



MACHAKOS UNIVERSITY

University Examinations for 2021/2022

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL ENGINEERING

FIRST YEAR FIRST SEMESTER EXAMINATION FOR

CRAFT CERTIFICATE IN AUTOMOTIVE ENGINEERING

APPLIED SCIENCE

DATE:

TIME:

INSTRUCTIONS: ANSWER ALL QUESTIONS

QUESTION ONE.

- (a) Define the following terms, stating their units of measurement.
- (i) Power.
 - (ii) Potential Energy
 - (iii) Work
- (6 marks)
- (b) A car of mass 750kg is travelling on a level road at a constant speed of 15km/h. It is accelerated uniformly to a speed of 85km/h in 30 seconds. Neglecting frictional resistance or effects, Determine;
- (i) The work done. (4 marks)
 - (ii) Power Supplied. (4 marks)
- (c) A vehicle hauls a trailer at 72km/h when exerting a steady pull of 800N at the tow rope. Calculate the work done in 20 minutes and power required to tow the trailer.
- (6 marks)

QUESTION TWO

- (a) State the law of conservation of energy. (2 marks)
- (b) 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. Determine the increase in kinetic energy of the vehicle during the acceleration period. (7 marks)

- c) An Engine has mass of 150kg and is suspended from a crane by a sling 4m above the ground.
- Determine the potential energy of the engine. (3 marks)
 - Due to a fault in the sling the engine falls freely to the ground from that height. Calculate the velocity and kinetic energy of the engine at the point of impact with the ground. (4 marks)
 - Determine the kinetic and potential energy of the engine after falling 3m. (4 marks)

QUESTION THREE

- (a) Define the following terms with reference to lifting machines
- Mechanical advantage. (2 marks)
 - Velocity ratio. (2 marks)
 - Efficiency (2 marks)
- (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. (6 marks)
- (c) 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;
- The law of the machine (2 marks)
 - The limiting mechanical advantage (2 marks)
 - Effort and efficiency when lifting a load of 2000N. (4 marks)

QUESTION FOUR

- (a) A lifting machine has a velocity ratio of 4 and can lift a load of 981N when the effort applied is 327N. Find;
- The efficiency
 - Effort to overcome friction at this load.
 - The work done against friction when the load is lifted 2m. (9 marks)
- (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;
- The law of the machine
 - Limiting efficiency (11 marks)

LOAD (N)	14	28	42	56	70	84
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EFFORT (N)	14.5	20.5	26	32	38.5	44.5
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QUESTION FIVE.

(a) In a certain weight lifting machine a weight of 1 kN is lifted by an effort of 25N. While the weight moves up by 100 mm, the point of application of the effort moves up by 8m. Find;

(i) The mechanical advantage.

(ii) Velocity ratio.

(iii) Machine efficiency.

(6marks)

(b) In a chain-operated lifting gear, the chain moves 6 m when lifting an engine through a vertical distance of 100 mm. The mass of the engine is equivalent to a force of 4kN. If the steady pull exerted by the operator was 200 N, Calculate;

(i) The movement ratio.

(ii) The force ratio

(iii) The efficiency of the machine.

(6marks)

(c) The table below shows the data obtained from a test on a hoisting gear whose velocity ratio is 3.

Load W (kN)	1.4	3.5	5.6	7.4	10.0	11.4	13.4	16
Effort E (kN)	1.0	1.75	2.5	3.1	4.0	4.5	5.25	6.1

Draw the effort-load graph, hence determine the;

(i) Law of the machine

(ii) Efficiency at a load of 6.4kN

(iii) Friction effort.

(8marks)