

注意：考試開始鈴響前，不得翻閱試題，
並不得書寫、畫記、作答。

國立清華大學 115 學年度碩士班考試入學試題

系所班組別：動力機械工程學系
丙組(固體與奈微米力學組)

科目代碼：1401

考試科目：材料力學

—作答注意事項—

1. 請核對答案卷(卡)上之准考證號、科目名稱是否正確。
2. 考試開始後，請於作答前先翻閱整份試題，是否有污損或試題印刷不清，得舉手請監試人員處理，但不得要求解釋題意。
3. 考生限在答案卷上標記「由此開始作答」區內作答，且不可書寫姓名、准考證號或與作答無關之其他文字或符號。
4. 答案卷用盡不得要求加頁。
5. 答案卷可用任何書寫工具作答，惟為方便閱卷辨識，請儘量使用藍色或黑色書寫；答案卡限用 2B 鉛筆畫記；如畫記不清(含未依範例畫記)致光學閱讀機無法辨識答案者，其後果一律由考生自行負責。
6. 提早交卷者不可攜出試題，請將試題連同答案卷(卡)交予監考人員，攜出將以違規論處。當節考試結束後試題將置於講台，可自行取回，本試場不負保管責任。
7. 其他應考規則、違規處理及扣分方式，請自行詳閱准考證明上「國立清華大學試場規則及違規處理辦法」，無法因本試題封面作答注意事項中未列明而稱未知悉。

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系所班組別：動力機械工程學系碩士班 丙組(固體與奈微米力學組)

考試科目 (代碼)：材料力學(1401)

共 4 頁，第 1 頁 *請在【答案卷】作答

1. [14 Points] Refer to Fig. 1. A thin-walled cylindrical pressure vessel of radius r and thickness t is subjected simultaneously to an internal gas pressure p and a compressive force F applied at its ends. What should be the magnitude of the force F in order to produce a state of pure shear in the wall of the cylinder at point A ?

(a) $2\pi pr^2$ (b) $3\pi pr^2$ (c) $2\pi rt$ (d) $3\pi rt$ (e) None of above

You must show your derivation process to receive full credit.



Fig. 1

2. [14 Points] Refer to Fig. 2. The compound beam segments are connected by a smooth roller contact at the location shown. A vertical load P (of magnitude P) is applied at the location shown. The flexural rigidity EI is constant. Answer the questions below:

(1) What is the reaction moment at the fixed support A : (a) $\frac{1}{9}PL$ (b) $\frac{2}{9}PL$

(c) $\frac{4}{9}PL$ (d) $\frac{1}{2}PL$ (e) $\frac{7}{9}PL$ (f) None of above

(2) What is the reaction moment at the fixed support B : (a) $\frac{1}{9}PL$ (b) $\frac{2}{9}PL$

(c) $\frac{4}{9}PL$ (d) $\frac{1}{2}PL$ (e) $\frac{7}{9}PL$ (f) None of above

You must show your derivation process to receive full credit.

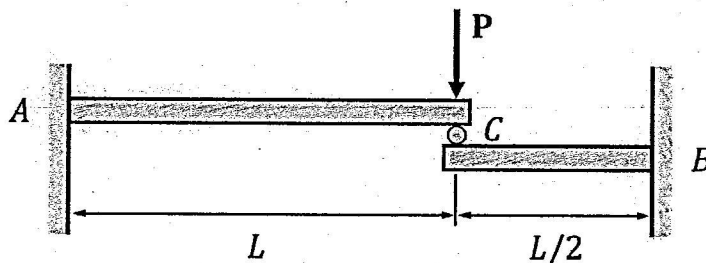


Fig. 2

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共 4 頁，第 2 頁

*請在【答案卷】作答

3. [14 Points] Refer to Fig. 3. The column is supported at B by a support that does not permit rotation but allows vertical displacement. The flexural rigidity EI is constant. What is the critical load P_{cr} ?

(a) $\frac{\pi^2 EI}{8L^2}$ (b) $\frac{\pi^2 EI}{7L^2}$ (c) $\frac{\pi^2 EI}{4L^2}$ (d) $\frac{\pi^2 EI}{3L^2}$ (e) $\frac{\pi^2 EI}{L^2}$ (f) None of above

You must show your derivation process to receive full credit.

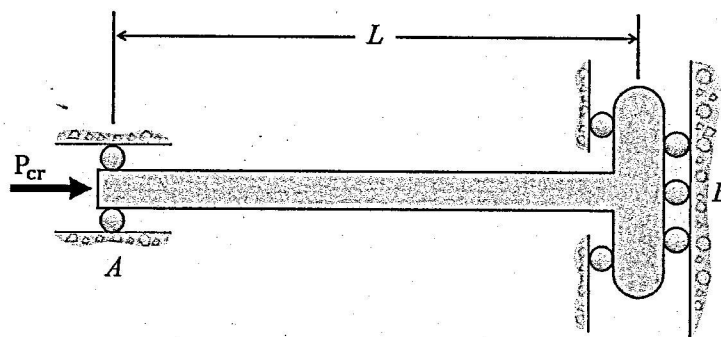


Fig. 3

4. [14 Points] Refer to Fig. 4. The rubber block is confined in the U-shape smooth rigid block. If the rubber has a modulus of elasticity E and Poisson's ratio ν , what is the effective modulus of elasticity of the rubber under the confined condition?

(a) $\frac{E}{1-\nu^2}$ (b) $\frac{2E}{1-\nu^2}$ (c) $\frac{2E}{1-\nu}$ (d) $\frac{E}{1-\nu}$ (e) None of above

You must show your derivation process to receive full credit.

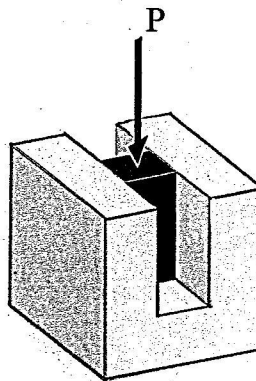


Fig. 4

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共 4 頁，第 3 頁 *請在【答案卷】作答

5. [18 Points] Refer to Fig. 5. What is the value of a for which the maximum positive moment has the same magnitude as the maximum negative moment? The flexural rigidity EI is constant.

(a) $0.236L$ (b) $0.414L$ (c) $0.5L$ (d) $0.646L$ (e) $0.75L$ (f) None of above

You must show your derivation process to receive full credit.

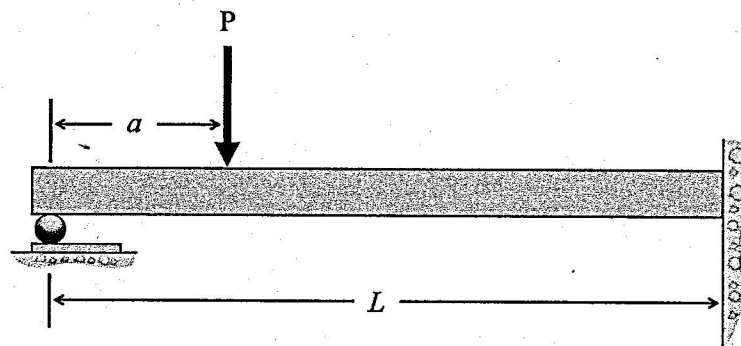


Fig. 5

6. [14 Points] Refer to Fig. 6. What is the torsional strain energy stored in the tapered rod when it is subjected to the torque T ? The rod is made of material having a modulus of rigidity of G .

(a) $\frac{9T^2L}{24\pi(r_0)^3G}$ (b) $\frac{9TL}{24\pi(r_0)^3G}$ (c) $\frac{7TL}{24\pi(r_0)^4G}$ (d) $\frac{7T^2L}{24\pi(r_0)^4G}$ (e) $\frac{9T^2L^2}{24\pi(r_0)^4G}$ (f) None of above

You must show your derivation process to receive full credit.

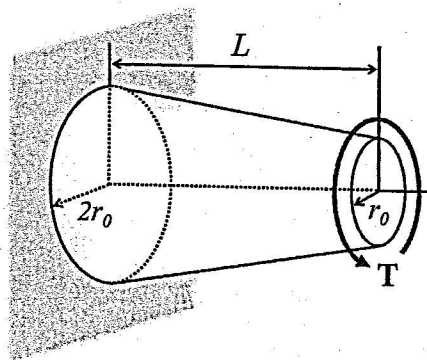


Fig. 6

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*請在【答案卷】作答

7. [12 Points] Compare ductile materials and brittle materials in terms of their behavior in a tensile test. What are the main differences between them, and how do these differences influence engineering design? You must answer this question in English.