(15)

(Knowledge for Development)

KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS

2017/2018 ACADEMIC YEAR

FIRST YEAR FIRST SEMESTER

SPECIAL/ SUPPLEMENTARY EXAMINATION

FOR THE DEGREE OF BACHELOR OF SCIENCE

MATHEMATICS

COURSE CODE: MAT 106

COURSE TITLE: APPLIED MATHEMATICS

DATE: 02/10/18 **TIME:** 3 PM -5 PM

INSTRUCTIONS TO CANDIDATES

Answer Question One and Any other TWO Questions

TIME: 2 Hours

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QUESTION ONE (30 MARKS)

a) Define the following (4mks)

i) Moment of inertia.

ii) Force couple

b) A brick rests on an inclined board with the coefficient of friction between the brick and the board being $\mu = 0.8$. One end of the board is lifted until the brick starts to slide. Determine the angle of inclination of the plank to the horizontal. (4mks)

c).A kite of mass 0.8 kg is attached to a fixed point on the ground by a string of length 40 metres and kept airborne by a lift force of 30 N from the wind. If the lift force is inclined at an angle of 60^0 to the vertical, at what height above the ground can the kite rest in equilibrium. (4mks)

d) Determine the acceleration of a 9000kg Lorry moving at 10m/s around a circle path with a radius of 25.0m. (3mks)

e) Particle A of mass 10kg travelling at 15 m/s collides head-on with B of mass 20kg which is at rest. After collision B moves away at 5m/s. Determine velocity of A after collision (4mks)

f) Determine the magnitude and direction of the resultant of two forces of magnitude 30N and 25N acting at a point if the angle between the two forces is 30^0 using parallelogram law of forces.

g) A block of mass 5kg attached to a spring undergoes simple harmonic motion with a period of T=0.5 sec. The total energy of the system is E=5.0 J Find (4mks)

a) Force constant of the spring.

b) Amplitude of motion.

h) calculate the power used when a force of 2kN pulls a crate along a level floor a distance of 10m in 50 seconds. (3mks)

QUESTION TWO (20 MARKS)

a) Define (2mks)

i) Periodic motion

ii) Simple harmonic motion

b) A student throws a block of metal on a spring scales which oscillates about the equilibrium position with a period of T=0.5 seconds. The amplitude of vibration A=2.0 cm and path length is 4.0cm. Find:

i) Frequency (2mks)

ii) Maximum acceleration (3mks)

iii) Maximum velocity (2mks)

c) A load of mass 200g stretches a spring by 10.0 cm. The spring is then stretched by 5.0cm and released. Determine:

i) The spring constant (2mks)

ii) Maximum acceleration (2mks)

iii) Velocity through equilibrium position. (2mks)

d) i) Define moment of inertia (1mk)

ii) Show that the radius of gyration for a uniform rod of length L rotating about its end is 0.577L from that end.

QUESTION THREE (20 MARKS)

a) Find the kinetic energy of a wheel rotating at 4 rads/s given the mass is 3kg and the radius of gyration is 0.2m. (4mks)

b) A stone of mass m falls from rest through a distance h, hitting the ground with speed v. Show how the principal of the conservation of mechanical energy applies. (4mks)

c. i) A 3 kg rock swings in a circle of radius 5m. If its constant speed is 8m/s. Determine ;

I) Centripetal acceleration (6mks)

II) Centripetal force

ii) A skater moves with 15m/s in a circle of radius 30m.The ice exerts a central force of 450 N. What is the mass of the skater? (3mks)

d) A load of mass 500g stretches a spring by 10.0 cm. The spring is then stretched by 5.0cm and released. Determine the spring constant. (3mks)

QUESTION FOUR (20 MARKS)

a) Define the terms (4mks)

i)Force

ii)Resultant Force

b)Given two forces F_1 and F_2 acting at a point O. Use parallelogram law of forces to show that $R = \sqrt{F_1^2 + F_2^2 + F_1^2 F_2^2 COS\alpha}$ Where R is the resultant force (5mks)

c) Given that $\vec{r} = \vec{i} + 3\vec{j} - 2\vec{k}$ and $\vec{F} = \vec{i} + 5\vec{j} - \vec{k}$. Find the momentum(M_O) using vector cross product (4mks)

d) Particle A of mass 1kg travelling at 5 m/s collides head-on with particle B of mass 2kg travelling at 2m/s. After collision B moves away at 3m/s. At what velocity will A move.

(4mks)

QUESTION FIVE (20 MARKS)

a) Define the following terms (2mks)

i) Couple

ii) Composition of force

b) A uniform plank 3 metres long is supported at a point under its mid-length. A lord of mass 10kg is placed at a distance of 0.5 metres from one end and a second load of mass 30kg placed at a distance of one metre from the other end. Find the resultant moment from the middle of the plank. (4mks)

c) A particle of mass 10kg is at limiting equilibrium on a rough plane which is inclined at an angle of 60^0 to the horizontal. Determine the coefficient of friction between the particle and the plane. (4mks)

d) A car of mass 800kg travelling at speed 15m/s skids on a road for a distance of 8m. When the driver regains control, the speed has been reduced to 10m/s.

i) Calculate the work done against frictional force between the tyres and the road. (4mks)

ii) Determine the magnitude of the frictional force. (3mks)

iii) Deduce the coefficient of friction between the tyres and the road. (3mks)