B14

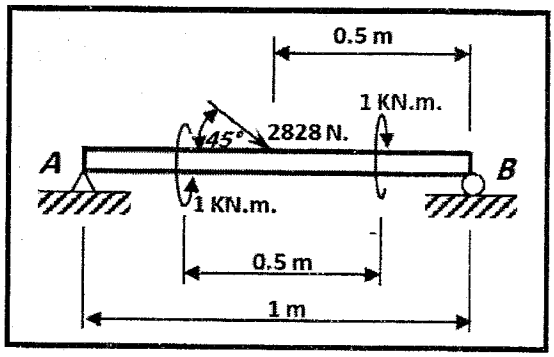
Tanta University
Faculty of Engineering
Production Engineering & Design Dept.
2nd Year Production Eng. & Design 2022/2023
Stress Analysis

MDP2107
Monday, 9.01.2023
Time allowed : 3 hours
Final Grade : 100 Marks
Number of Pages : 2

Final Exam

Solve all questions and make use of the information given in the last page:

Question 1 : (40 marks)



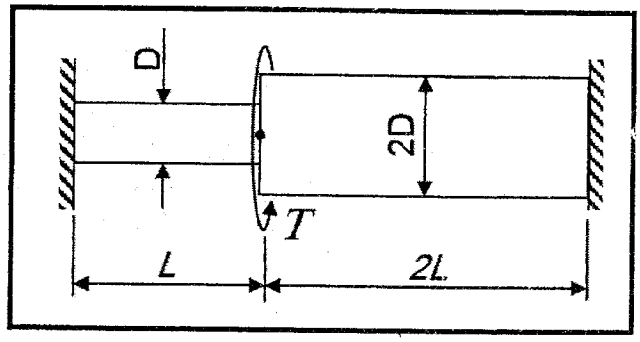
The shown steel beam has a solid rounded section of 40 mm diameter. It is subjected to a concentracted force of 2828 N and twisting moments of 1 kN.m., as shown in the figure. You are requested to:

i. Get the reactions at supports **A** and **B**.
ii. Plot the **NFD, TMD, SFD** and **BMD**.
iii. Compute the horizontal deflection of point **B**.
iv. Determine the most loaded cross section.
v. Plot the stress distributions at that cross section and hence identify the position of the critical point.
vi. Plot a stress element at the critical point showing all the stresses exerting at that point.
vii. Use Mohr's circle to get the position and values of the principal stresses at the critical point.
viii. For a factor of safety of **2.5**, what will be the minimum yield strength for the used steel alloy according to both von-Mises and Tresca yield criteria.
ix. Get the vertical deflection at the mid-span.
x. Calculate the critical load at which this beam will buckle.
xi. If the support at **A** is replaced by a fixed support, only state (don't solve) the necessary steps to get the new reactions at points **A** and **B**.

Question 2 : (20 marks)

The shown solid stepped shaft is loaded with a twisting moment ***T*** at the shown position. Determine in terms of ***D***, ***L***, ***T*** and ***G*** :

i. the reactions at the walls.
ii. Draw the changes of twisting moment and twist angle along the shaft.
iii. Calculate the maximum shear stress in the shaft and plot the stress variation across the section having maximum stress.
iv. Determine the strain energy absorbed by the shaft.



Question 3 : (15 marks)

For a plane stress condition plot the yield locas on the stress space (σ_1 - σ_2) for both Tresca and von-Mises criteria (on one graph). Hence, determine the loading conditions (σ_1 with respect to σ_2) at which both criteria coincides (يتطابقوا).

Question 4 : (25 marks)

a) A thick-walled cylindrical pressure vessel made of steel, has an inside diameter of 100 mm and an outside diameter of 173.2 mm. The length of the vessel is 200 mm. The pressure inside the vessel reaches 300 MPa.

i. Determine the stress and strain components at the inner and outer diameters.
ii. Sketch the stress components across the wall thickness.
iii. What are the changes of length and inner diameter.

b) A gas is contained in a 75 cm long thin walled closed cylinderical tank under a pressure of 25 MPa. The cylinder has a mean diameter of 100 mm and made of steel sheets with thickness of 5 mm and a yield strength of 400 MPa.

i. Use von-Mises criterion to get the factor of safety used in the design of this cylinder?
ii. Derive an expression to calculate the change of the mean diameter in terms of the internal pressure ***P***, the cylinder dimension and the material properties.
iii. Get the percentage change in the internal volume of the used tank.

مع تمنياتى بالتوفيق و النجاح د/ نادر نبيل

Useful information:

For steel : E = 210 GPa , $\nu = 0.27$

Deformation due to normal force: $\delta_{mech} = \frac{PL}{EA}$ & Twist angle $\theta = \frac{TL}{GJ}$

Direct shear on circular section: $\tau = \frac{4Q}{3A}\left[1 - \left(\frac{y}{R}\right)^2\right]$

Principal stresses : $\sigma_{1\atop 2} = \frac{(\sigma_x+\sigma_y)}{2} \pm \sqrt{\left(\frac{\sigma_x-\sigma_y}{2}\right)^2 + \tau_{xy}^2}$

Double integration method : $\frac{d^2v}{dx^2} = \frac{M}{EI}$ & Castigliano's theorem : $v = \frac{\partial}{\partial P_c}\int_0^L \frac{M^2}{2EI}dx$

von-Mises criterion : $\frac{\sigma_y}{F.S.} \geq \frac{1}{\sqrt{2}}\sqrt{(\sigma_1-\sigma_2)^2 + (\sigma_2-\sigma_3)^2 + (\sigma_3-\sigma_1)^2}$

Tresca criterion: $\sigma_{all} \geq |\sigma_1 - \sigma_3|$

For buckling of columns: $P_{cr} = \frac{\pi^2 EI}{L^2}$

Stresses in thin cylinders: $\sigma_h = \frac{PD}{2t}$ and $\sigma_a = \frac{PD}{4t}$

Stresses on thick-walled cylinders : $\sigma_{r\atop \theta} = \frac{P_i}{(\lambda^2-1)}\left(1 \mp \frac{r_o^2}{r^2}\right)$; $\sigma_a = \frac{P_i}{(\lambda^2-1)}$

Stress-strain relation : $\epsilon_x = \frac{1}{E}[\sigma_x - \nu(\sigma_y + \sigma_z)]$

B13

Tanta University

Total Marks: *40 Marks*

Faculty of Engineering

Course Title: *Engineering Economy*	Course Code: *MPD21H3*	Year: *2nd Mech. Students*
Date: *11-01-2023 (Final Exam)*	Allowed time: *2 Hrs*	No. of Pages: *(2)*

Answer All The Following Questions By Illustrating Your Answers With Neat Sketches (Solve As You Can)
(6 Questions....Every Question Carries The Same Marks)

Question (1):-

A company is considering the advantages of automating a part of their production line. The company' financial statement is shown below:-

Total sales	*= L.E. $40x10^6$*
Direct labor	*= L.E. $12x10^6$*
Indirect labor	*= L.E. $2x10^6$*
Direct material cost	*= L.E. $8x10^6$*
Depreciation	*= L.E. $1x10^6$*
Taxes	*= L.E. $0.5x10^6$*
Insurance	*= L.E. $0.4x10^6$*
Sales cost	*= L.E. $1.5x10^6$*

The above report is based on the production and sales of 100000 units. The production manager believes that with an additional investment of L.E. $5x10^6$ he can reduce variable costs by 30%. The same production volume would be maintained. Using of five-years, straight-line depreciation (that is L.E. $1x10^6$ per year), construct a break-even chart.
If the company inserts an a 20% return on its investments, should they automate?.

Question (2):-

(a) When the minimum-cost batch size is produced, it is known that the variable costs constitute 25% of the total production costs. If "Q" is increase by 20%, what increase in production costs can expected?.

(b) Given a nonlinear price function of :-

	$b = 21000\ Q^{(-0.5)}$	*L.E. per unit*
	a = 1000	*L.E. per unit*
	F = 1000000	*L.E. per period*

Determine :-
(a) The break-even point.
(b) The production level for maximum profit.
(c) What are the marginal costs, marginal revenue, and marginal profit?.

Question (3):-

(a) Prove that the production range: $Q_{I,II} = Q_m [\, p + \sqrt{p^2 - 1}\,]$.
(b) In the minimum-cost batch size, prove that: $Qm = \sqrt{2a_\xi / [\,(I + \gamma) + 2B\,]}$.
(c) Prove that the allowable increase in costs per piece: $\xi = (p - 1) / (0.5u + 1)$.
(d) Define: BEP – Production Range – Management – Depreciation – Replacement – Maintenance.

Question (4):-

(a) Define and explain the break-even analysis with neat sketches and what are methods to increase profit?.
(b) It is required to establish the production range for the following data:-

Set up.....= L.E. 1000
Carrying charges factor.....= L.E. $0.25x10^{-3}$ / unit / day
Constant cost per piece.....= L.E. 2
Allowable increase in cost per piece....= 2.5%

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Question (5):-

(a) What is depreciation? and what are all the causes of depreciation? and state in few words the various types of depreciation?.

have an economic life of 5 years. They can be sold for an average of $800 each after 5 years of use. The company currently receives 7% interest on invested funds.

Determine:- 1- The depreciation charge during year 1.

2- The depreciation charge during year 2.

3- The depreciation reserve accumulated by the end of year 2.

4-The book value at the end of year 3.

Question (6):-

(a) What is replacement? And what the reasons for replacement? And what are the two types of replacement? And list out the different types of maintenance?.

(b) A city delivery service with a fleet of panel trucks makes store-to-home deliveries for several merchants. Past records, modified to account for recent price trends, indicate a cost pattern over a 6-year period that is expected to apply to depreciation and maintenance for future truck acquisitions.

Table: The purchase price per truck is $ 3000.

	1	2	3	4	5	6
Operating cost	$800	$1000	$1300	$1600	$2000	$2500
Resale price	$1600	$1000	$600	$500	$400	$300

Assuming a zero interest rate and that all the trucks are going to be replaced at one time. How many years should they be kept in service before replacement?.

End of Examination Paper

...[[With My Best Wishes And Good Luck]]...

{{{Examiner: Dr Eng: Alaa-Eldin A. El-Hammady}}}

B12

Tanta University

Production Engineering and Mechanical Design Department

Total marks: 85 Marks

Faculty of Engineering

Course Title: Theory of Machines
Course Code: MPD2109+MPD2150
Year: 2nd year Mech. Eng.

Final exam

Date: 14 / 01 / 2023
Allowed time: 3 Hour
No. of pages: 2 page

Solve the following questions

Q1- (17 Marks)

The crank AE of the mechanism shown in Fig. 1 has angular velocity of 60 *rpm* clockwise. Draw the space, velocity and acceleration diagrams. Find the accelerations of points B and C and the angular accelerations of links BC and CD. The lengths of the links are as follows:
AE = 150 *mm*, OB = 400 *mm*, BC = 600 *mm*, and CD = 200 *mm*.

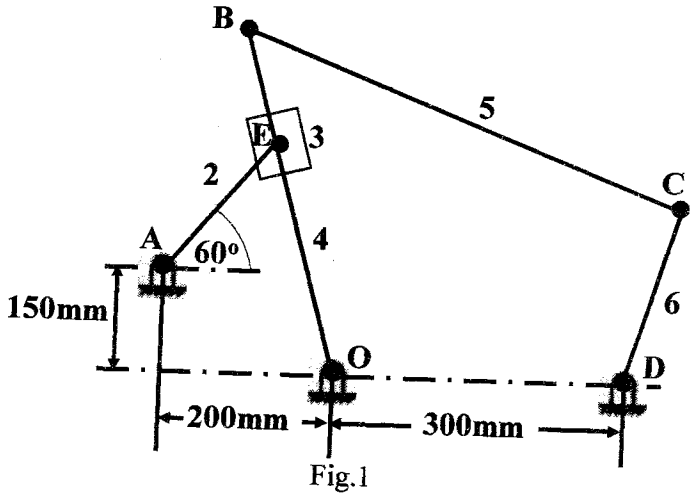

Fig.1

Q2- (17 Marks)

Determine the torque T_2 required to be applied for the static equilibrium of the mechanism shown in Fig. 2. The force P acting on the slider is 5000 *N* and the dimensions of the mechanism are as follows:
OA = 240 *mm*, AB = 1000 *mm*, BC = 620 *mm*, CD = 400 *mm* and DE = 600 *mm*.

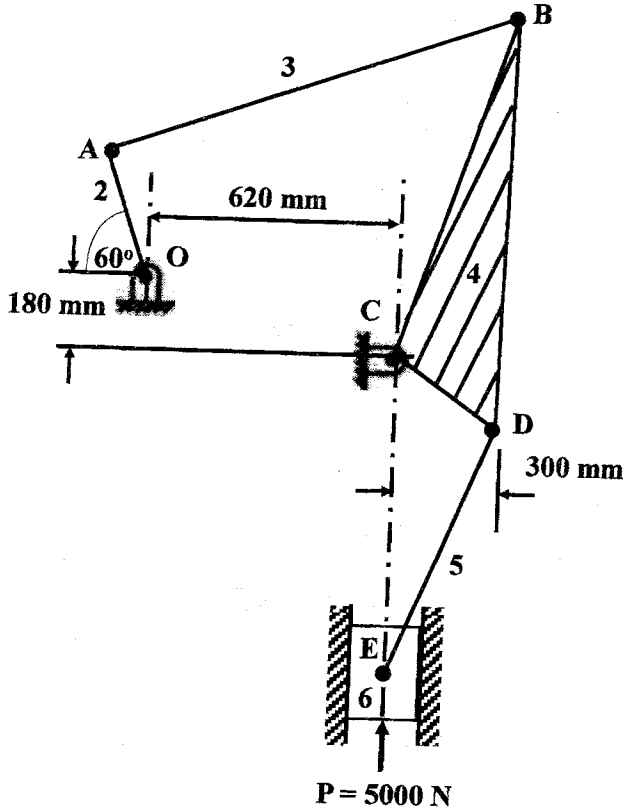

Fig.2

Q3- (17 Marks)
Draw the profile of a cam operating a reciprocating roller follower and with the following data:
Minimum radius of cam = 25 mm, lift = 30 mm and roller diameter = 15 mm.
The cam lifts the follower for 120^o with simple harmonic motion followed by a dwell period of 30^o. Then the follower lowers down during 150^o of the cam rotation with uniform acceleration and retardation followed by a dwell period.
If the cam rotates at a uniform speed of 150 rpm, calculate the maximum velocity and acceleration of the follower during the descent period.

Q4- (17 Marks)
In the epicyclic gear train shown in Fig.3, an arm carries two gears C and E. The shaft S_1 carries two gears A and B. If the arm rotates at 150 rpm in the clockwise direction about the center of the gear F. Using the tabular method, determine the speed of gear D on the output shaft S_2 when

(a) Gear F is fixed.
(b) Gear F rotates at 15 rpm in the clockwise direction.

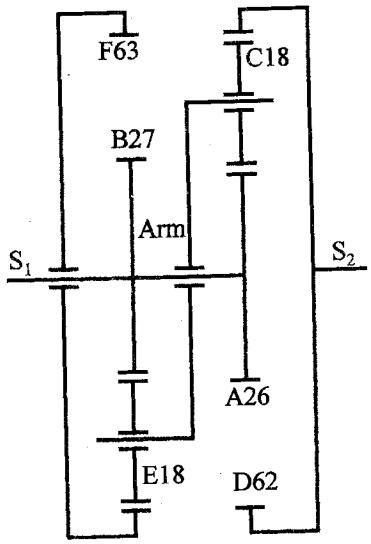

Fig.3

Q5- (17 Marks)
The equation of the turning moment curve of a three crank engine is $(8000 + 180\ sin3\theta)\ N.m$, where θ is the crank angle in radians. The flywheel and other rotating parts have a mass of 350 Kg and radius of gyration 220 mm and the mean speed is 400 rpm. Calculate:

1. power of the engine, and
2. the maximum fluctuation of the speed of the flywheel in percentage when
   (a) the resisting torque is constant, and
   (b) the resisting torque is $(800 + 80\ sin\theta)\ N.m$.

End of exam

With best wishes
Dr. Abdelhameed Zayed

B 10.

Physics and Engineering Mathematics Department

Tanta University	Year: 2nd Year Production Engineering and Mechanical Design Department	Faculty of Engineering
Date: Jan.18th, 2023 (1st term) Allowed time: 3 hours	Course Title: Engineering Mathematics (3) Course Code: PME2112 FINAL EXAM	Total Marks: 100 No. of pages: 2

Please answer the following questions:

Question (1) **(50 Marks)**

(a) If $J_0(2.2) = 0.1104$ and $J_1(2.2) = 0.556$, obtain $J_{-2}(2.2)$. **[5 Marks]**

(b) Show that $\int_0^1 x^m \left(ln\, x\right)^n dx = \frac{(-1)^n n!}{(m+1)^{n+1}}$, where n is a positive integer. **[10 Marks]**

(c) Put in the form of $u + iv$ the following: $(4+4i)^5(-2+2\sqrt{3}i)$. **[5 Marks]**

(d) let $z = x + iy$ and $f(z) = \frac{(z-i)(z-2)}{(z^2+1)\cos\left(\frac{z+\bar{z}}{2}\right)}$. Show graphically where in the following domains, this function fails to be defined:

(d-1) $|z| < 1$ (d-2) $\left|z - (1+i)\frac{\pi}{2}\right| < \frac{\pi}{2}$ **[10 Marks]**

(e) Solve the following equations using the series solution method: **[20 Marks]**

(e-1) $y'' - 2xy = 0$ where $y(2) = 1,\ y'(2) = 0$.

(e-2) $x^2y'' + (x^2 - 2x)y' + 2y = 0$ around $x_0 = 0$.

(e-3) **Bessel's equation** $x^2y'' + xy' + (x^2 - k^2)y = 0$ for $k =$ ***not integer***.

(e-4) $x^2y'' + xy' + (x^2 - \frac{1}{9})y = 0$.

Please, consider page 2/2

Question (2) **(50 Marks)**

(a) Let $f(z) = u + i\,v$ to be an analytic function with $u = 3x^2y + 2x^2 - y^3 - 2y^2$. Find the conjugate harmonic v and $f'(z)$. **[5 Marks]**

(b) Solve the following equation $\sin z = 10$. **[5 Marks]**

(c) Use De Moiver's theorem to obtain $cos3\theta$ and $\frac{sin3\theta}{sin\theta}$ in terms of powers of $cos\theta$. **[5 Marks]**

(d) If $\sin^{-1} z = -i\,\ln\left(iz + \sqrt{1-z^2}\right)$ and $\frac{d}{dz}\left(\sin^{-1} z\right) = \frac{1}{\sqrt{1-z^2}}$. Find $\sin^{-1} z$ and $\frac{d}{dz}(\sin^{-1} z)$ at $z = \sqrt{5}$. **[5 Marks]**

(e) Prove Cauchy-Goursat theorem $\oint_C f(z)dz = 0$ for analytic function on a simple closed contour C. **[5 Marks]**

(f) Let C is as shown in Fig.2. Evaluate $\oint_C \frac{1}{z^2-1}dz$. (Hint: the indicated direction is the counterclockwise direction). **[10 Marks]**

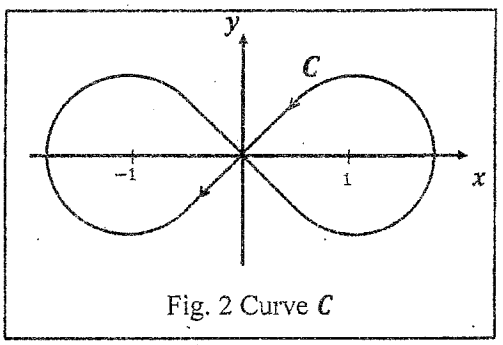

Fig. 2 Curve C

(g) Show that $|z_1 + z_2|^2 + |z_1 - z_2|^2 = 2|z_1|^2 + 2|z_2|^2$. **[5 Marks]**

(h) Evaluate the following integrals

(f-1) $\int_c cos\,z\,dz$ for C any contour from $z = 0$ to $z = 2 + i$. **[5 Marks]**

(f-2) $\oint_C \frac{z-1}{z(z-2)(z+4)}dz$ inside C: $|z| = \frac{5}{2}$. (Hint: the indicated direction is the counterclockwise direction). **[5 Marks]**

Best of Luck *Dr. Manar Omran*

Tanta University

Mechanical Power Engineering Dept.
Total Marks: 75 marks

Faculty of Engineering

Course Title: Fluid Mechanics
ميكانيكا الموائع
Date: 21st Jan, 2023 (Final Exam)

Course Code: MPE 2150
Allowed Time: 3 hrs.

Final Written Exam
No. of Pages: 2 pages

ANSWER ALL THE FOLLOWING QUESTIONS

Question (1) (15 Marks)

A) The Stokes-Osteen formula for drag on a sphere at low velocity V is:

$$F = 3\pi\mu DV + \frac{9\pi}{16}\rho V^2 D^2$$

Where, D is sphere diameter, μ is viscosity, and ρ is density. Is the formula dimensionally homogeneous? **(5 Marks)**

B) A cylinder of diameter 122mm and length 200mm is placed inside a concentric long pipe of diameter 125 mm as shown in figure (1). An oil film is introduced in the gap between the pipe and the cylinder. What force is necessary to axially move the cylinder at a velocity of 1 m/s? Assume that the kinematic viscosity of oil is 30 cSt and the specific gravity is 0.9.

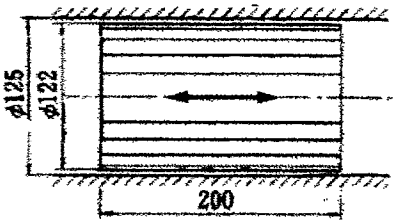

Figure (1)

Question (2) (15 Marks)

A) Define the following: Compressibility of liquids, Mach Number, and Boundary layer. **(6 Marks)**

A) A cylinder 7.5 cm radius and 60 cm in length rotates coaxially inside a fixed cylinder of the same length and 9 cm inner radius as shown in Figure (2). Glycerin μ = 8 Poise fills the space between to cylinders. A Torque 0.4 N.m is applied to the inner cylinder. After a constant velocity is attended, calculate the following: (a) velocity gradient at the cylinder walls, (b) the velocity rustling and (c) the power dissipated by the fluid resistance. **(9 Marks)**

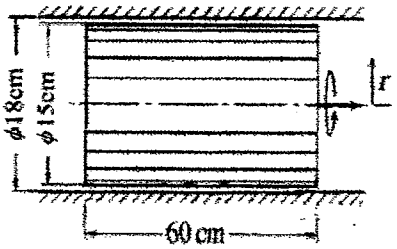

Figure (2)

Question (3) (15 Marks)

A) Explain with drawing the effect of increasing the horizontal linear acceleration (a_x) subjected to open tank on: **(6 Marks)**

i. Water surface slope (θ).
ii. Water volume (V).
iii. Rotation point location.

P.T.O >>>>

B) A 120-cm-long tank contains 80 cm of water and 20 cm of air maintained at 60 kPa above the water. The 60-cm-wide tank is accelerated at 10 m/s². After equilibrium is established, find the force acting on the bottom of the tank. **(9 Marks)**

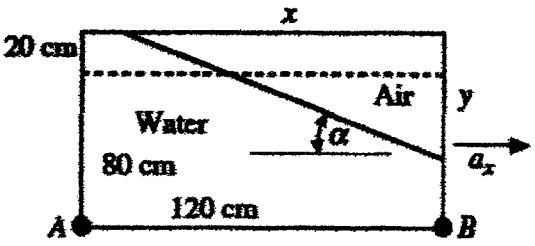

Figure (3)

Question (4) **(15 Marks)**

A) In Figure (4): If the specific weight of used fluids is: Benzene =8640 N/m & Mercury =133100 N/m & Kerosene =7885 N/m & Water =9790 N/m & Air =12 N/m. Determine the pressure difference (in Pa) between points A and B. **(5 Marks)**

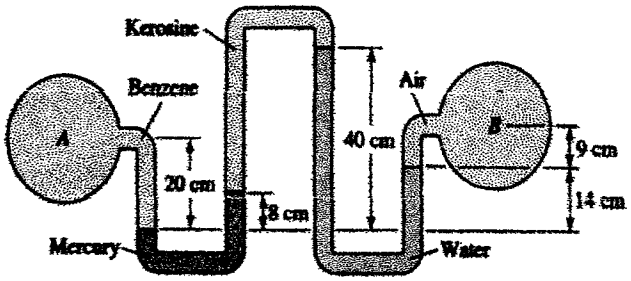

Figure (4)

B) A closed cylindrical tank (Fig. 5) with the air space subjected to a pressure of 102.0424 kPa, 1.9 m height and 0.9 m in diameter, contains 1.45 m of oil (S.G. = 0.9). If the cylinder rotates about its geometric axis,

i. When the angular velocity is 10 rad/sec, what are the pressures in bar at points C, D and E?

ii. At what speed must the tank be rotated in order that the center of the bottom has zero depth? **(10 Marks)**

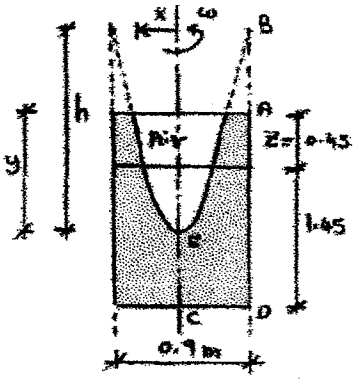

Figure (5)

Question (5) **(15 Marks)**

A) Draw total energy line (EGL) and hydraulic gradient line (HGL) for a pipe flow connecting two tanks with sudden contraction. **(4 Marks)**

B) What is Cavitation? Mention with drawing where does it probably occur? **(5 Marks)**

C) Water is flowing through a pipe having diameters 600 mm and 400 mm at the bottom and upper end, respectively. The intensity of pressure at the bottom end is 350 KN/m², and the pressure at the upper end is 100 KN/m². Determine the difference in datum head if the rate of flow through the pipe is 60 litter. **(6 Marks)**

End of Questions ***With my Best Wishes...*** ***Dr. Ayman Refaat Eltohami***