' or 'False' with explanation (use diagram if required)

**(Marks 4 × 2 = 8)**

- (a) Deep ocean water moves from equator to high latitudes.
- (b) Walker circulation strengthens during El-Nino.
- (c) Equatorial counter current always flow eastward.
- (d) It is not possible to saturate moist air without lifting it up.

2. The following observations (5 measurements for each time) and forecasts of RH (in %) are reported for a site.

**(Marks 3 + 2 + 2 = 7)**

Time	Observations					Forecast
	0 UTC	72	71.9	71.9	72	72.1
12 UTC	60	60.1	60.1	60.1	60	60.11

- (a) At which time do you have smaller uncertainty in the observations and why?
- (b) Which forecast in your opinion is more accurate and why?
- (c) Is it possible to make extremely precise measurements which are grossly inaccurate? Explain your answer briefly.

3. Mark the right answer(s) [there may be more than one correct answers – full marks only for all correct answers]:

**(Marks 10 × 1 = 10)**

(a) Which of the following is/are prognostic variable(s) in a weather forecast model?

- (i) Surface elevation
- (ii) Meridional wind
- (iii) Earth's radius
- (iv) RH

(b) For  $T_e = 200 \text{ K}$ , Stefan-Boltzmann feedback would be (in unit  $\text{KW m}^{-2}$ )

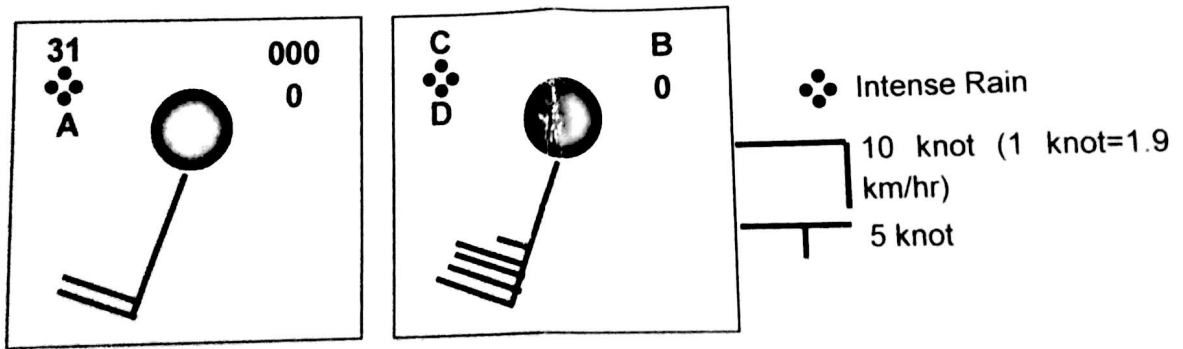
- (i) 0.0055
- (ii) 0.055
- (iii) 0.55
- (iv) 5.5

(c) The following currents transport cold water from the extra tropics -

- (i) California
- (ii) Mozambique
- (iii) Benguela
- (iv) Canary

- (d) Following parameters are important in determining monsoon onset in India  
 (i) OLR (ii) rainfall data from Kerala (iii) meridional wind data (iv) all of the above
- (e) Number of gyres and surface currents, where water moves anti-clockwise in northern hemispheric winter is  
 (i) 2 (ii) 3 (iii) 4 (iv) 5
- (f) The following is/are paleo-climate indicator(s)  
 (i) O and Sr isotopes (ii) Tree ring (iii) rock and fossils (iv) all of the above
- (g) If visual threshold to define visibility changes to 10%, visibility for  $\beta_{ext} = 2.3 \text{ km}^{-1}$  will be  
 (i) 0.01 km (ii) 0.1 km (iii) 1 km (iv) 10 km
- (h) If the cloud cover increases in the Earth's atmosphere  
 (i) OLR will increase (ii) outgoing SW radiation will increase  
 (iii) difficult to quantify change in OLR (iv) difficult to quantify change in SW
- (i) The following forces are important in case of a cyclone  
 (i) PGF (ii) Coriolis force (iii) Centrifugal force (iv) all of the above
- (j) Density of ocean water decreases with a decrease in  
 (i) Temperature (ii) Wind speed (iii) Rain (iv) River discharge

4. The following weather station models have been reported for a site with data collected at surface (left figure) and at cloud top at 6 km (right figure) during a thunderstorm.  
 (Marks 2 + 2 + 2 + 2 + 2 + 2 + 2 + 1 = 15)



- (a) If LCL is 850 hPa, find the value of A in the left figure.
- (b) What is the value of B in the right figure? Mention the entire value, not abbreviation, as pressure is reported in abbreviated form only for the surface.
- (c) Find the values of C and D in the right figure.
- (d) Is the condition conducive to sustain the thunderstorm? Explain your answer briefly.
- (e) Will hydrostatic balance be a valid assumption for this condition? Justify your answer.
- (f) Can frontal fog form in this condition and why?
- (g) Estimate the OLR from cloud top. Assume cloud emissivity is 0.9.
- (h) What will be peak wavelength of cloud emission?