MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR

FIRST YEAR FIRST SEMESTER
SUPPLEMENTARY/SPECIAL EXAMINATIONS FOR THE DIPLOMA
IN
MECHANICAL AND INDUSTRIAL ENGINEERING

COURSE CODE: DME 052/DCE051/DBC051

COURSE TITLE: PHYSICS

DATE: Monday 25th July, 2022   **TIME: 8.00 – 10.00am**

INSTRUCTIONS TO CANDIDATES

Answer Question **ONE** and any other **TWO** questions

TIME: 2 Hours

    a) Define the following units as used in physics

i. Micron

ii. Angstrom

iii. Light Year

iv. Fermi

v. Atomic Mass Unit   **(5MKS)**

    b) Given the following SI units derive their dimensional formulas

i. N/M^2

ii. Joule (J)

iii. Watt   **(3MKS)**

    c) A physical quantity P is related to four observable a, b, c and d as follows: $= \frac{a^3 b^3}{d\sqrt{c}}$. The percentage errors of measurement in a, b, c and d are 1%,3%,4% and 2%, respectively. What is the percentage error in the quantity P?   **(4MKS)**

    d) Derive the 3 equations of linear motions   **(8MKS)**

    e) A car starts from rest and accelerates at a constant acceleration of $3m/s^2$ for 10 seconds. The car then travels at a constant velocity for 5 seconds. The breaks are then applied and the car stops in 5 seconds, what is the total distance travelled by the car? **(4MKS)**

    f) A man pulls a garden roller of mass 200kg with a force of 400N acting at 45° to the horizontal. If there is a frictional force of 150N between the roller and the ground, what is the acceleration of the roller along the ground?   **(3MKS)**

    g) A block slides down a 30-degree inclined starting from rest

i. What is the acceleration of the block?

ii. What is the final speed of the block after it travels 200m the inclined.   **(3MKS)**

**QUESTION TWO**   **20MKS**

    a) A wheel of diameter 540mm is rotating at $(1500/\pi)$rev/min, Calculate the angular Velocity of the wheel and the linear velocity of a point on the rim of the wheel.

    b) A car is travelling at 64.8km/h and has wheels of diameter 600mm

i. Find the angular velocity of the wheels in both rad/s and rev/min   **(3MKS)**

ii. If the speed remains constant for 1.44km, determine the number of revolutions made by a wheel, assuming no slipping occurs   **(3MKS)**

c) A conical pendulum rotates at a horizontal angular velocity of 5 rad/s. If the length of the string is 2m and the pendulum mass is 0.3kg, determine the tension in the string. Determine also the radius of the turning circle. Take g as $9.81m/s^2$ **(4MKS)**

d) Show that from a Pendulum; $\omega = \sqrt{\frac{g}{h}}$ **(10MKS)**

a)   A body has a mass of 30g and is moving with a velocity of 20m/s. It collides with a second body which has a mass of 20g and which is moving with a velocity of 15m/s. Assuming that the bodies both have the same velocity after impact, determine this common velocity

  i.   When the initial velocities have the same line of action and the same sense   **(3MKS)**
  ii.   When the initial velocities have the same line of action but are opposite in sense   **(3MKS)**

b)   A pile driver of mass 500kg falls freely through a height of 1.5m on to a pile of mass 200kg. Determine the velocity with which the driver hits the pile. If, at impact, $3KJ$ of energy being possessed by the pile and driver as they are driven together into the ground a distance of 200mm, determine

    i.   The common velocity immediately after impact
    ii.   The average resistance of the ground   **(11MKS)**

c)   State **THREE** types of inertia   **(3MKS)**

a)   A 90kg mountain climber is suspended as shown below, Rope 1 and Rope 2 are very strong, but rope 3 is only an anchoring rope, so it can only support 1500N before breaking. What is the smallest angle θ allowed before Rope 3 Snaps?
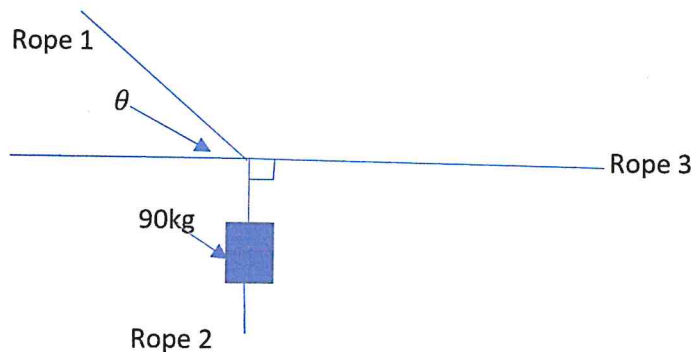
    i.   Draw a FBD of the climber, and calculate all forces   **(2MKS)**
    ii.   Draw a FBD of the knot and create an equation for F_{T3} in terms of θ **(4MKS)**
    iii.   Calculate the smallest angle θ allowed before Rope 3 snaps   **(4MKS)**

b)   ) A conical pendulum rotates about a horizontal circle at 90rpm. If the speed of rotation of the mass increases by 10% ,how much does the mass of the pendulum rise (in mm) Take g as $9.81m/s^2$ **(4MKS)**

c)   ) A wagon of mass 10 Tones is moving at a speed of 6m/s and collides with another wagon of mass 15 Tones, which is stationary. After impact, the wagons are coupled together. Determine the common velocity of the wagon after impact.   **(4MKS)**

d)   State TWO advantages of Frictional Force   **(2MKS)**