Minoufiya University
Faculty of Engineering
Mechanical Power Eng. Dept.
Second Semester Examination
Academic Year: *2012-2013*

Subject/Code: *Gas Dynamics*
Year: Post Graduates
Date: *10/06 /2014*
Time allowed: *3 hours*
Grades: 100 **(Master)**

Answer all the following questions

Question-1 ***[30marks]***

a) Prove that: $\frac{dM^2}{M^2} = 2\frac{dV}{V} - \frac{dT}{T}$

b) What happen for the position of sonic line in convergent divergent nozzle if friction and heat addition is considered?

c) Consider steady air flow through a duct that has a circular cross sectional area shape. The inlet diameter of the duct is 6 cm and the duct has a length of 1.5 m. the air enters the duct with a Mach number of 0.35 and a temperature of 40 c°. Heat is added to the flow in the duct at a uniform rate which is such that the stagnation temperature increases by 246 K in the duct. If the fanning friction factor is assumed to be 0.003, **determine** the Mach number and temperature variations along the duct if

i) - Its diameter increases linearly by 20 percent.

ii) - Its diameter decreases linearly by 2 percent.

iii) -The diameter remains constant.

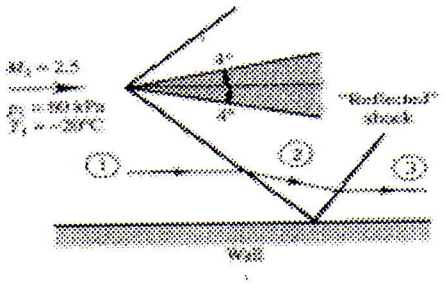
Assume that the air behaves as a perfect gas and that the flow is steady.

Question-2 ***[40 marks]***

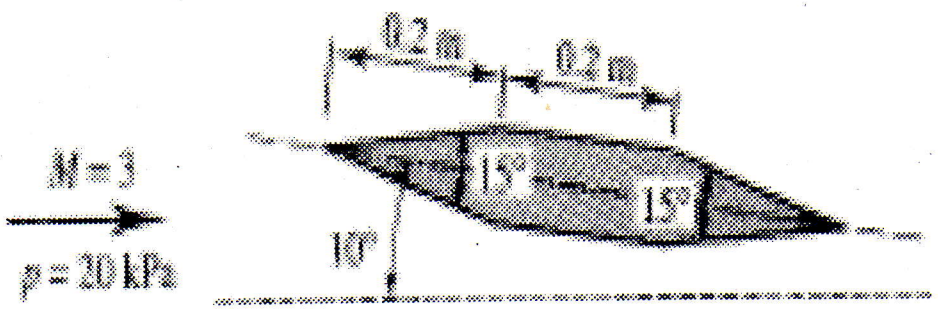
a) Explain with drawing the following:

i- Mach reflection ,
ii- Shock cancellation,
iii- Oblique shock wave intersection

b) Air flowing with a Mach number of 2.5 with a pressure of 60 kPa and a temperature of 253K passes over a wedge which turns the flow through an angle of 4° leading to the generation of an oblique shock wave impinges on a flat wall, which is parallel to the flow upstream of the wedge, and is "reflected" from it. **Find** the pressure and velocity behind the reflected shock wave.



C) Consider a two-dimensional flow over the double-wedge airfoil shown in the following figure. **Find** the lift and drag per meter span acting on the airfoil and sketch the flow pattern. Show graphically how the pressure varies over the surface shown of the airfoil?



Question-3 ***[30 marks]***

a) What is the usage of under relaxation factor?

b) Consider air flow through the convergent-divergent nozzle. Assuming that the flow goes from subsonic to supersonic in nozzle, **write** flow chart and steps that will give the distribution of the variables along the nozzle in terms of the values existing at the throat, i.e., at the sonic point. If the pressure on the nozzle inlet section is 200 kPa use the results given by the program to find the throat and exit section pressures