Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(ONLINE)
SEMESTER I
SESSION 2020/2021

COURSE NAME	:	PHYSICS MECHANICS
COURSE CODE	:	DAU 10103
PROGRAMME CODE	:	DAU
EXAMINATION DATE	:	JANUARY/ FEBRUARY 2021
DURATION	:	2 IIOURS AND 30 MINUTES
INSTRUCTIONS	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

Q1 (a) Define the following and state the S.I unit:

(i) Displacement.

(1 marks)

(ii) Velocity.

(1 marks)

(b) A sphere with a radius, r = 400 mm is floating in oil with density, $\rho = 0.78$ g/cm^3. Given; gravity g = 9.81 m s^{-2} and $V_{sphere} = \frac{4}{3}\pi r^3$.

(i) Convert the density of oil in SI unit.

(3 marks)

(ii) Determine the buoyancy force of the sphere in SI unit.

(5 marks)

(c) A person standing on the edge of a cliff throw a rock straight up with an initial velocity of 13.0 m/s. The rock misses the edge of the cliff as it falls back to earth.

(i) Calculate the position of the rock for time 1.00 s, and 3.00 s after it is thrown.

(6 marks)

(ii) Sketch the vertical position versus time and velocity versus time for the rock from the moment it leaves the person's hand until it fall to earth.

(6 marks)

(d) A long jumper leaves the ground at an angle of 20° to the horizontal and at speed of 11.0 m/s.

(i) Calculate how long does it take for him to reach maximum height?

(3 marks)

(ii) Determine the maximum height he can reach.

(3 marks)

(iii) Find how far does he jump?

(3 marks)

Q2 (a) Define Newton's Third Law

(2 marks)

(b) **Figure Q2 (b)** shows a box of weight 5000 N lying on an inclined plane with an angle of 35° above the horizontal plane. The box is connected to a ball of weight 70 N by a light string passing over a smooth pulley. Assume the coefficient of kinetic friction for the inclined plane is 0.15.

(i) Draw a free body diagram for the system.

(4 marks)

(ii) Calculate the normal force, N for the box

(3 marks)

(iii) Calculate the frictional force, f experienced by the box

(3 marks)

(iv) Calculate the acceleration of a ball as the box moves down the inclined plane

(7 marks)

(v) Calculate the tension in the string

(3 marks)

Q3 (a) **Figure Q3 (a)** shows a trolley of weight 60 N passing through point A with a velocity of 6 ms^{-1}. It slides down a rail to point C. From A to C, 250 J of energy is lost due to friction. Calculate the followings:

(i) The total energy at point A.

(4 marks)

(ii) The velocity of the trolley at point C.

(5 marks)

(b) Define the followings:

(i) Work-Energy Theorem.

(2 marks)

(ii) Conservation of Mechanical Energy.

(2 marks)

(c) Verify that work input equal work output for a hydraulic system by assuming no losses of energy due to friction and volume of fluid remain constant.

(3 marks)

Q4 A spring stretches 0.150 m when a 0.3 kg mass is gently attached to it as in **Figure Q4 (a)**. The spring is then set up horizontally with the 0.3 kg mass resting on a frictionless table as in **Figure Q4 (b)**. The mass is pushed so that the spring is compressed 0.1 m from the equilibrium point, and released from rest. Determine

(i) The spring stiffness constant k and angular frequency, ω.

(4 marks)

(ii) The amplitude of the horizontal oscillation, A.

(2 marks)

(iii) The magnitude of the maximum velocity, v_{max}.

(2 marks)

(iv) The magnitude of the maximum acceleration, a_{max} of the mass.

(2 marks)

(v) The period T and the frequency f.

(3 marks)

(vi) The displacement graph x as a function of time.

(3 marks)

(vii) The velocity at $t = 0.15$ s.

(2 marks)

Q5 (a) Define centripetal acceleration and centripetal force.

(4 marks)

(b) Calculate the angular velocity of a 0.300 m radius tyre when the car travels at 15.0 m s^{-1} as shown in **Figure Q5 (b).**

(3 marks)

(c) A car with mass 900 kg move at curve of road with radius 500 m at speed of 25 m s^{-1} as shown in **Figure Q5 (c).**

(i) Draw free body diagram acting on the car.

(4 marks)

(ii) Calculate the magnitude of the centripetal acceleration of a car following a curve of radius

(4 marks)

(iii) Compute the centripetal force exerted by the car.

(4 marks)

(iv) Determine the minimum coefficient of static friction between the tyres and the road (static friction being the reason that keep the car from slipping).

(4 marks)

-END OF QUESTIONS –

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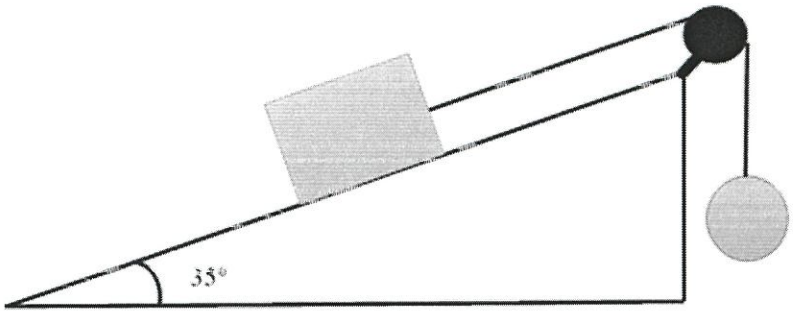

Figure Q2 (b)

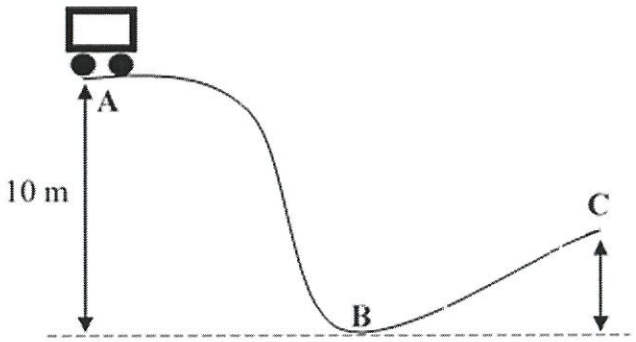

Figure Q3 (a)

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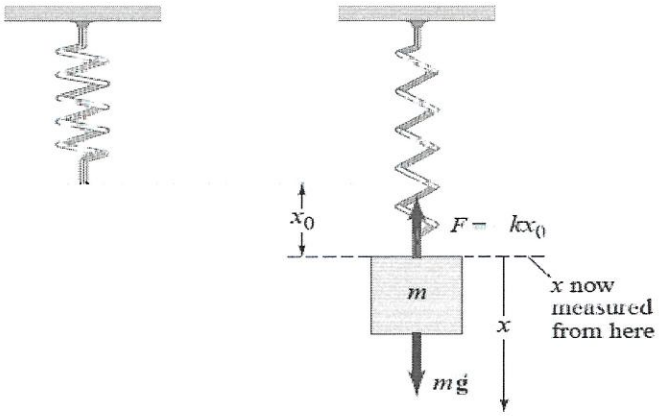

Figure Q4 (a)

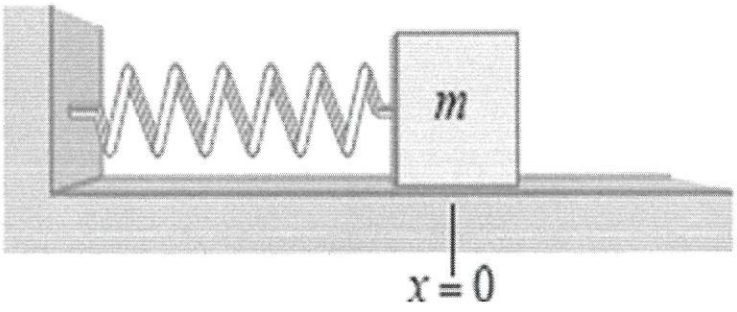

Figure Q4 (b)

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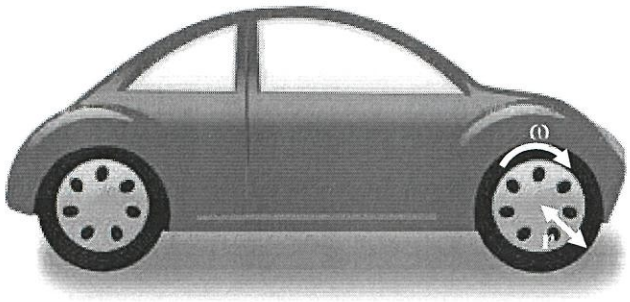

Figure Q5 (b)

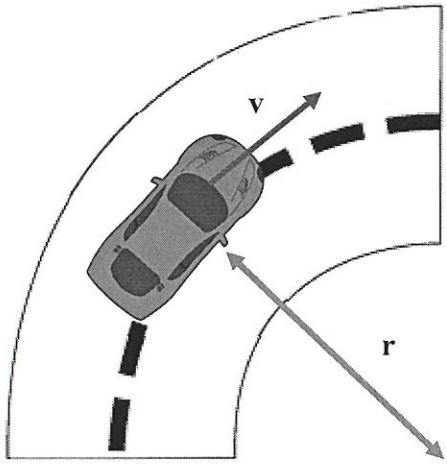

Figure Q5 (c)

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LIST OF FORMULA

$v_x = v_{0x} + a_x t$

$F_b = \rho g V$

$\rho = \frac{m}{V}$

$v_x^2 = v_{x0}^2 + 2a_x(x - x_0)$

$x = x_0 + v_{x0}t + \frac{1}{2}a_x t^2$

$\vec{a} = \frac{\sum \vec{F}}{m} = \frac{\vec{F}_{net}}{m}$

$T_K = T_C + 273.15$

$a_c = \frac{v^2}{r}$

$T_C = \frac{T_F - 32}{1.8}$

$\vec{p} = m\vec{v}$

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

$\Delta E = W = F_{\parallel} = Fd\cos\theta$

$\omega = \omega_0 + \alpha t$

$U_s = \frac{1}{2}kx^2\sqrt{\frac{Y}{\rho}}$