



KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2011/2012

SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE (MECHANICAL ENGINEERING)

EMM 211: ENGINEERING MECHANICS II(DYNAMICS)

DATE: MONDAY, 16TH APRIL 2012

TIME: 2.00 P.M – 4.00 P.M

INSTRUCTIONS

This paper contains FIVE questions

All questions carry EQUAL MAXIMUM marks

Attempt any THREE Questions

All symbols have their usual meaning unless specified wise

Use clear and net sketches

QUESTION ONE

- a) A particle moves along a straight line with acceleration $a = 4t - 30$, where a is in m/s^2 and t is in seconds. At $t=0$, the position of particle is -5 m and it has a velocity of 3 m/s. Determine:
- i) The expressions for velocity and position in terms of t ;
 - ii) The times at which the velocity is zero and their corresponding positions from the origin;
 - iii) The maximum velocity. [11 marks]
- b) A stone is dropped from the top of a building. A person near a window which is of 1.5 m height finds the stone has taken 0.1 seconds to cross the window. Find the height of the building if the sill of the window is 1 m above ground level. [5marks]

- c) An aeroplane of weight 60 kN lands on the deck of an aircraft carrier at a speed of 200 kmph relative to the carrier and is brought to a stop in 3 seconds. Determine the average horizontal force exerted by the carrier on the plane. [4 marks]

QUESTION TWO

- a) A shotputter tosses a shot upwards at 40 degrees to the horizontal from a height of 1.8 m above the ground as shown in Fig Q 2 a). If the shot lands 15m away, determine:
- The initial speed of the shot
 - The maximum height attained by the shot
 - The distance from the shotputter to the position where maximum height occurs
 - The final velocity of the shot just before hitting the ground. [11 marks]
- b) A soldier fires a bullet at a velocity of 80m/s at an angle of 30 degrees upward to strike a target 50m lower than his position, as shown in fig Q2 b) calculate :
- the maximum height to which the bullet will rise, the horizontal range and the times elapsed .
 - the time elapsed to hit the target and its horizontal distance;
 - the velocity with which it will hit the target and its direction [9 marks]

QUESTION THREE

- a) In a circus, a motor cyclist moves inside a spherical cage of radius 3m. The motor cycle and the man together weigh 7.3kN. Find the minimum velocity the motor cyclist should maintain at the highest point of the cage to be in contact with the cage. [5 marks]
- b) A flywheel made up of steel ring 40mm thick and 200mm wide with mean diameter of 2m is rotating at 300rpm. Find the time taken by the wheel to come to rest due to frictional couple of 100N.m Take density of steel as 7900 kg/m^3 . Neglect the effect of spokes. [5 marks]
- c) Two blocks weighing 400kN and 500kN are hung at the two ends of an inelastic light string passing over a smooth pulley of 400mm diameter . Determine
- acceleration of the blocks and the pulley
 - the tension in the string [5marks]

- d) A block of 300N is placed on a smooth table at 2m from its edge where the string connecting the block passes over a smooth pulley and carries a weight of 30N at the other end.

Determine:

- i) the acceleration of the system
- ii) the tension in the string

[5 marks]

QUESTION FOUR

- a) Two blocks A of mass 16 kg and B of mass 8kg are connected by a light rope which passes around a pair of frictionless pulleys of negligible mass as shown in Fig Q4 a). Block A is acted upon by a 200N force. The coefficient of kinetic friction between Block A and the horizontal surface is 0.4. If the system is released from rest, determine the velocity of the two blocks when block A has moved 3m to the left. Use the method of work- energy principle. [9 marks]
- b) An automobile with a rear wheel drive has a wheel base (b) of 3m and weight (w) 60kN. The c.g is 1m above the pavement (h) and 1.2 ahead of rear wheel (l). The coefficient of friction (μ) between the wheel and pavement is 0.6. Determine the maximum acceleration, the automobile could have when moving along a level road and the force exerted by the rear wheel on the pavement (reaction R_r). If it is changed to a front wheel drive, find the acceleration and hence, state which is more efficient.

What is the possible acceleration on a four wheel drive?

[11 marks]

QUESTION FIVE

- a) A bullet enters a 50mm thick plank with a speed of 600m/s and leaves with a speed of 240m/s. Determine the maximum thickness of the plank that could be fully penetrated by the bullet.
- b) A bullet of mass 30g is fired into a body of mass 10kg which is suspended by a string 0.8 m long. Due to this impact, the body swings through an angle of 30 degrees. Find the velocity of the bullet just before impact. [5 marks]
- c) State the parallel axis theorem. Illustrate your answer with a neat sketch. [3 marks]
- d) Determine the moment of inertia and the radius of gyration of the shaded area as shown in Fig Q5d) w.r.t x-axis. [8 marks]

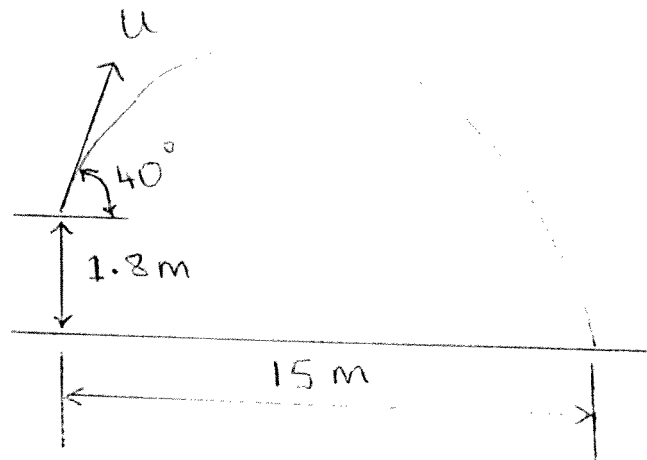


FIGURE Q2 (a)

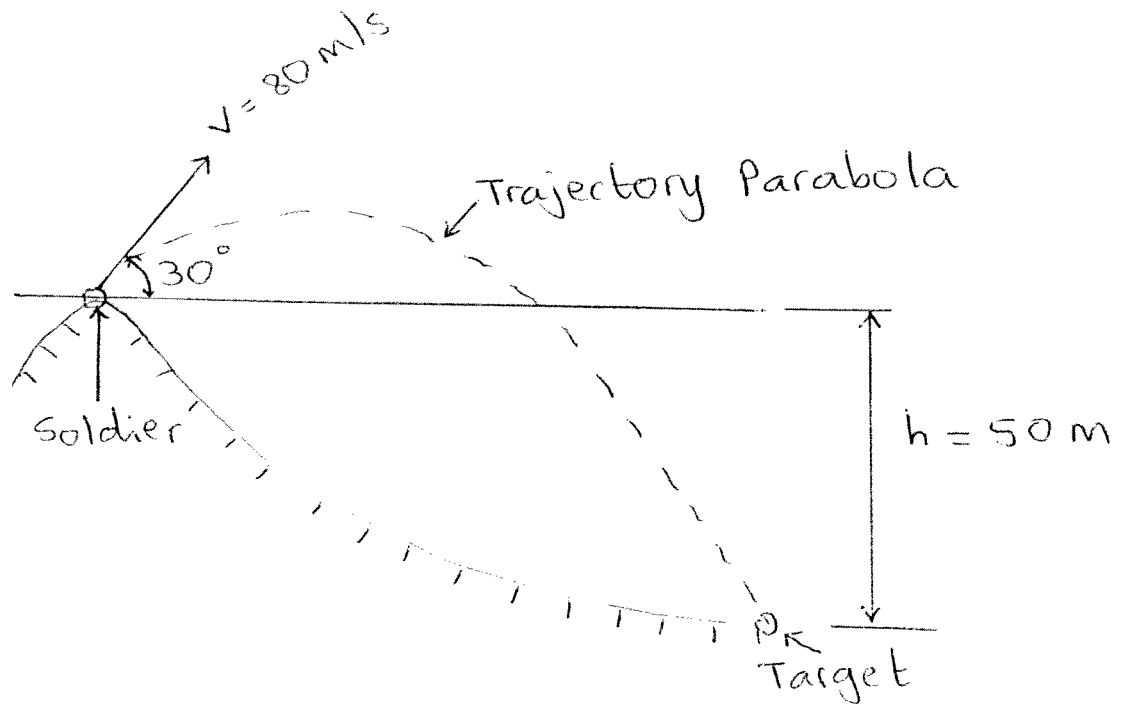


FIGURE Q2 (b)

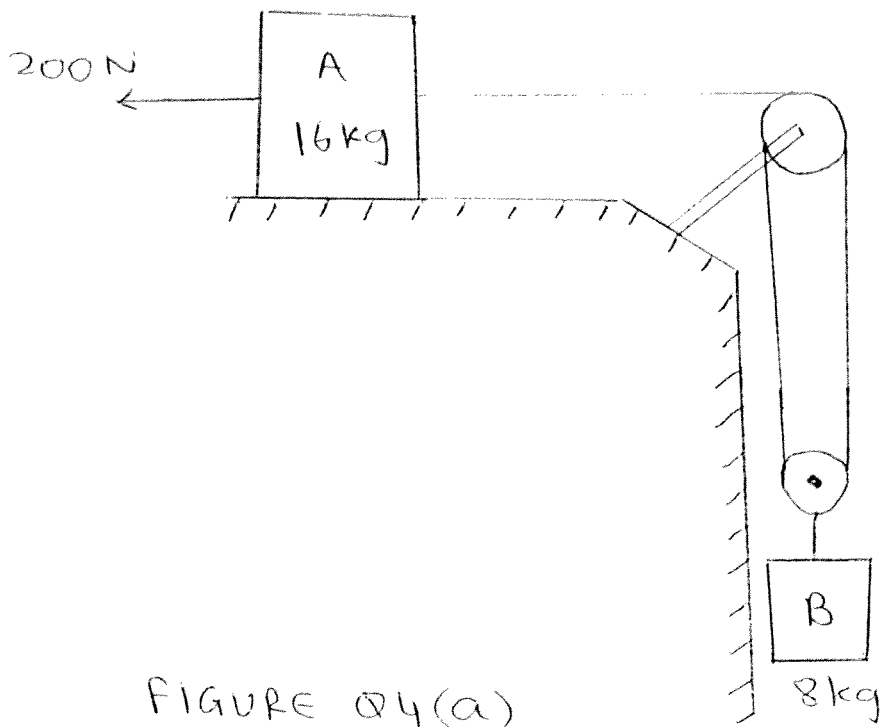


FIGURE Q4(a)

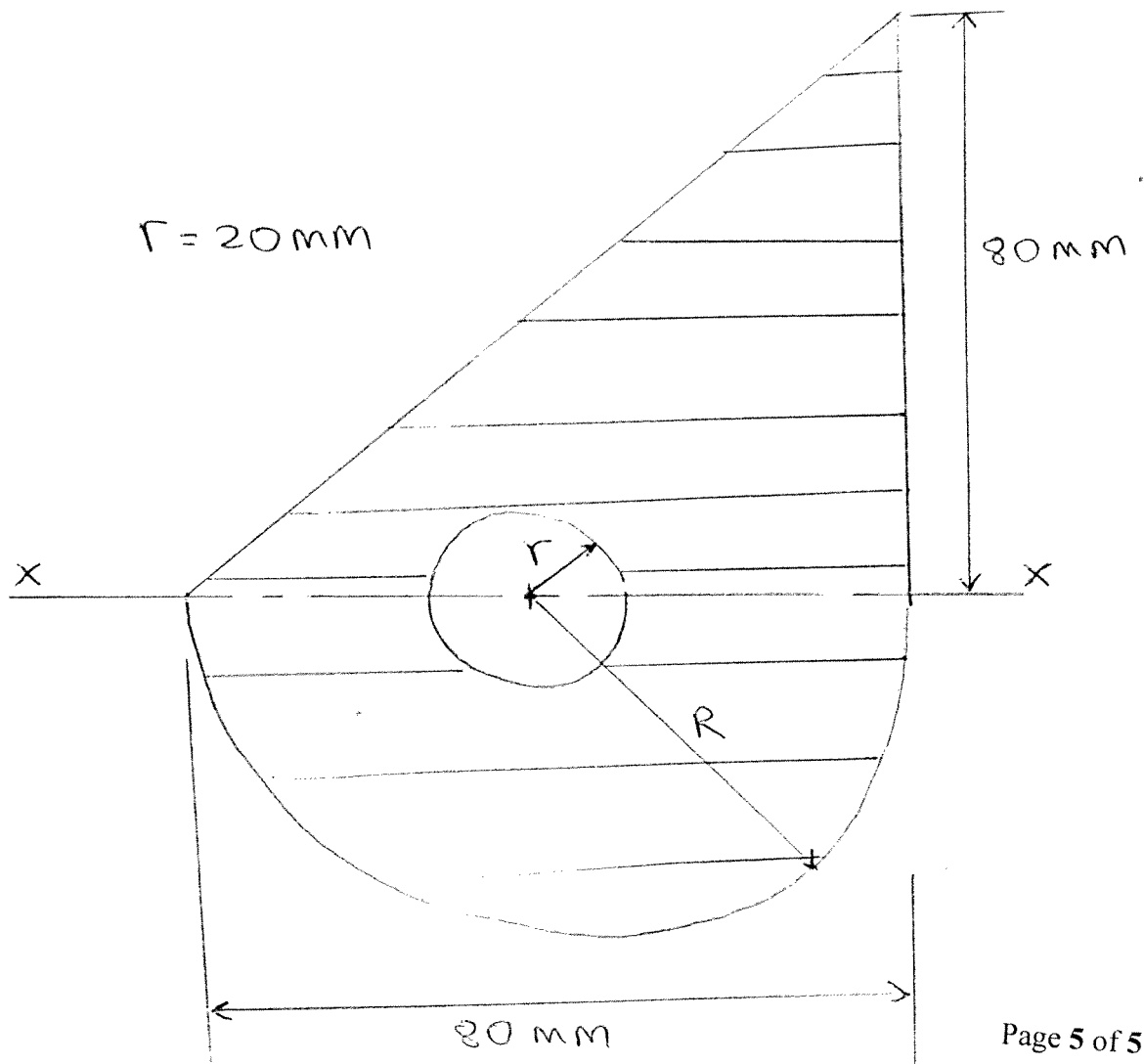


FIGURE Q5(d)

