



## **SEAGOING ENGINEER OFFICER CLASS 1**

### **CERTIFICATE OF COMPETENCY**

#### **APPLIED MECHANICS**

*Time allowed: 3 hours*

#### ***INSTRUCTIONS :-***

This paper consists of NINE questions where

Candidates are required to attempt ANY SIX questions.

All questions carry equal marks.

*Pass marks: 50 %*

***CANDIDATES ARE NOT ALLOWED TO WRITE ON OR DEFACE THIS PAPER***

***This paper consists of this page and FOUR other printed pages.***

**Notes to Candidates:-**

- i) Write down your name in the top right-hand corner on the first page of the answer sheets.
- ii) Write down the question number in the top left-hand corner on each page.
- iii) Answer each question on a new page.
- iv) No need to copy the questions' details onto the answer sheets.
- v) **Switch off all your mobile phones and communication devices when in the examination room.**
- vi) **Return all the question paper(s), the used and unused answer sheets before leaving the examination room.**
- vii) **Do not disturb other candidate(s) in the examination room.**
- viii) **Do not attempt to take any photos or recordings of any question papers and/or answer sheets.**
- ix) The progress of the examination is being recorded by close-circuit television (CCTV) and voice recorders in the examination room.

**If the above rules from item v) to viii) are infringed, candidates will be regarded as having failed the examination as a whole and will not be accepted for re-examination for such period as may be decided by the Director.**

**考生注意事項：-**

- i) 在答題紙首頁右上角寫上姓名。
- ii) 在每頁答題紙的左上角標明回答的問題題號。
- iii) 每一條問題另開新頁作答。
- iv) 不需要抄寫問題到答題紙上。
- v) 進入試場後，把手機及所有通信設備關閉。
- vi) 離開試場前，交回所有試卷、所有用過和未用過的答題紙及草稿紙。
- vii) 試場內不可干擾其他考生。
- viii) 切勿嘗試拍攝或錄取任何試卷或答案。
- ix) 考試期間試場內會有閉路電視(CCTV)和錄音系統進行記錄。

**如果違反上述 v) 至 viii) 規則，即當作所有考試不及格，以及在處長決定的期間內不得重考。**

1. In a four-ram electric-hydraulic steering gear, the relief bypass valves are set to lift when the oil pressure is 75 bar. The diameter of the rams is 300 mm, distance from centre of rudder stock to centerline of each pair of rams is 760 mm, and the maximum angle of helm is 35 degrees from mid-position. The tiller arms are parallel round section from the end to 560 mm from the rudder stock centre, and the maximum bending stress in them may be taken as occurring at this section.

Calculate

- (a) the diameter of the rudder stock to limit the maximum torsional stress to  $75 \text{ MN/m}^2$ ; and
  - (b) the diameter of the tiller arms to limit the maximum bending stress to  $105 \text{ MN/m}^2$ .
2. A siphon has a uniform circular bore of 75 mm diameter and consists of a bent pipe with its crest 1.8 m above water level discharging into the atmosphere at a level 3.6 m below water level. Find the velocity of the flow, the discharge and the absolute pressure at crest level if the atmospheric pressure is equivalent to 10 m of water. Neglect losses due to friction.
3. (a) State the advantages and disadvantages of an open-loop control system.
  - (b) An engineering organization system is composed of major function groups, such as management, research and development, preliminary design, experiments, product design and drafting, fabrication and assembling, and testing. These groups are interconnected to make up the whole operation.

The system may be analysed by reducing it to the most elementary set of components necessary which can provide the analytical detail required and by representing the dynamic characteristics of each component by a set of simple equations. Draw a block diagram showing the engineering organization system.

4. As shown in Fig.1, with the assumption of no slipping, determine the mass of the block ( $M$ ) which must be placed on the top of the 6 kg cart in order that the system period is 0.75 second. What is the minimum coefficient of static friction for which the block will not slip relative to the cart if the cart is displaced 50 mm from the equilibrium position and released (Assume no friction on the ground)? Draw the free body diagrams.

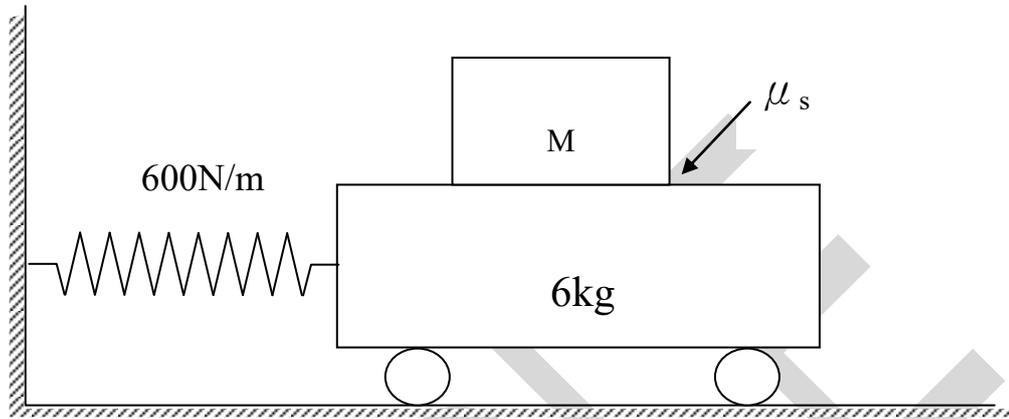


Fig.1

5. A uniform ladder weighting 200 N is propped against a smooth wall as shown in Fig.2. The ladder is in equilibrium and the coefficient of friction ( $\mu$ ) = 0.4 for the ground. If a man of weight 800 N starts to climb the ladder, how far up the ladder will he reach before the ladder starts to slip?

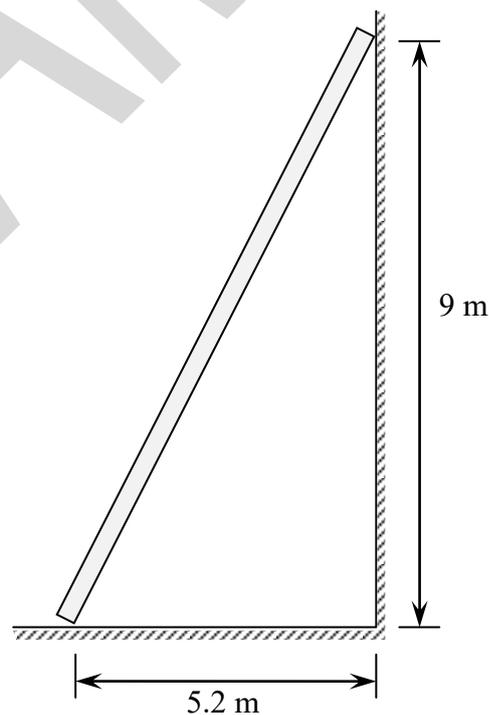


Fig.2

6. A solid shaft is to transmit 750 kW at 200 rev/min. If the shaft is not to twist more than  $1^\circ$  on a length of twelve diameters ( $l = 12d$ ) and the shear stress is not to exceed  $45 \text{ MN/m}^2$ , calculate the minimum shaft diameter required.  
(modulus of rigidity  $G = 84 \text{ GN/m}^2$ )

7. A beam carries a dead load of 200 kg and is subject to a vertical force of 2 kN and to an inclined force of 1 kN acting at the points shown in Fig. 3. The beam is 'encastre', i.e. built-in to a wall, at each end, and due to the fixing there are moments of 2 kN m and 1.6 kN m acting in the directions shown. Find the reactions R, L and H.

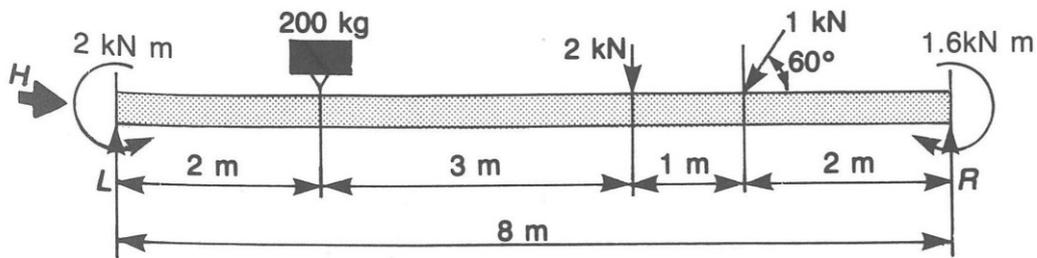


Fig.3

8. A dashpot consists of a cylinder 7 cm diameter in which slides a piston 8 cm long having a radial clearance of 1 mm. The cylinder is filled with an oil of viscosity 1 poise. Calculate the velocity of the piston when acted upon by a load having a mass of 18 kg.  
(Remark: 1 poise =  $0.1 \text{ kg/ms}$ )

9. A cam-operated exhaust valve opens vertically with a lift of 50 mm, its motion being simple harmonic. The valve is opened and closed during  $95^\circ$  of camshaft movement. The mass of the valve is 1.1 kg, and there is a spring force at the highest and lowest positions of the valve of 1,000 N and 150 N, respectively.

The camshaft speed is 300 rev/min; calculate:

- the maximum velocity of the valve;
- the maximum acceleration of the valve; and
- the force between the cam and the valve when it is at the top and when it is at the bottom of its travel.

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