

First name

Last name

Matrikel-ID

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Disclaimer: Please write your name and , most important, your student-ID in clear letters.

Please give on EACH PAGE the number of the page and the total number of pages

This Exam is consists of two sections: A single-choice section and a free section.

In the single-choice section, 5 statements are given and five options A, B, C, D, E, which statement(s) is/are correct. ONE AND ONLY ONE OPTION IS CORRECT!

Mark your selected answer by either tickmarking or by encircling the correct letter, but give no room for ambiguities! Ambiguities will be interpreted as NO CORRECT ANSWER = NO POINT.

This is of special importance should you later change your first answer – no ambiguities!

In the free text section you should answer the question in your own words to show that you have an idea about the subject of the question. You can use full sentences or give important keywords, but at least with short explanations. Good Luck!

Multiple choice: 20 x 1P = 20P

Free Text: 2 x 5P = 10P

Total: 30P

Required to pass: 15P

Time available: 90min

1: Global Circulation: Which of the following statements is correct?

- (1) The solar radiation is a significant driver of the global circulation
- (2) The Temperature Gradient from Equator to the Poles is the reason for four seasons.
- (3) Heating in the Tropics generates one global circulation cell
- (4) The global circulation is subject to the Coriolis force
- (5) The ITCZ (Inner Tropical Convergence Zone) is near the Equator.

[A] 3 only [B] 1, 2, 4, 5 [C] 1, 4, 5 [D] 1, 4 [E] 1, 4, 5

2: Coriolis Force: Which of the following statements is correct?

- (1) The Coriolis force is a function of the geographical latitude.
- (2) The Coriolis Force is a function of the geographical longitude.
- (3) The Coriolis force results from the Earth's rotation.
- (4) The Coriolis force is a function of speed.
- (5) The Coriolis Force varies with the seasons.

[A] 1 only [B] 1, 2, 3, 4 [C] 1, 3, 4 [D] 1, 4, 5 [E] 1, 3

3: Global Circulation: Which of the following statements is correct?

- (1) The wavenumber describes the number of troughs over the hemisphere.
- (2) The higher the wavenumber, the slower the propagation of the wave.
- (3) The higher the wavenumber, the faster the propagation of the wave.
- (4) The higher the wavenumber, the longer the wavelength.
- (5) A stationary wave results from a wavenumber 4 and is called Rossby wave.

[A] 3 [B] 2, 3, 4 [C] 1, 3, 5 [D] 1, 4, 5 [E] 1, 2, 3

4: Basic parameters: Which of the following statements is correct?

- (1) The vertical rate of change of air pressure (hPa / m) is constant.
- (2) The vertical rate of change depends on the air temperature.
- (3) The air pressure decreases with altitude.
- (4) Same MSL-Press: The higher the average temperature of the air column, the higher 500 hPa level
- (5) Same MSL-Press: The lower the average temperature of air column, the higher the 500 hPa level

[A] 1, 2, 3 [B] 1, 2, 4 [C] 1, 3, 4 [D] 2, 3, 4 [E] 3, 4, 5

5: Thermodynamics: Which of the following statements is correct?

- (1) The absolute height of a pressure level is determined by air column temperature only
- (2) The absolute height of a pressure level is determined by air column temperature and MSL Press
- (3) The height difference between two pressure levels is determined by air column temperature only
- (4) The height difference between two pressure levels is determined by air column temperature and MSL Pressure-
- (5) The higher the temperature of the air column, the higher the Tropopause+

[A] 1, 3, 5 [B] 1, 3 [C] 2, 4 [D] 2, 4, 5 [E] 2, 3, 5

6: Thermodynamics: Which of the following statements is correct?

- (1) The density of warm air is higher than the density of cold air.
- (2) The density of warm air is lower than the density of cold air.
- (3) The density of moist air is higher than the density of dry air.
- (4) The density of moist air is lower than the density of dry air.
- (5) The density of air is independent from the moisture.

[A] 2 only [B] 1, 2, 4 [C] 2, 4 [D] 2, 5 [E] 2, 3, 4

7: Land-Sea-Breeze: Which of the following statements is correct?

- (1) The onset of the sea breeze depends the absolute wind direction.-
- (2) The onset of the sea breeze depends wind direction relative to the shore.+
- (3) The onset of the sea breeze depends on the wind speed.+
- (4) The higher the difference ($T_{\text{land}} - T_{\text{water}}$), the stronger the sea breeze.+
- (5) The lower the difference ($T_{\text{land}} - T_{\text{water}}$), the stronger the sea breeze.-

[A] 1 only [B] 2 only [C] 1, 2, 4 [D] 2, 3, 4 [E] 1, 2, 5

8: Vertical Temperature Profile : Which of the following statements is correct?

- (1) The vertical lapse rate of dry air is about $1^{\circ}\text{C}/100\text{m}$
- (2) The vertical lapse rate of moist air is about $1^{\circ}\text{C}/100\text{m}$
- (3) The greater the vertical lapse rate, the higher the vertical stability
- (4) The vertical lapse rate determines the vertical stability
- (5) Convective clouds (CB, shower, thunderstorm) develop in vertical stable stratification.

[A] 1, 2, 4 [B] 1, 2, 3 [C] 1, 2, 5 [D] 1, 4 only [E] 1, 2, 4

9: Clouds: Which of the following statements is correct?

- (1) Clouds in stable vertical stratification are typically stratiform
- (2) Clouds in unstable vertical stratification are typically cumuliform
- (3) Convective clouds are typically stratiform
- (4) Convective clouds are typically cumuliform
- (5) The cold front of a low has typically a convective character

[A] 1, 2, 3 [B] 1, 2, 4, 5 [C] 1, 3, 5 [D] 1, 2 [E] 1, 3, 4

10: Basic Dynamics: Which of the following statements is correct?

- (1) The Coriolis force is a function of the geographical latitude
- (2) The Coriolis force acts in the direction of motion
- (3) The Coriolis force acts perpendicular to the direction of motion
- (4) With the same pressure, the windspeed is higher in anticyclones than in Cyclones (Low)
- (5) With the same pressure, the windspeed is lower in anticyclones than in Cyclones (Low)

[A] 1, 2, 5 [B] 1, 3, 5 [C] 1, 2 only [D] 1, 3 only [E] 1, 3, 4

11: Basic Dynamics: Which of the following statements is correct?

- (1) The distance between the isobars determines windspeed
- (2) The greater the distance between two isobars, the higher the windspeed.
- (3) The smaller the distance between two isobars, the higher the windspeed.
- (4) Cyclonic Curvature of the isobars increases the windspeed.
- (5) Anti-cyclonic Curvature of the isobars increases the windspeed

[A] 1, 2, 3 [B] 1, 3, 5 [C] 1, 3, 4 [D] 1, 3 only [E] 1, 2, 4

12: Basic Dynamics: Which of the following statements is correct?

- (1) The distance between the isobars only determines the windspeed
- (2) The windspeed (at equal pressure gradient) is higher near Highs than near Lows
- (3) Due to the centrifugal force in curved isobars, the windspeed is higher near Highs
- (4) In cyclonic curvature, the centrifugal force acts in direction of the pressure gradient force
- (5) In anti-cyclonic curvature, the centrifugal force acts in direction of the pressure gradient force

[A] 1, 3, 5 [B] 1, 2, 5 [C] 3, 5 only [D] 2, 3, 5 [E] 2, 3, 4

13: Tropical Storms (TS): Which of the following statements is correct?

- (1) TS start to develop near the Equator with geographical latitude $< 3^\circ$ N/S
- (2) Water temperatures greater than 27° Celsius are required for the forming of TS.
- (3) Strong vertical windshear supports the forming of TS.
- (4) Upper air convergence supports the forming of TS.
- (5) The main season for TS starts in the late hemispheric summer.

[A] 1, 2, 3 [B] 2, 3, 4 [C] 3, 4, 5 [D] 2, 3, 5 [E] 2, 5

14: Numerical Weather Prediction (NWP): Which of the following statements is correct?

- (1) NWP is a mathematical initial value problem.
- (2) NWP today can forecast all observed meteorological parameters
- (3) MOS (Model Output Statistics) can forecast all observed meteorological parameters
- (4) MOS is independent from the Numerical Model with which it is used.
- (5) PP (Perfect Prog) is independent from the Numerical Model with which it is used.

[A] 1, 2, 3 [B] 2, 3, 4 [C] 1, 3, 5 [D] 1, 3 [E] 1, 2, 5

15: Remote Sensing Satellite: Which of the following statements is correct?

- (1) The geostationary orbit is 10 times higher than the Polar Orbiter orbit (approx. ISS)
- (2) Polar orbiting satellites show always the same area of the Earth.
- (3) Geostationary satellites show always the same area of the Earth.
- (4) For Arctic/Antarctic regions, geostationary satellites are more useful.
- (5) For Arctic/Antarctic regions, polar orbiting satellites are more useful.

[A] 2 only [B] 2, 3, 4 [C] 3, 4, 5 [D] 2, 4, 5 [E] 1, 3, 5

16: Remote Sensing RADAR: Which of the following statements is correct?

- (1) When looking horizontally (elevation=0), the Radar beam height in distance 250 km is appx 2 km
- (2) When looking horizontally (elevation=0), the Radar beam height in distance 250 km is appx 7 km
- (3) Radar can be used to investigate non-raining clouds
- (4) Radar can be used to investigate raining clouds
- (5) The smaller the wavelength, the longer is the 'penetration depth' of Radar into a raining cloud.

[A] 1, 2, 3 [B] 2, 3, 4 [C] 2, 3, 5 [D] 2, 4 [E] 2, 4, 5

17: Oceanography: Which of the following statements is correct?

- (1) The mean value of the highest third of the wave is the characteristic wave height.
- (2) The height of the most frequent wave height is the characteristic wave height.
- (3) The shorter the waves, the faster they propagate.
- (4) The longer the waves, the faster they propagate.
- (5) The same direction of wind and current shortens the wave length.

[A] 1, 2, 3 [B] 1, 2, 4 [C] 1, 4 [D] 1, 3, 4 [E] 1, 4, 5

18: Marine Meteorology: Which of the following statements is correct?

- (1) The basic definition by Admiral Beaufort of the Beaufort Scale was the wind speed
- (2) The basic definition by Admiral Beaufort of the Beaufort Scale was the wave height
- (3) The basic definition by Admiral Beaufort of the Beaufort Scale was the sail setting
- (4) Beaufort Force 8 is 34-40 knots, defined as 'Gale'
- (5) Beaufort Force 13 is 64 knots or more, defined as 'Hurricane Force'

[A] 1, 4, 5 [B] 2, 4, 5 [C] 3, 4, 5 [D] 3, 4 [E] 3, 5

19: Climatology : Which of the following statements is correct?

- (1) Tree rings, ice and sediment cores can be used as climatological proxy data
- (2) Information about CO₂ content by tree rings goes further into the past than ice cores
- (3) Information about CO₂ content by ice cores goes further into the past than tree rings
- (4) CO₂ absorbs longwave IR radiation thus increasing the temperature of the Earth
- (5) The Global Warming is strongest at lower latitudes (Tropics).

[A] 1 only [B] 1, 2, 4 [C] 1, 2, 4, 5 [D] 1, 3, 4 [E] 1, 2, 3, 5

20: Climatology Which of the following statements is correct?

- (1) Less than 30 % of the energy due to Global Warming goes into the Ocean
- (2) About half of the energy due to Global Warming goes into the Ocean.
- (3) More than 90 % of the energy due Global Warming goes into the Ocean.
- (4) The increase of CO₂ is reducing the global vegetation
- (5) The decrease of the Arctic ice shield is due to the high geographical latitude

[A] 2, 4, 5 [B] 3, 4 [C] 3, 4, 5 [D] 3 only [E] 3, 5

Open Questions

Please give important keywords to the subject with short explanations to show that you have an idea about the subject.

Question 1

How is modern Weather Forecasting achieved today? Science and Technology from observation to cellphone app.

Please do NOT name different cellphone weather apps!

Give meteorological processes and technologies to generate the weather information in the apps!

Question 2

What is the idea behind 'Grosswetterlage' may be translated to 'General Weather Situation', but is also used as German expression in the English language.