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 109 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：1301

考試科目：工程力學（含材力、靜力、動力）

—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. 作答中如有發現試題印刷不清，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. 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。

國立清華大學 109 學年度碩士班考試入學試題

系所班組別：動機系 丙組

考試科目（代碼）：工程力學 (1301)

 *請在【答案卷、卡】作答

1. As shown in Fig. 1, an accessory belt for an engine is shown in which pully A is attached to the engine's crankshaft and rotates clockwise. The belt tensioner consists of a frictionless idler pulley at B which is mounted to a horizontal bar D that cab slide in a frictionless track with the horizontal force P. The pulley C operates a hydraulic pump that requires 200 Nm torque. The coefficients of static friction for pulleys A and C are 0.4 and 0.6, respectively. The radii of pulleys A and C are 110 mm and 80 mm, respectively. Please determine the minimum value of P so that the belts does not slip. (25%)

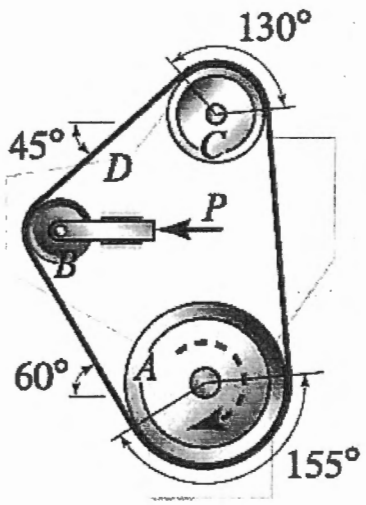

Fig. 1

2. As shown in Fig. 2, the platform scale consists of a combination of third and first class levers so that the load on one lever becomes the effort that moves the next lever. Through this arrangement, a small weight can balance a massive object. If x = 450 mm and, the mass of the counterweight S is 2 kg, determine the mass of the load L required to maintain the balance. (25%)

國立清華大學 109 學年度碩士班考試入學試題

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　　*請在【答案卷、卡】作答

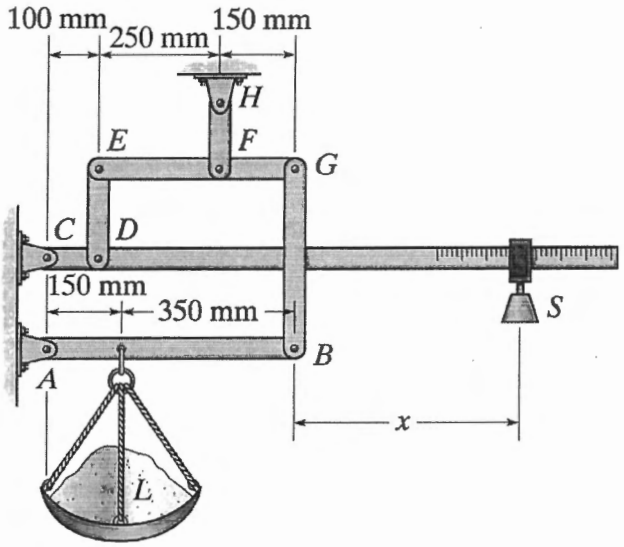

Fig. 2

3. The 4-kg disk shown in the Fig. 3 rests on a smooth horizontal surface and is attached to an elastic cord that has a stiffness k_c = 14 N/m and is initially unstretched. If the disk is given a velocity $(v_D)_1$ = 2 m/s, perpendicular to the cord, determine the rate at which the cord is being stretched and the speed of the disk at the instant the cord is stretched 0.25 m. (25%)

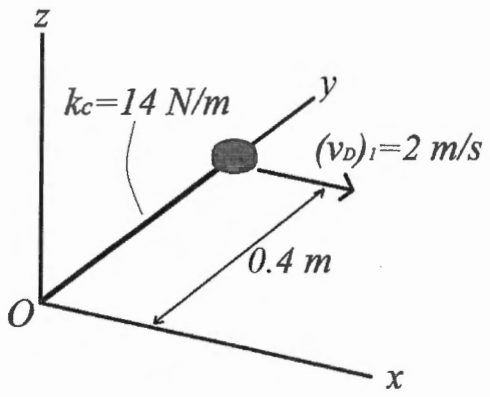

Fig. 3

國立清華大學 109 學年度碩士班考試入學試題

系所班組別：動機系 丙組

考試科目（代碼）：工程力學 (1301)

4. The 20-kg homogeneous disk shown in Fig. 4 is attached to a uniform 10-kg rod AB. If the assembly is released from rest when θ=60°, determine the angular velocity of the rod when θ=0°. Assume that the disk rolls without slipping. Neglect friction along the guide and the mass of the collar at B. (25%)

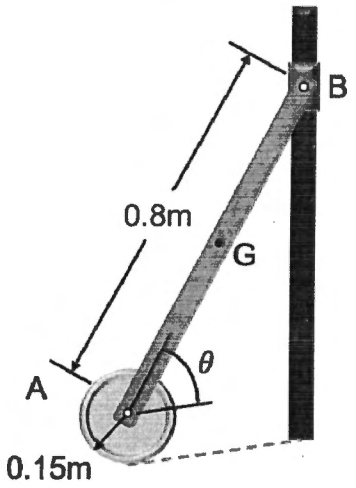

Fig. 4

5. As shown in Fig. 5, you're given a task to design diameter of the solid circular shaft in automobile transmission system as shown in the figure. Due to space constraints, R&D team has decided to locate ideal bearings at A and B and length of the shaft to transmit forces as shown in the figure through pulleys at C and D. The ideal bearing at A supports vertical and axial forces whereas the ideal bearing at B supports only vertical forces. You may model pinned boundary conditions at A and B. To find out the proper diameter of the shaft, please complete the following items and questions.

(a) Draw the shear-force and bending moment diagrams along the shaft's axial direction. (10%)

(b) What and where are the absolute maximum shear force and absolute maximum moment inside the shaft ? (5%)

(c) You're advised that allowable bending stress is σ_{allow} = 160 MPa. What is the smallest closest allowable diameter of the shaft ? (5%)

(d) With the shaft diameter you obtained in (c), what are the axial, torsion and bending displacements at D ? (5%)

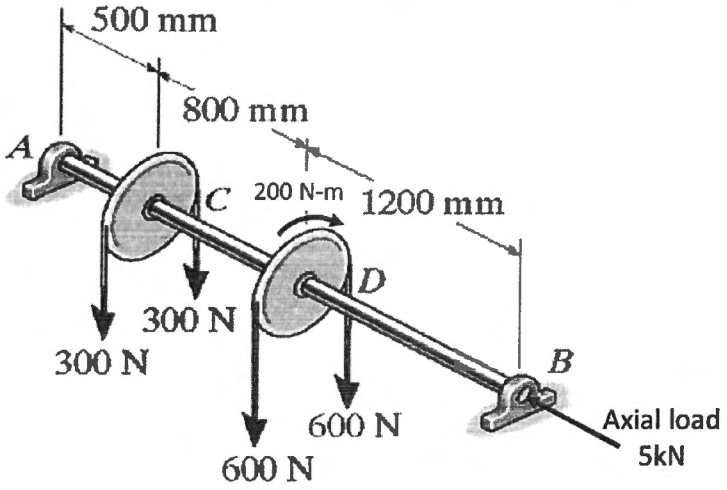

Fig. 5

6. As shown in Fig. 6, if the bearing pads at A and B support only vertical forces, determine the greatest magnitude of the uniform distributed loading w that can be applied to the beam. The beam is made of a material having an allowable normal stress of 15 MPa and an allowable shear stress of 1.5 MPa. (25%)

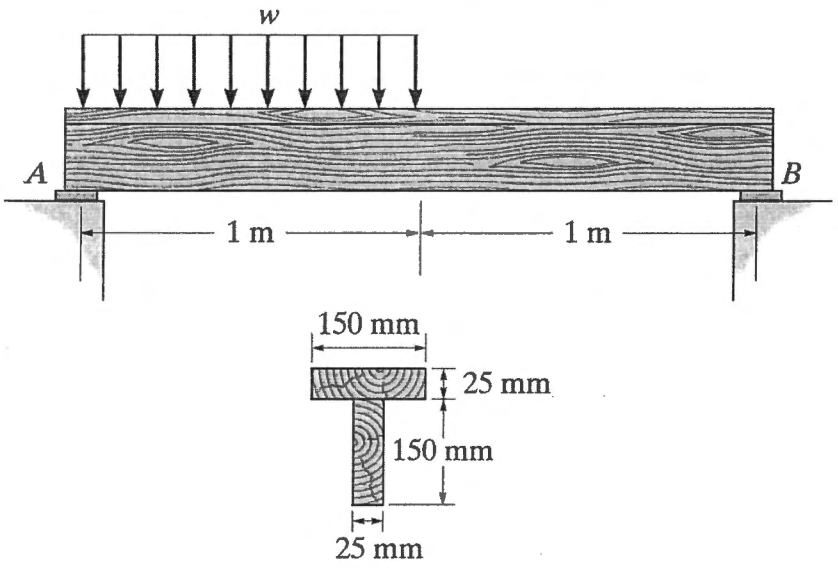

Fig. 6