UNIVERSITY COLLEGE TATI (UC TATI)

FINAL EXAMINATION QUESTION BOOKLET		
COURSE CODE	:	BMT 2122
COURSE TITLE	:	DYNAMIC & MECHANISM
SEMESTER/SESSION:		2 – 2022/2023
DURATION	:	3 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 $x = 2m$ (5 marks)

ii) the position where the velocity is again zero (5 marks)

iii) the position where the velocity is maximum (5 marks)

QUESTION 2

a) A bus as shown in Figure 1 is accelerated at the rate of *1.2m/s* as it travel from *A* to *B*. Knowing that the speed of the bus was v_0 = 36km/h as it passed *A*, calculate:

i) the time required for the bus to reach *B* (5 marks)

ii) the corresponding speed as it passes *B* (5 marks)

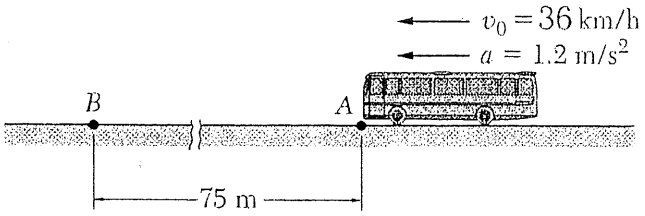

Figure 1

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 *10m* in *5s*, calculate:

i) the accelerations of the elevator and the cable *C* (10 marks)

ii) the velocity of the elevator after *5s* (5 marks)

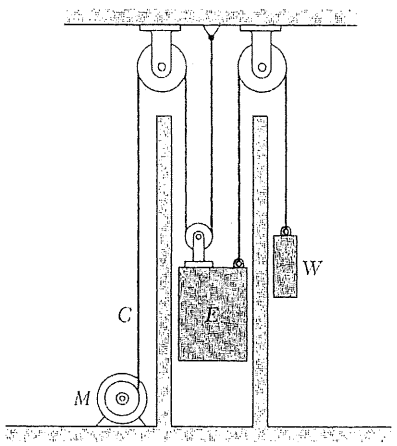

Figure 2

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:

i) the time and height of the ball hit the elevator (10 marks)

ii) the relative velocity of the ball with respect to the elevator when the ball hits the elevator (5 marks)

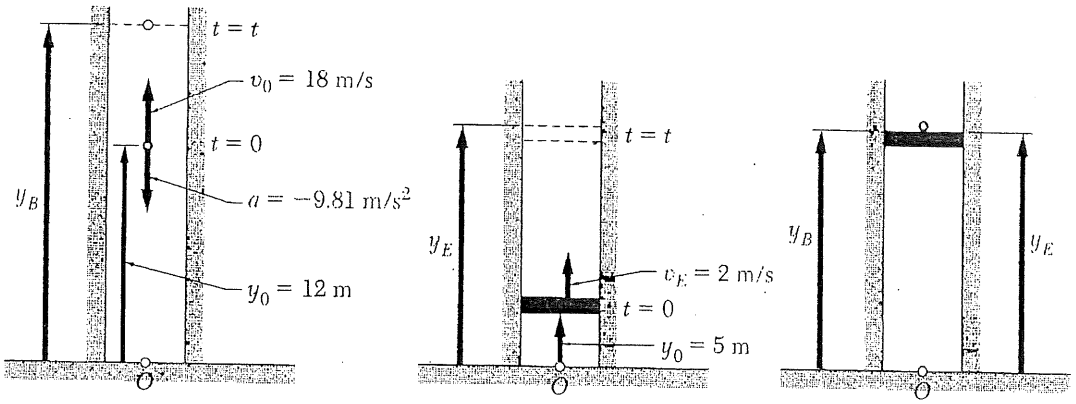

Figure 3

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:

i. the horizontal distance from the gun to the point where the projectile strikes the ground. (5 marks)

ii. the greatest elevation above the ground reached by the projectile. (5 marks)

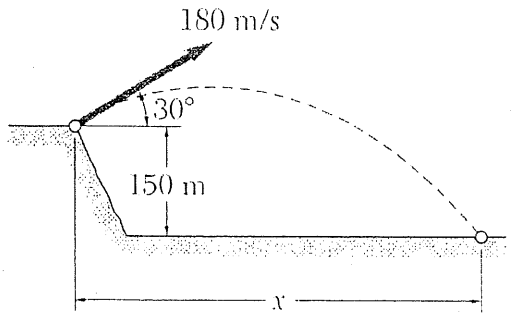

Figure 4

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)

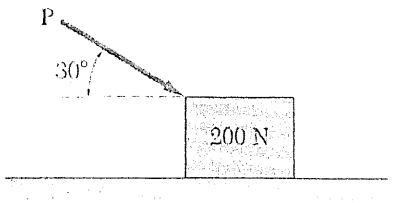

Figure 5

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)

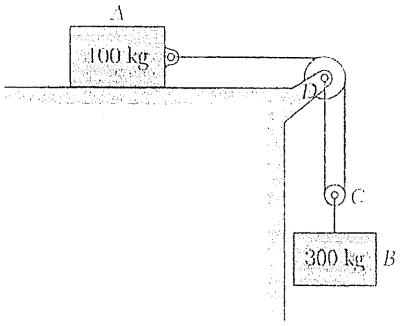

Figure 6

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

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

Attachment

F = ma

W = mg

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

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

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

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

$$x = x_0 + vt$$

$$v = v_0 + at$$

$$x = x_0 + v_0 t + \frac{1}{2}at^2$$

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

$X_B = X_A + X_{B/A}$

$V_B = V_A + V_{B/A}$

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

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

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

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

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

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

$$x = (v_x)_0 t$$

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

$dU = \mathbf{F} \bullet ds$

$U = \int F_t ds$

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

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

$T_1 + U = T_2$

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

$$mv_1 + \int_{t_1}^{t_2} F\,dt = m\,v_2$$

$$mv_1 + \mathrm{Imp}_{1\to 2} = mv_2$$

$$mv_1 + \sum \mathrm{Imp}_{1\to 2} = mv_2$$