Intructions:

1. **Please write your name and nationality in English on the cover page.**
2. **The time allocated for this examination is three hours.**
3. **Please write your answer legibly. Illegible answers will be counted as incorrect.**
4. **Please keep your answers short and focus on the key points.**
5. **Please write your answers only in this test booklet.**
    a. **Encircle or mark the answer of your choice.**
    b. **Write essay-type answers where indicated by the question, and**
    c. **Use extra paper provided by the committee for calculation.**
6. **You may answer the questions in English, your native language, or a combination of both.**
7. **Read the entire question group carefully before starting to answer. Each question has a point value assigned, for example, (1 pt).**
8. **For some questions, you will be asked to provide answers on the figures. Please do so carefully.**
9. **Any inappropriate examination behaviour will result in your removal.**

METEOROLOGY

1. One of the following is **NOT** a term for atmospheric divisions/subdivisions (5 points)
   (a) thermosphere
   (b) ionosphere
   (c) cryosphere
   (d) heterosphere
   (e) homosphere.

2. With regard to atmospheric electricity, which statement is correct? (5 points)
   (a) Lightning always strikes from cloud to ground
   (b) Cloud particles are always negatively charged
   (c) Lighting sometimes strikes from the top of the cloud to the ionosphere
   (d) Electrical charges (+ and -) are evenly distributed inside a thunderstorm cloud
   (e) All the above statements are true.

3. (A). The temperature and relative humidity of an air parcel at 1013 hPa are 30^0C and 53.65% respectively. Given 10^0C/km as the dry adiabatic lapse rate for the tropical region, determine the height of the condensation level. (10 points)

Temperature Degrees Celsius	Vapor (g) per Kilogram of Dry Air
50	88.12
40	49.81
30	27.69
20	14.85
10	7.76
0	3.84

(B). What is the temperature of the air parcel when it arrives at the mountain slope at a height of 2539 m? Assume that the saturated adiabatic lapse rate for tropical region is 6.5^0C/km. (10 points)

(C). Calculate the temperature and relative humidity of the air parcel after passing over the top of the mountain (height of 3308 m) and then moving down to the initial pressure level (1013 hPa) on the other side of the mountain. (15 points)

4. Wind speed measurements at the Equator in Pontianak, West Kalimantan, Indonesia, give an average value of 20 m/s. If the pressure difference between two nearest isobars, separated by a distance of 800 km, is 8 hPa and the air density is 0.364 kg/m^3, how large is the Coriolis force per unit mass in that site? (3 points)
   (a) 0.02 ms^{-2}
   (b) 1.37 x 10^{-4} ms^{-2}
   (c) 0 ms^{-2}
   (d) 1.37 x 10^{-6} ms^{-2}
   (e) 1.37 ms^{-2}

5. Refer to the diagram of a mature wave cyclone in Figure 6. Which one of the stations listed below has the least likelihood of rain and cloud cover? (6 points)
   (a) point A
   (b) point H
   (c) point B
   (d) point I
   (e) point G

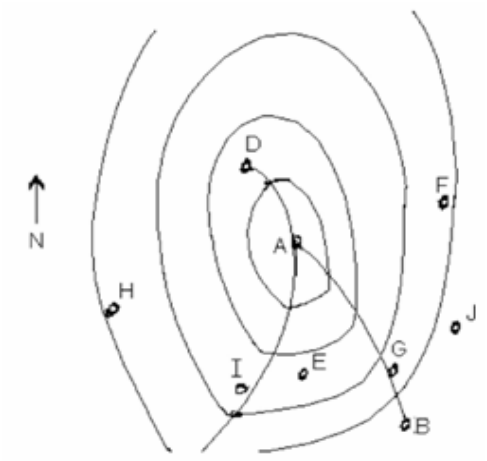

Figure 6. Mature wave cyclone diagram (contours are isobar)

6. At a location where the Coriolis parameter $f \approx 10^{-4}$ s^{-1}, a geostrophic wind speed of 5 ms^{-1} is observed blowing to the west. Which pressure gradient force per unit mass is corresponding to the geostrophic wind? : (6 points)
   (a) 5×10^{-4} ms^{-2}
   (b) 0.005 ms^{-2}
   (c) -0.00005 ms^{-2}
   (d) -5×10^{-4} ms^{-2}
   (e) 0.00005 ms^{-2}

7. Look at the figure below

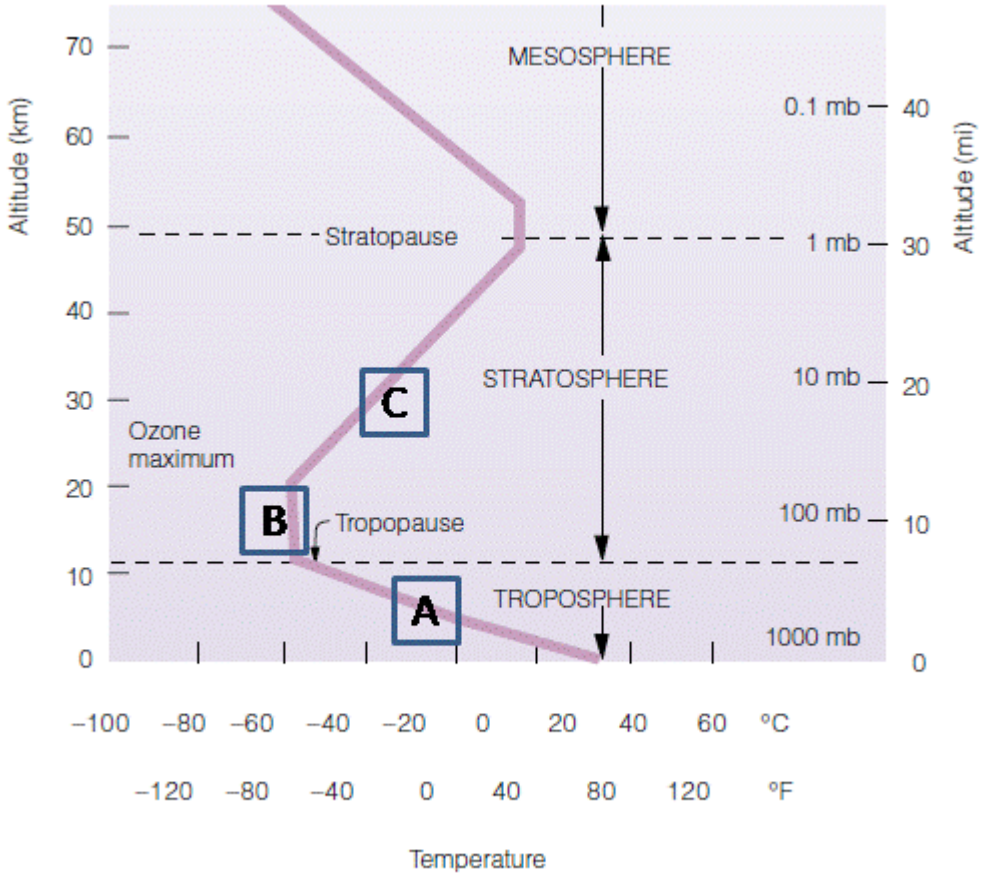

Figure 7. Illustration for essay question 7

Three air parcels A, B, and C are placed at altitudes of 5, 15, and 30 km as shown in the figure above. If the parcels are displaced vertically upward, predict the responses/trajectories of the parcels. (10 points)

Parcel	Responses*
A	
B	
C	

*) Provide your answers using the following symbols :

▲ : keeps moving upward

⊤ : stays at new altitude

↕ : oscillates around the original altitude

8. According to Ramage, the Maritime Continent of Indonesia is in a monsoon region. During the Indonesian west monsoon (season), the main wind over the Sangihe Talaud Islands (5^0 30' 23" N 126^0 34' 35" E) just south of the Philippines is mostly (3 points)
   (a) Westerly
   (b) Easterly
   (c) Southerly
   (d) Northeasterly
   (e) Southwesterly

9. Figure 8 below is the Indonesian annual rainfall type map. It shows that the western part of Sumatra (coastal area) has the equatorial rainfall type even though some areas are located some distance from the equator. Choose the best explanation for this phenomenon from the options below. (6 points)
   (a) Under the influence of the Indonesia-Australia Monsoon
   (b) Combination effects of the orography of the Bukit Barisan mountain range and the Indian Ocean
   (c) Because of the South China Sea
   (d) Because of the activity of tropical cyclones
   (e) Under the influence of the Indonesian through flow.

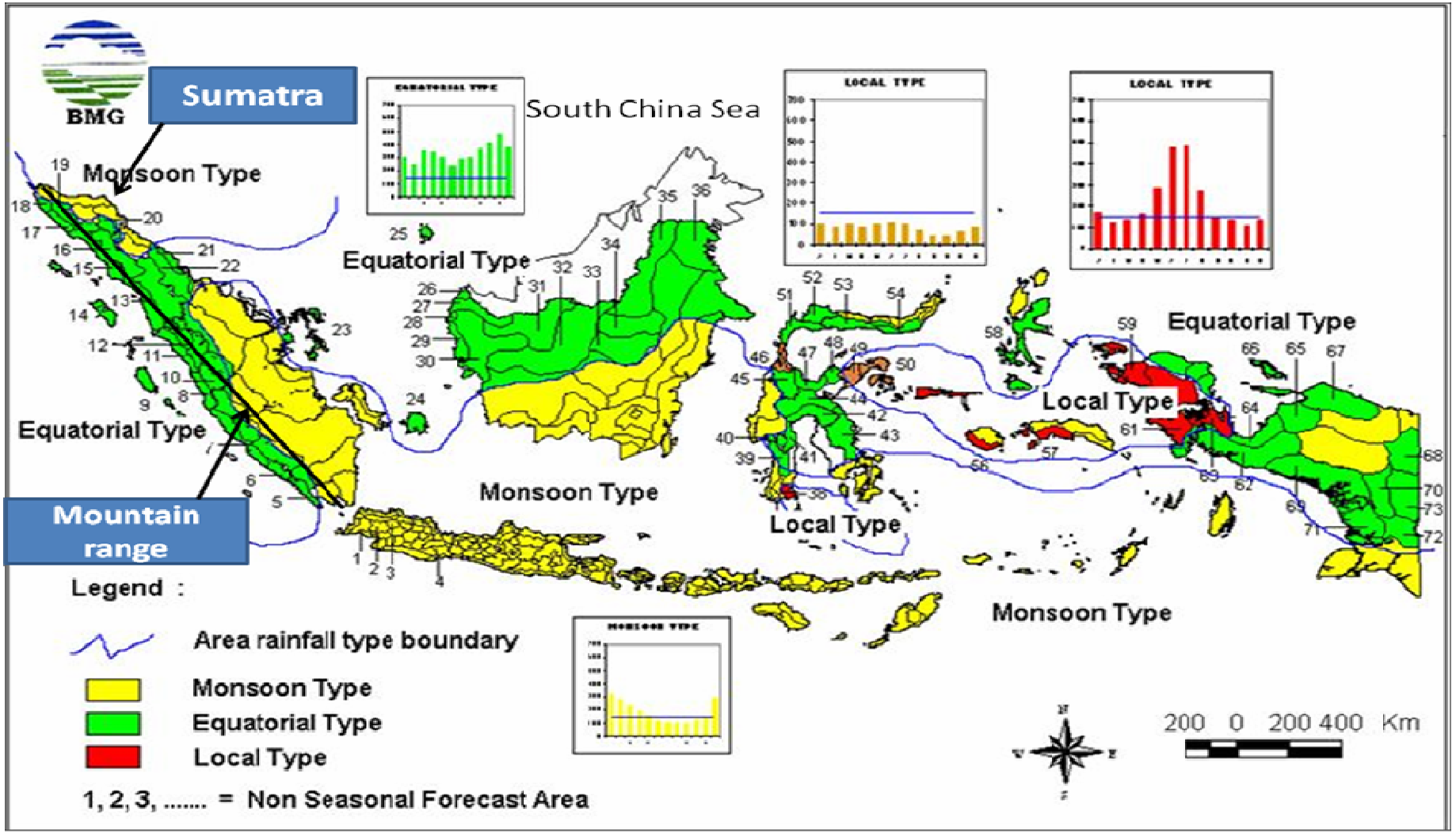

Figure 8. Indonesian Annual Rainfall Type Map

10. Greenhouse gases are transparent to visual radiation and not transparent to infrared radiation. Sequence the gases according to their radiative forcings, starting from the largest impact. (6 points)
    (a) CO_2, CH_4, H_2O, NO_2
    (b) H_2O, CH_4, CO_2, NO_2
    (c) H_2O, CO_2, CH_4, NO_2
    (d) CO_2, H_2O, NO_2, CH_4
    (e) None is true.

11. When you attempt to predict the weather for the next 25 minutes by assuming that conditions in general will not change during that time, you would employ (3 points)
    (a) persistence forecasting
    (b) statistical forecasting.
    (c) historical forecasting.
    (d) numerical forecasting.
    (e) synoptic forecasting.

12. Look at figure 9.

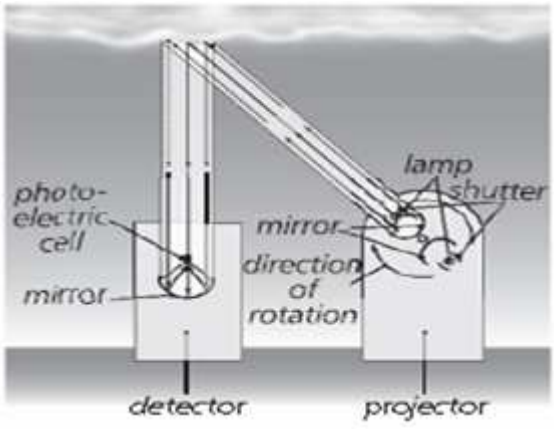

Figure 9. Ceilometer for essay question 40

It is a ceilometer, the device to measure the elevation of cloud ceiling. It consists of a projector and detector. The projector has two lamps that each emit a focused beam through a shutter. The focusing mirrors and lamps rotate, so the beams are transmitted as pulses, shining at an angle onto the base of the cloud. The detector responds electronically to a series of pulses at the predetermined frequency. The height of the cloud base is calculated trigonometrically from angles of the transmitted and reflected beams and the known distance between the projector and the detector. A ceilometer can measure cloud bases up to 3000 m during the day and up to about 6000 m at night.

If the distance *b* between the projector and the detector of a ceilometer is fixed at 20 m and the angle α between the transmitted beam and the reflected beam onto a cloud is 0.5 deg, calculate the distance *d* to the base of the cloud.

(12 points)