



SEAGOING ENGINEER OFFICER CLASS 2

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. (a) A train of mass 400 tonnes moves up an incline of 1 in 100. At a given instant the speed is 20 m/s. If the resistance is 10 N per tonne calculate the effort and the power required at this instant.
(b) A locomotive starts from rest accelerates uniformly at 1 m/s^2 until a constant of 90 km/h is reached. After travelling at a constant speed for $1 \frac{1}{2}$ minutes the locomotive begins decelerate uniformly at 1.25 m/s^2 . Determine the distance between two stations.

2. A bar of copper 40 mm diameter and 500 mm long is firmly fixed at each end so that it cannot expand. If it is now heated through 50°C of temperature, find the stress, the strain and the equivalent load. Take the values for copper.
Modulus of Elasticity = 125 GN/m^2
Coefficient of main expansion = $18 \times 10^{-6}/^\circ\text{C}$.

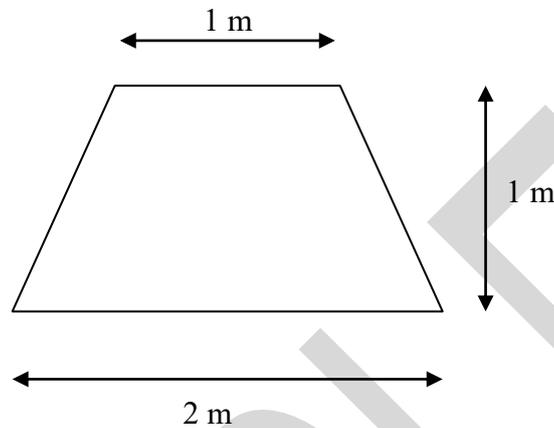
3. A uniform ladder 5 m long and 14 kg mass is placed against a vertical wall at an angle of 50° to the horizontal ground. The coefficient of friction between ladder and wall is 0.2, and between ladder and ground it is 0.5. Calculate the reactions at the wall and the ground if a man of mass 63 kg climbs up the ladder a distance 3.3 m when it is at the point of slipping.

4. (a) A stone is thrown vertically upwards from ground level with an initial velocity of 16 m/s. Find the maximum height the stone will reach and the total time taken from leaving the ground to returning to ground.
(b) A locomotive starts from rest accelerates uniformly at 1 m/s^2 until a constant of 90 km/h is reached. After travelling at a constant speed for $1 \frac{1}{2}$ minutes the locomotive begins decelerate uniformly at 1.25 m/s^2 . Determine the distance between two stations.

5. The uniform and symmetrical cross section of a horizontal tank is shown below. The tank is 3 m long with vertical ends and sloping sides.

When the tank is filled up with sea water of density $1,025 \text{ kg/m}^3$, determine:

- (a) the load on the tank bottom, and
 (b) load on each vertical end.



6. A straight length of copper steam pipe 450 mm long connects two components. Find the stress in the pipe if heated through 140°C and the expansion is restricted to 0.8 mm, taking the values:

Coefficient of linear expansion = 17×10^{-6} per $^\circ\text{C}$

Modulus of elasticity = 103 GN/m^2

7. A circular door 1.5 m diameter lies at 35° below the horizontal and its upper edge is 1 metre below the surface of the water (density $1,000 \text{ kg/m}^3$). Calculate the hydrostatic load on the door and the position of the centre of pressure.

$$(I_G = \frac{\pi D^4}{64} \text{ for a circle})$$

8. A balloon rises vertically at a uniform speed of 8 m/s. When a height of 100 m is reached one ballast weight is released. Find the time taken for the ballast to reach the ground.

9. Calculate the final velocities of two objects, when they are moving on a frictionless surface, following an elastic collision, given that
 $m_1 = 0.500 \text{ kg}$, $m_2 = 3.5 \text{ kg}$, $v_1 = 4.00 \text{ m/s}$, and $v_2 = 0$

- END -

SAMPLE