



MACHAKOS UNIVERSITY COLLEGE

(A Constituent College of Kenyatta University)

University Examinations for 2015/2016

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

FIRST SEMESTER EXAMINATION FOR DEGREE IN BACHELOR OF SCIENCE IN CIVIL
ENGINEERING

ECV 202: FLUID MECHANICS 1

Date: 9/12/2015

Time: 8:30 – 10:30 AM

INSTRUCTIONS:

- *This paper comprises five questions*
- *Answer question one and any other two questions*
- *All the optional questions carry equal marks*

QUESTION ONE (30 MARKS)

- a) A litre of petrol has a specific gravity of 0.7. Calculate its:
- i) density (2 marks)
 - ii) specific weight (2 marks)
 - iii) weight (1 mark)
- b) The velocity profile of a fluid whose viscosity is 8.5 Poise, over a plate is parabolic with a vertex 20 cm from the plate where the velocity is 120 cm/s; at distances 0, 10 and 20 centimeters from the plate, calculate:
- i) the velocity gradients (3 marks)
 - ii) shear stresses. (2 marks)
- c) Calculate the pressure exerted by 5kg of Nitrogen gas at temperature of 10^0C if the volume is 0.4 m^3 . Molecular weight of Nitrogen is 28. Assume ideal gas laws are applicable. (5 marks)
- d) Calculate the bulk modulus of elasticity of a liquid which is compressed in cylinder from a volume of 0.0125 m^3 at 80N/cm^2 pressure to a volume of 0.0124 m^3 at 150N/cm^2 pressure. (5 marks)

- e) Find the surface tension in a soap bubble of 40mm diameter when the inside pressure is 2.5 N/m^2 above atmospheric pressure. (5 marks)
- f) i) State Bernoulli's theorem for steady flow of an incompressible fluid. (2 marks)
 ii) Derive the expression for Bernoulli's equation from first principles (2 marks)
 iii) state two assumptions made for such a derivation. (1 mark)

QUESTION TWO (20 MARKS)

The diameters of the small and large pistons of a hydraulic jack are 3 cm and 10 cm respectively. A force of 80N is applied on the small piston. Find the load lifted by the large piston when:

- (i) The pistons are at the same level. (10 marks)
 (ii) The small piston is 40 cm above the large piston (10 marks)

Take the density of the liquid in the jack as 1000 kg/m^3 .

QUESTION THREE (20 MARKS)

Find the density of a metallic body which floats at the interface of mercury of specific gravity 13.6 and water such that 40% of its volume is submerged in mercury and 60% in water.

QUESTION FOUR (20 MARKS)

A body has the cylindrical upper portion of 3m diameter and 1.8 m deep. The lower portion is a curved one, which displaces a volume of 0.6 m^3 of water. The Centre of buoyancy of the curved portion is at a distance of 1.95 m below the top of the cylinder. The Centre of gravity of the whole body is 1.20 m below the top of the cylinder. The total displacement of water is 3.9 tones. Find the meta-centric height of the body.

QUESTION FIVE (20 MARKS)

A 30 cm diameter pipe, conveying water branches into two pipes of diameters 20 cm and 15 cm respectively. If the average velocity in the 30 cm diameter pipe is 2.5 m/s, find

- i) the discharge in this pipe. (10 marks)
 ii) determine the velocity in the 15 cm diameter pipe if the average velocity in 20 cm diameter pipe is 2 m/s. (10 marks)