



UNIVERSITY COLLEGE TATI (UC TATI)

FINAL EXAMINATION QUESTION BOOKLET

COURSE CODE	:	BMT 2122
COURSE TITLE	:	DYNAMIC & MECHANISM
SEMESTER/SESSION:		2 – 2023/2024
DURATION	:	2 HOURS

Instructions:

1. This booklet contains **4** questions. Answer **all** questions.
2. All answers should be written in answer booklet.
3. Write legibly and draw sketches wherever required.
4. If in doubt, rise up your hands and ask the invigilator .

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO

THIS BOOKLET CONTAINS 7 PRINTED PAGES INCLUDING COVER PAGE

QUESTION 1

- a) A projectile is fired vertically with an initial velocity of 250 m/s . Calculate :
- i) the maximum altitude h reached by the projectile (5 marks)
 - ii) the time t after firing for it to return to the ground. (5 marks)

Neglect air resistance and take the gravitational acceleration to be constant at 9.81 m/s^2 .

- b) The acceleration of a particle is defined by the relation $a = 25 - 3x^2$, where a is expressed in m/s^2 and x in meters. The particle starts with no initial velocity at position $x = 0$. Calculate:
- i) the velocity when $x = 2\text{m}$ (5 marks)
 - ii) the position where the velocity is again zero (5 marks)
 - iii) the position where the velocity is maximum (5 marks)

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QUESTION 2

- a) A bus as shown in Figure 1 is accelerated at the rate of 1.2 m/s^2 as it travel from A to B . Knowing that the speed of the bus was $v_0 = 36 \text{ km/h}$ as it passed A , calculate:
- the time required for the bus to reach B (5 marks)
 - the corresponding speed as it passes B (5 marks)

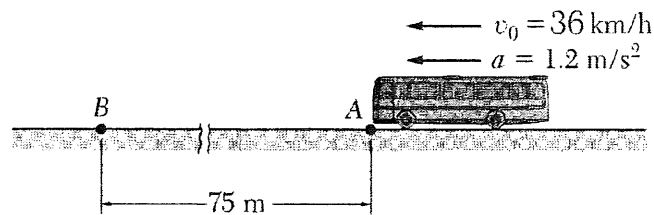


Figure 1

- b) The elevator E as shown in Figure 2 starts from rest and moves upward with a constant acceleration. If the counterweight W moves through 10 m in 5 s , calculate:
- the accelerations of the elevator and the cable C (10 marks)
 - the velocity of the elevator after 5 s (5 marks)

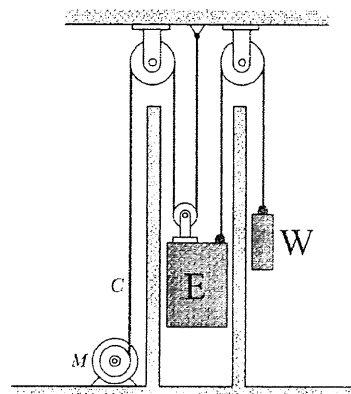


Figure 2

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QUESTION 3

- a) A ball as shown in Figure 3 is thrown vertically upward from the 12m level in an elevator shaft, with an initial velocity of 18m/s. At the same instant an open-platform elevator passes the 5m level, moving upward with constant velocity of 2m/s. Calculate:
- the time and height of the ball hit the elevator (10 marks)
 - the relative velocity of the ball with respect to the elevator when the ball hits the elevator (5 marks)

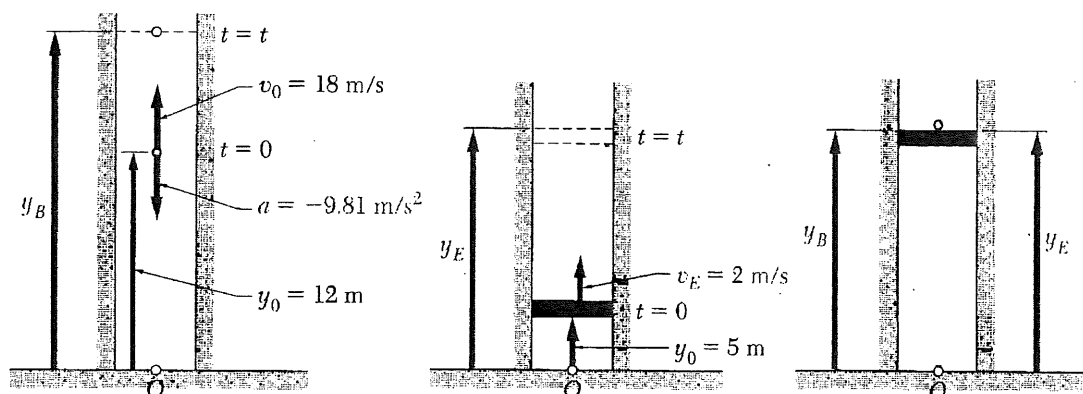


Figure 3

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- b) A projectile as shown in Figure 4 is fired from the edge of a 150m cliff with an initial velocity of 180m/s , at an angle of 30° with the horizontal. Neglecting air resistance, calculate:
- the horizontal distance from the gun to the point where the projectile strikes the ground. (5 marks)
 - the greatest elevation above the ground reached by the projectile. (5 marks)

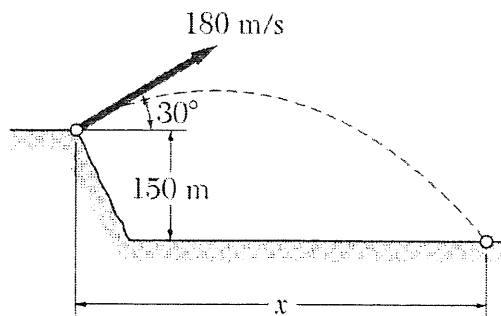


Figure 4

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QUESTION 4

- a) A 200N block as shown in Figure 5 rests on a horizontal plane. Find the magnitude of the force **P** required to give the block an acceleration of 10m/s^2 to the right. The coefficient of kinetic friction between the block and the plane is $\mu_k = 0.25$

(5 marks)

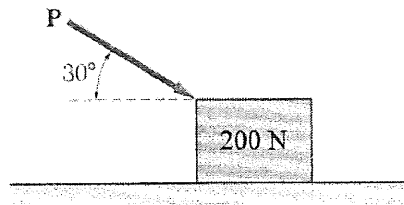


Figure 5

- b) The two blocks as shown in Figure 6 start from rest. The horizontal plane and pulley are frictionless and the pulley is assumed to be of negligible mass. Determine:

- i) the acceleration of each block (10 marks)
 ii) the tension in each cord. (10 marks)

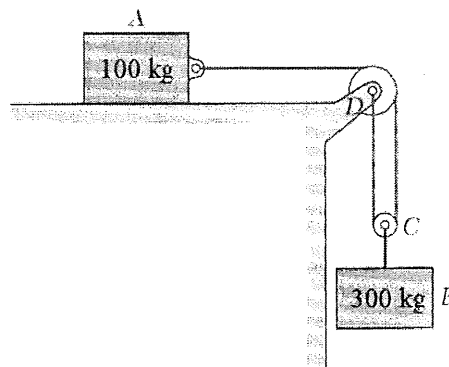


Figure 6

-----End of questions-----

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Criteria	Marks
All questions answered will be marked according to the answer schema	/100

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Attachment

$$F = ma$$

$$W = mg$$

$$v = \frac{dx}{dt}$$

$$a = \frac{dv}{dt}$$

$$a = \frac{d^2x}{dt^2}$$

$$a = v \frac{dv}{dx}$$

$$x = x_0 + vt$$

$$v = v_0 + at$$

$$x = x_0 + v_0t + \frac{1}{2}at^2$$

$$v^2 = v_0^2 + 2a(x - x_0)$$

$$x_B = x_A + x_{B/A}$$

$$v_B = v_A + v_{B/A}$$

$$a_B = a_A + a_{B/A}$$

$$v = \frac{ds}{dt}$$

$$v^2 = v_x^2 + v_y^2$$

$$\tan \alpha = \frac{v_y}{v_x}$$

$$\dot{x} = (v_x)_0$$

$$\dot{y} = (v_y)_0 - gt$$

$$x = (v_x)_0 t$$

$$y = (v_y)_0 t - \frac{1}{2}gt^2$$

$$dU = F \cdot ds$$

$$U = \int F_t ds$$

$$U = \int F \cdot dr = \frac{1}{2}m(v_2^2 - v_1^2)$$

$$T = \frac{1}{2}mv^2$$

$$T_1 + U = T_2$$

$$F = \frac{d}{dt}(mv)$$

$$mv_1 + \int_{t_1}^{t_2} F dt = mv_2$$

$$mv_1 + \text{Imp}_{1 \rightarrow 2} = mv_2$$

$$mv_1 + \sum \text{Imp}_{1 \rightarrow 2} = mv_2$$

