

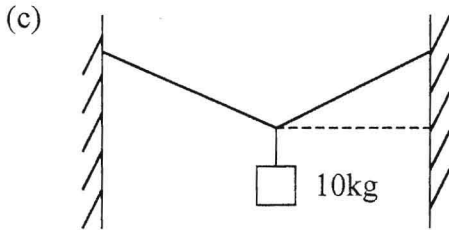
NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF APPLIED CHEMISTRY
END OF SECOND SEMESTER EXAMINATIONS – APRIL/MAY 1999
MECHANICAL ENGINEERING – SCH 2205
TIME: THREE HOURS

INSTRUCTIONS TO CANDIDATES:

Answer ANY FIVE questions. Total marks = 100

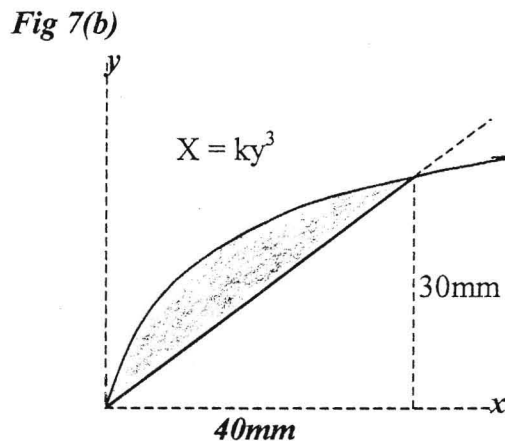
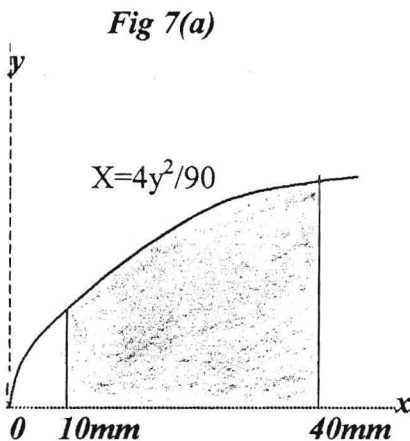
1. (a) Define the following terms with respect to the :
- (i) strength of materials
 - (ii) flexural modulus
 - (iii) modulus of rupture
 - (iv) modulus of rigidity (10 marks)
- (b) A three-point bend test is performed on a block of silicon carbide that is 10 cm long, 1.5 cm wide and 0.6 cm thick and is resting on two supports 7.5 cm apart. The sample breaks after a deflection of 0.09 mm is recorded. The flexural modulus of silicon carbide is 480 GPa . Assuming no plastic deformation occurs, calculate:
- (i) the force that caused the fracture.
 - (ii) The flexural strength of SiN₃ (10 marks)
2. (a) State the *four* elastic constants and give the relation between *any three* of them. (6 marks)
- (b) (i) What is meant by the resolved shear stress? (4 marks)
- (ii) A force of 660N is applied in the [111] direction of a cubic crystal. What is the resolved force in the [110] direction? (10 marks)
3. (a) An aeroplane travelling horizontally at 150m/sec at an altitude of 600m is to drop a package on a target that is at ground level.
- (i) At what horizontal distance from the target must the package be released? (4 marks)
 - (ii) How long is the package in flight? (4 marks)
 - (iii) With what velocity does it strike the ground? (4 marks)
 - (iv) What is the displacement of the target area relative to the aeroplane at the moment the target is released? (4 marks)
- Assume no air resistance.

3. (b) What is the difference between static and dynamic friction? Of what importance is friction in industry. (4 marks)
4. (a) Determine the centre of mass of a uniform rectangular plate. (5 marks)
- (b) What is the moment of inertia of a thin rod of length L and mass M with respect to an axis of rotation that is perpendicular to the rod and passes through the centre of the rod. (5 marks)



A 10kg weight is suspended from the centre of a massless rope. The rope sags making an angle of 10° with the horizontal. What is the tension in the rope segments. (10 marks)

5. A stone is dropped from the top of a tower of unknown height h . At the instant it has fallen c metres, a second stone is released from rest from a point b metres below the top of the tower (b is greater than c). The two stones strike the ground at the same time. Determine the height of the tower. (20 marks)
6. A ladder 6m long weighing 300N is resting against a wall at an angle of 60° to the horizontal ground. A man weighing 750N climbs the ladder. At what position along the ladder from the bottom does he induce slipping. The coefficient of friction for both the wall and the ground with the ladder is 0.2. (20 marks)
7. Calculate the moment of inertia of the shaded areas for both Fig 7 (a) and 7 (b).



(10 marks)

END OF QUESTION PAPER!!!