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GENERAL SIR JOHN KOTELAWALA DEFENCE UNIVERSITY
Faculty of Engineering
Department of Mechanical Engineering

BSc Engineering Degree
Semester 2 Examination – November 2022
(Intake 39- ENG)

ME 1222- APPLIED MECHANICS

Time allowed: 2 hours | 18 November, 2022

INSTRUCTIONS TO CANDIDATES

This paper contains from page 3 to page 7

Answer ALL questions

This is a closed book examination

This examination accounts for 70% of the module assessment. A total maximum mark obtainable is 100. The marks assigned for each question and parts thereof are indicated in square brackets

If you have any doubt as to the interpretation of the wordings of a question, make your own decision, but clearly state it on the script

Assume reasonable values for any data not given in or provided with the question paper, clearly make such assumptions made in the script

All examinations are conducted under the rules and regulations of the KDU

Question 01

(a) Using a suitable sketch, state the Varigons Theorem

(04 Marks)

(b) Three forces namely A, B, and C with magnitudes 450N, 300N and 500N respectively are represented in OXYZ space. The forces are acted upon at origin O, as given in Figure Q1. Notice that $\overrightarrow{OU}, \overrightarrow{OV}$ and $\overrightarrow{OW}$ are in X-Z plane.

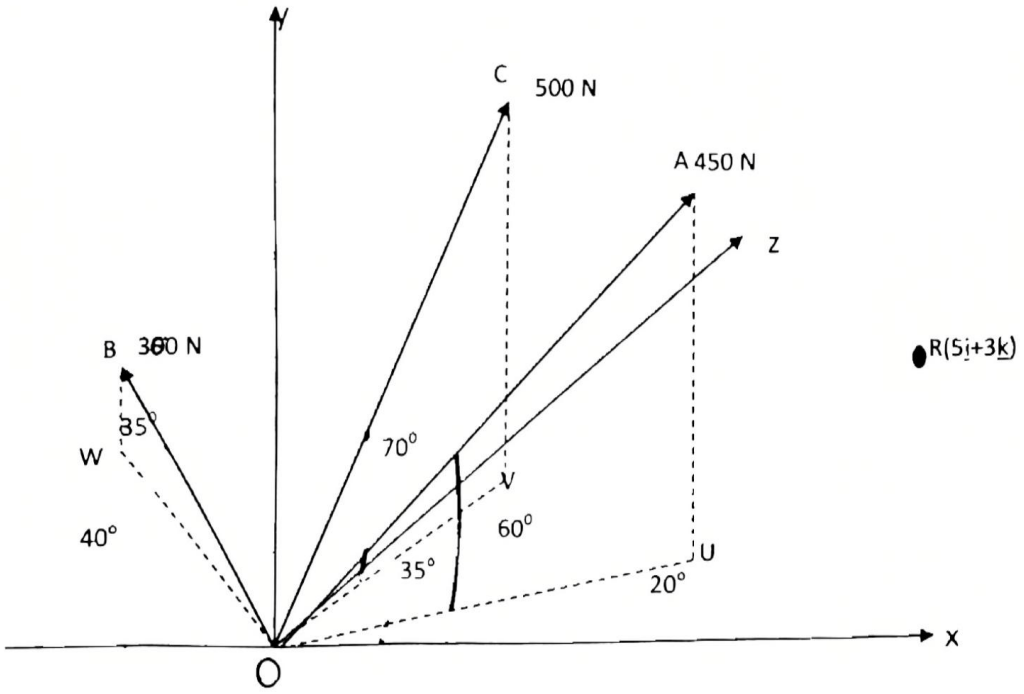

Figure Q1

i. Represent the forces A,B and C in rectangular components. **(06 Marks)**

ii. Calculate the moment M around point R (5i+3k) **(02 Marks)**

iii. Represent the system as a force couple system at R. **(04 Marks)**

iv. Represent the system as a force couple system at N (2i+4k) **(04 Marks)**

Question 02

A thin weightless rectangular plate is attached to a wall at F by using a pin and bracket. The pin joint allows it to rotate about C-D axis, as shown in figure Q2 the plate is kept perpendicular to the wall by using two cables AP and BQ. A weight W is placed on the plate at point E. If tension of the cable AP is 440 N, determine,

(a) The tension of the cable BQ 240
(b) The Weight W 520
(c) The Reaction at point F. 400

(20 Marks)

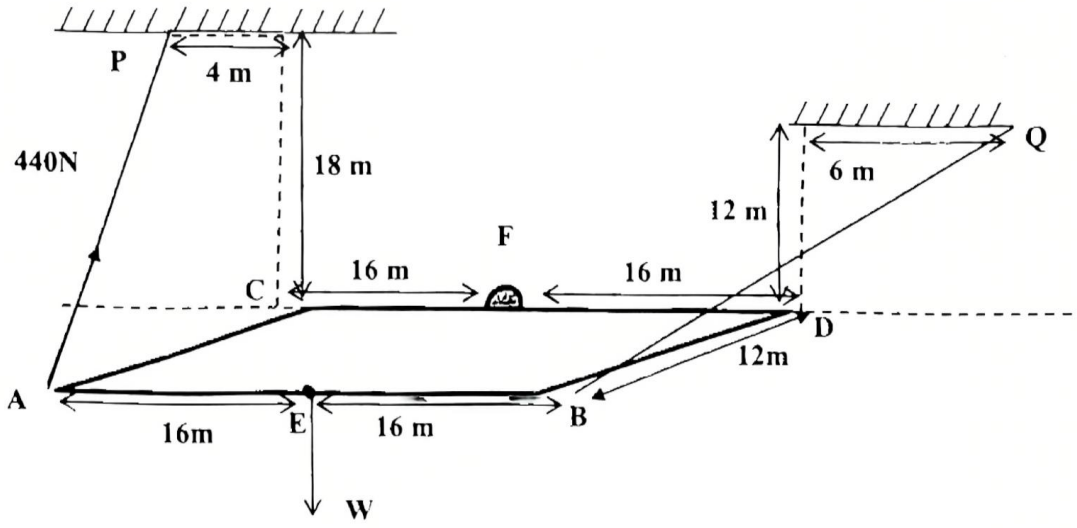

Figure Q2

Question 03

(a) Two pulleys of diameter 20 cm, can rotate about a fixed shaft of diameter 15cm. They are placed in the arrangement shown in figure Q 3.a. A weight of 900N is attached to one end of the cable, and a weight of W is attached to the other end of the cable. there is an unknown weight W. The coefficient of static friction between the pulleys and shafts are 0.10. Calculate the tension of the cable and W. **(06 Marks)**

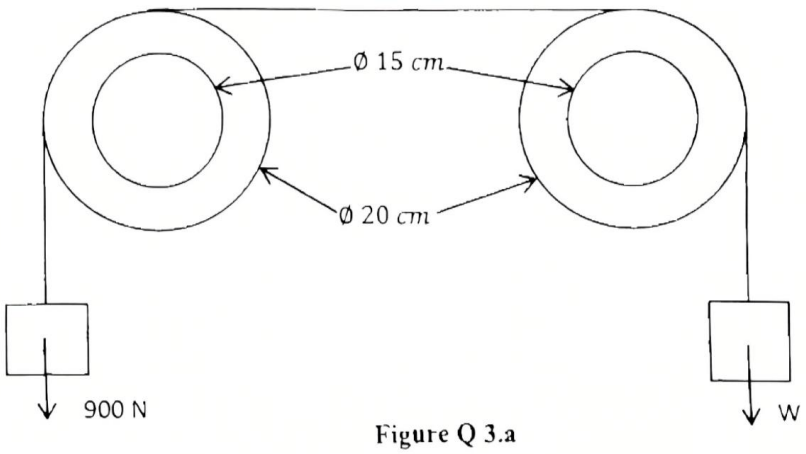

Figure Q 3.a

(a) Three blocks A,B and C with masses 10 kg, 6 kg and 4 kg placed on top of each other and block C is attached to a wall in the way shown in figure Q 3.b. Static friction coefficients of A and floor is 0.1, A and B is 0.2, B and C is 0.5. Determine the minimum force P that breaks the equilibrium of the system, and the tension of the cable in that point.

(14 Marks)

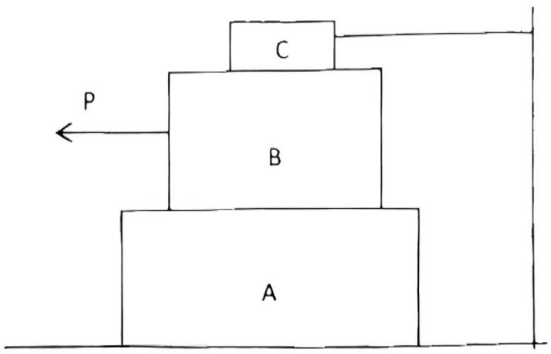

Figure Q 3.b

Question 04

(a) A Block of 500 g is hanged to a ceiling using two springs having constants 2.7 Nm^{-1} 1.8 Nm^{-1} as shown in figure Q4.a. The block is released 2 cm down from the equillibrium position.

(10 Marks)

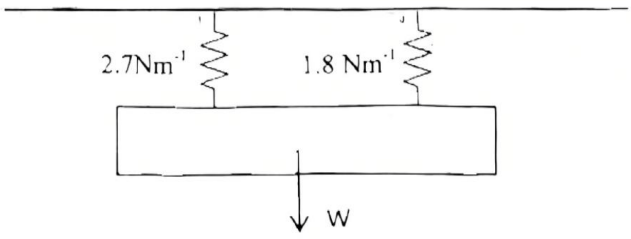

Figure Q 4.a

i. Calculate the period of the motion.

ii. Write the relationship of displacement with respect to time

iii. Calculate the maximum velocity.

(b) A mass is attached to 40 cm string hanging from the ceiling as shown in figure Q 4.b. The mass is released so that it exhibits simple harmonic motion.

i. Derive the relationship between the displacement angle θ and acceleration. (State the assumptions required) **(04 Marks)**

ii. Calculate the period of the motion **(02 Marks)**

iii. The approximated solution to period of the pendulum is given as equation 1, calculate the period of the pendulum for maximum θ at 10° and 30° (θ_m) **(4 Marks)**

$$\tau_{II} = \frac{2K}{\pi}\left(2\pi\sqrt{\frac{l}{g}}\right) \longrightarrow \text{Eq 1}$$

Table Q 4.b: Correction factor for the period of a simple pendulum

θ_m	0°	10°	20°	30°	60°	90°	120°	150°	180°
K	1.571	1.574	1.583	1.598	1.686	1.854	2.157	2.768	∞
$2K/\pi$	1.000	1.002	1.008	1.017	1.073	1.180	1.373	1.762	∞

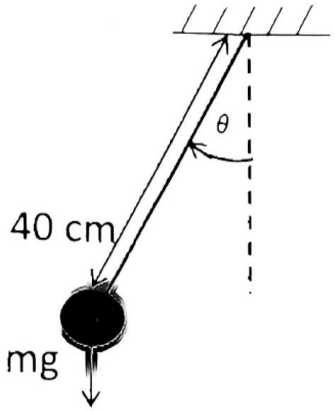

Figure Q 4.b

Question 05

(a) State the Pappus Goldinus theorem. **(04 Marks)**

(b) Find the centroid of the shaded area using integration. **(12 Marks)**

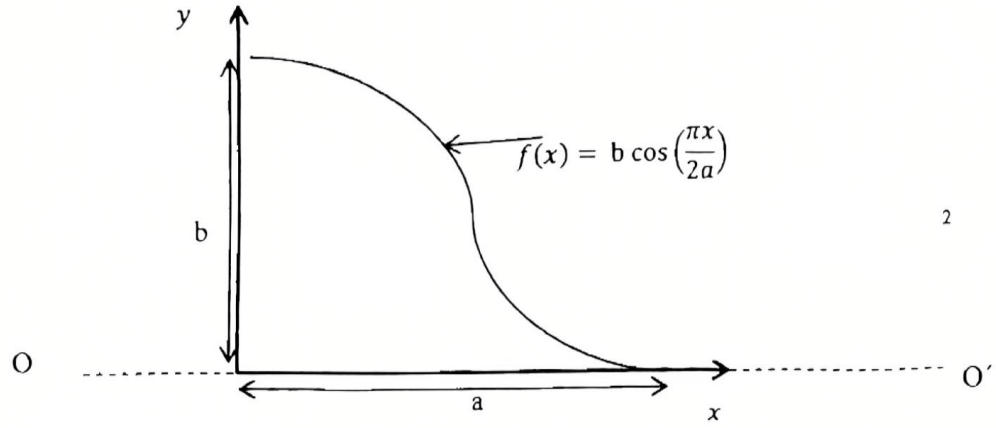

Figure 7

(c) Calculate the area of the solid achieved by rotating the above shape around **O-O′** axis.

(04 Marks)

End of question paper