Machakos University

(University Examinations 2018/2019)

SCHOOL OF ENGINEERING

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

FIRST YEAR SECOND SEMESTER EXAMINATION FOR DIPLOMA IN MECHANICAL ENGINEERING MODULE 1(TVET)

MECHANICAL ENGINEERING SCIENCE.

DATE: **TIME:2HRS 30MIN**

INSTRUCTIONS

This paper contains FIVE questions

Answer all questions.

QUESTION ONE.

(a) Define the following terms with reference to lifting machines

(i) Mechanical advantage. (2marks)

(ii) Velocity ratio. (2marks)

(iii) Efficiency (2marks)

(b) The law connecting the effort (E) and the load (W) of a lifting machine is E=Aw+b where a and b are constants.The machine has a velocity ratio of 40.The efficiencies when lifting loads of 2000N and 8000N are 25% and 40% respectively.The maximum permitted load on the machine is 18000N.By determining the constants a and b,Find the efficiency of the machine when lifting its maximum load. (6marks)

(c) (i) During a lifting operation an effort of 200N was found to lift a load of 1200N while an effort of 250N lifted a load of 2500N.Given that the velocity ratio of the machine is 30, Determine;

(i) The law of the machine (2marks)
(ii) The limiting mechanical advantage (2marks)
(iii) Effort and efficiency when lifting a load of 2000N (4marks)

QUESTION TWO.

(a) A lifting machine has a velocity ratio of 4 and can lift a load of 981N when the effort applied is 327N.Find;

(i) The efficiency

(ii) Effort to overcome friction at this load.

(iii) The work done against friction when the load is lifted 2m. (9marks)

(b) The table below shows the values of load- effort during a test series of a lifting appliance.The velocity ratio of the machine was 3.Draw a graph of effort against load and determine;

(i) The law of the machine

(ii) Limiting efficiency (11marks)

QUESTION THREE.

(a) A Vehicle having a mass of 2000kg accelerates uniformly from 27km/h to 72km/h in 20 seconds.Calculate the force required,the total work done and the power developed in producing this acceleration (6marks)

(b) A lathe rotates at 60rev/min while turning a 150mm diameter cylinder.The force on the tool is 2.4KN and the efficiency of the lathe is 80%.Determine the power required to drive the motor. (6marks)

(c) A Vehicle having a mass of 1600kg increases its speed uniformly from 36km/h to 72km/h by the action of an accelerating force of 2.4KN. By how much will its kinetic energy have increased during the acceleration period.Show that this increase in K.E is equal to the work done by the accelerating force. (8marks)

QUESTION FOUR.

(a) A Steel component having a mass of 20kg and a temperature of 700c is dropped into a tank containing 40kg of water at 15^0c.Neglecting the energy absorbed by the tank and any losses of heat energy to the surrounding air determine;

(i) The final temperature of the water
(ii) The heat energy absorbed by the water

(Take specific heat capacities of steel and water as 0.48KJ/KgK and 4.2 KJ/KgK respectively. (10marks)

(b) Calculate the amount of heat required to convetr 0.5kg of ice at -20^0c into steam at 100^0c. (10marks)

QUESTION FIVE.

(a) State the following laws with reference to gas laws.

(i) Boyle's law
(ii) Charles law
(iii) Pressure law (6marks)

(b) A gas whose original pressure and volume were 350KN/m^2 and 0.15m^3 respectively is expanded until its new pressure is 50 KN/m^2 with its temperature remaining constant.Calculate its new volume. (4marks)

(c) At the start of the first stage of compression process, the volume of a gas was 450 litres,absolute pressure 120KPa and Temperature 80^0c.At the end of this stage the volume was110 litres and temperature 140^0c.The gas was then compressed during the second stage at constant pressure to a volume of 50 litres.Determine the;

(i) Pressure at the end of first stage.

(ii) The temperature at the end of second stage. (10marks)