Abu Dhabi Polytechnic
Meteorology Department

MET-324 NWP & Num. Analysis

I-Mid Examination
2nd Semester (2018-19)

Instructor: Dr. Nageswara Rao G.

Time: 1 Hr. 30 Min.

STUDENT NAME	

STUDENT NUMBER	A								

CRN	**3**	**3**	**1**	**8**	DEPARTMENT	**MET**

READ THESE INSTRUCTIONS CAREFULLY

Write your *name*, *number*, *CRN* and department **clearly** in the boxes above.
Answer **all** questions.
Show **all** your working and use appropriate **units.** Otherwise, you may lose marks.
You may use a pencil for all your work.
Answers that are not **clearly readable**, if any, will not be marked.

- **All mobile devices are not allowed during examination.**
- **Abu Dhabi Polytechnic considers cheating or attempting to cheat a serious offense that will result in disciplinary action taken against involved individuals.**

Section	Score	CLO
1	/60	1
2	/40	2

Total	/20

Section-1 (60 Marks)

1. Curvature terms in the momentum equations can be neglected in _____ **(5)**
   a) Grid Point Models
   b) Spectral Models
   c) Non-Hydrostatic Models
   d) None of the above

2. _____ equations are more accurate **(5)**
   a) Hydrostatic
   b) Non-hydrostatic
   c) Basic hydrodynamic
   d) None of the above

3. Suppose today's temperature at a place is 30° C and the temperature tendency due to cold advection is 0.5 ° C/3 hrs. What will be tomorrow's temperature? **(5)**
   a) 34.0 ° C
   b) 30.5 ° C
   c) 26.0 ° C
   d) none of the above

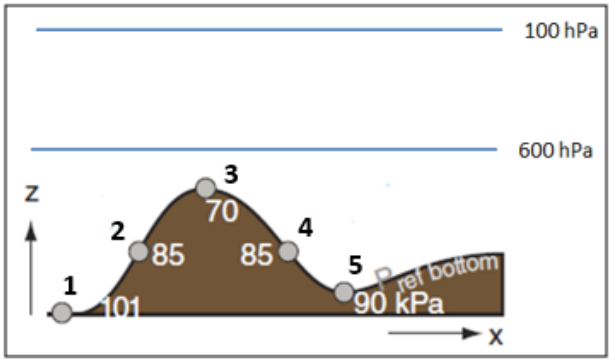
4. Isentropic surfaces intersect in _____ **(5)**
   a) Free atmosphere
   b) Boundary layer
   c) Troposphere
   d) None of the above

5. From the following continuity and thermodynamic energy equations, derive a prediction equation for pressure. Show all the steps in the derivation. **(12)**

   $\frac{d\rho}{dt} = -\rho\nabla.\vec{V}$ and $\frac{dT}{dt} = \frac{RT}{c_p p}\frac{dp}{dt}$

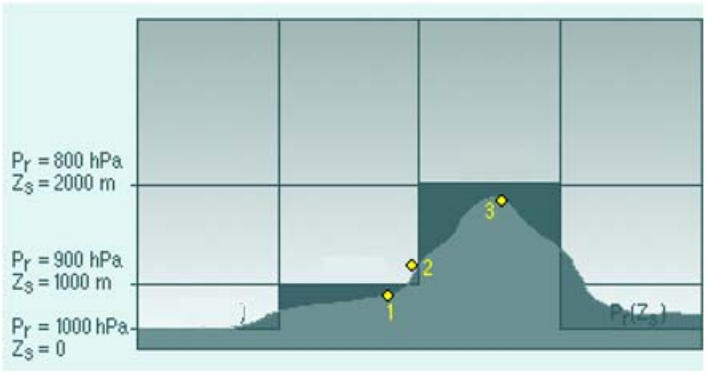
A.

6. Calculate the σ values for the model reference pressure of 600 hPa at the given 5 points, as shown in the diagram. Model top pressure is given as 100 hPa. Surface pressures are given in kPa. **(8)**



A.

7. Calculate the η (eta) vertical coordinate values for the model reference heights 1000 and 2000 m for the 3 points, using the data given in the diagram. Model top pressure is given as 100 hPa. **(8)**



A.

8. Explain how sigma coordinates introduce errors in PGF calculation with a neat diagram. **(12)**
What is the difference between sigma and eta coordinates? Explain how eta coordinates eliminates the errors in the PGF calculation.

A.

Section-2 (40 Points)

1. What is the nature of NWP model equations? How do you solve them using Finite Difference method? **(6)**

A.

2. Giving the expressions for a derivative of a variable (φ) and its finite difference, explain the differences between them, with the necessary diagram. **(8)**

A.

3. With the help of a 9-point square stencil and centered difference formula for the derivative, obtain a finite difference expression for the mixed 2nd derivative ($\partial^2 u/\partial y \partial x$). **(10)**

A.

4. Give a diagram showing a 9-point square stencil. Giving the Taylor's expansion series for the four vortices of the square, derive an expression for the Laplacian, $\nabla^2 u$. Consider $\Delta x = \Delta y = \Delta$. **(16)**

A.