UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020

COURSE NAME	:	PHYSICS FOR ENGINEERING TECHNOLOGY
COURSE CODE	:	BWM 12603
PROGRAMME CODE	:	BNA/ BNB/ BNC/ BNN
EXAMINATION DATE	:	DECEMBER 2019 / JANUARY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	A) ANSWER **ALL** QUESTIONS IN PART A. B) ANSWER **THREE (3)** QUESTIONS ONLY IN PART B.

TERBUKA

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

PART A

Q1 (a) (i) Define interference of waves.

(1 mark)

(ii) Differentiate between constructive and destructive interference.

(4 marks)

(b) (i) State the principle of superposition of waves.

(1 mark)

(ii) Write the mathematical relation for principle of superposition of waves.

(3 marks)

(iii) Give an example of superposition of waves in our daily life.

(1 mark)

(c) Bats navigate and search out prey by emitting and then detecting reflections of ultrasonic wave. These sound wave have frequencies greater than what can be heard by human. Suppose a bat emits ultrasound at frequency 82.52 kHz while flying with velocity 9 ms^{-1} as it chases a moth that flies with velocity 8 ms^{-1}. Calculate the frequency that the

(i) moth detect.

(5 marks)

(ii) bat detect in the returning echo from the moth.

(5 marks)

Q2 (a) (i) Define the term of entropy.

(1 mark)

(ii) State the second law of thermodynamics.

(1 marks)

(iii) Write mathematical formula for second law of thermodynamics.

(3 marks)

(b) Describe briefly the force due to entropy.

(5 marks)

(c) A Carnot engine that operates between high temperatures, T_H = 850 K and lower temperatures, T_L = 300 K performs 1200 J of work for each cycle that takes 0.25 s. Calculate the

(i) efficiency of this engine.

(2 marks)

(ii) average power of this engine.

(2 marks)

(iii) energy that extracted as heat from the high temperature reservoir for every cycle.

(2 marks)

(iv) energy that delivered as heat to the low temperature reservoir for every cycle.

(2 marks)

(v) entropy of the working substance change as a result of the energy transferred from the high and low temperature reservoir.

(2 marks)

PART B

Q3 (a) The density, ρ of ozone at 0^oC is 2.14 kgm^{-3} and its coefficient of volume expansion, β is 1.82×10^{-4} $^oC^{-1}$.

(i) Calculate the density of ozone at 55 ^oC.

(5 marks)

(ii) Show that the density of a ozone changes with temperature is $\Delta\rho = \rho\beta\Delta T$.

(5 marks)

(b) A steel wire of 2.0 mm^2 cross-section is held straight by attaching it firmly to two points a distance 1.50 m apart at 30^oC. If the temperature decreases to -10^oC and the two tie points remain fixed, determine the tension in the wire. [Given linear expansion coefficient, $\alpha_{steel} = 1.1 \times 10^{-5}$ $^oC^{-1}$ and Young Modulus, $Y = 2 \times 10^{11}$ Nm^{-2}.]

(5 marks)

(c) When a building is constructed at temperature -10^oC, a steel beam with cross sectional area 45 cm^2 is put in place with its ends cemented in pillars. If the sealed ends is fixed at one position, what will be the compressional force in the beam when the temperature is 25^oC? [Given linear expansion coefficient, $\alpha_{steel} = 1.1 \times 10^{-5}$ $^oC^{-1}$ and Young Modulus, $Y = 2 \times 10^{11}$ Nm^{-2}].

(5 marks)

Q4 (a) A partly filled beaker of water sits on scale and its weight is 2.3 N. When a piece of metal suspended from a thread is totally immersed in the beaker but not touching its bottom, the scale give a reading of 2.75 N. Compute the volume of the metal. [Given density of water, ρ_{water} = 1000 kgm^{-3}].

(5 marks)

(b) Given the mass, m of fluid has volume, V_o at the surface, and volume, $V_o - \Delta V$ at a depth, h. If we assume that density, ρ is close to initial density, ρ_o, show that the pressure at depth, h is

$$\frac{\rho}{\rho_o} = \frac{1}{(1 - \frac{\rho_o g h}{\beta})}$$

(5 marks)

(c) A piece of alloy has a measured mass of 86 g in air and 73 g when immersed in water as shown in **Figure Q4(c)**. Find its volume and density. [Given density of water, ρ_{water} = 1000 kgm^{-3}].

(6 marks)

(d) How high would water rise in a pipe of a building if the water pressure gauge shows the pressure at the ground floor is 270 kPa?

(4 marks)

Q5 (a) In unloading grain from the hold of a ship, an elevator lifts the grain through a distance of 12 m. Grain is discharged at the top of the elevator at a rate of 2 kg/second and the discharge speed of each grain particle is 3 ms^{-1}. Predict the maximum power of the lifts motor that can elevate the grain.

(5 marks)

(b) An advertisement claims that a certain 1200 kg car can accelerate from rest to a speed of 25 ms^{-1} in a time of 8 s.

(i) What average power must the motor produce to cause this acceleration?

(5 marks)

(ii) Calculate the power of the motor if the car going up a 20° incline.

(5 marks)

(c) A 60000 kg train is being pulled up at 1% incline and rises 1.0 m for each horizontal 100 m by a drawbar pull of 3 kN. The friction force opposing the motion of the train is 4 kN. The train's initial speed is 12 ms^{-1}. At what horizontal distance, s will the train move before its speed is reduced to 9 ms^{-1}?

(5 marks)

Q6 (a) In **Figure Q6(a)**, friction and the mass of the pulley are both negligible. Calculate the acceleration of m_2 if the mass for both objects are m_1 = 300 g, m_2 = 500 g and F = 1.5 N.

(5 marks)

(b) In **Figure Q6(b)**, the weights of the objects are 200 N and 300N. The pulleys are essentially frictionless and massless. Pulley P_1 has a stationary axle but pulley P_2 is free to move up and down. Determine the

(i) tension F_{T1}.

(3 marks)

(ii) tension F_{T2}.

(3 marks)

(iii) acceleration of each body.

(3 marks)

(c) Each of the objects in **Figure Q6(c)** is in equilibrium. Calculate the normal force, F_N in (i), (ii) and (iii).

(6 marks)

-END OF QUESTIONS –

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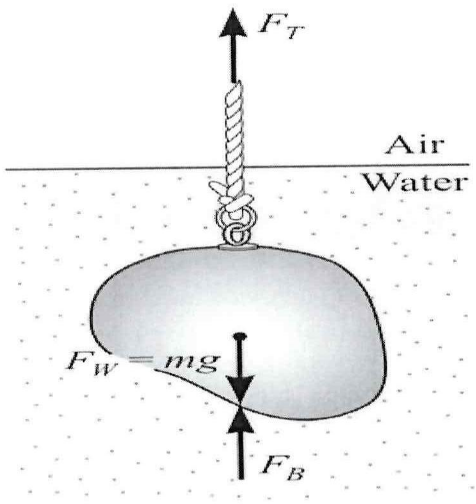

Figure Q4(c)

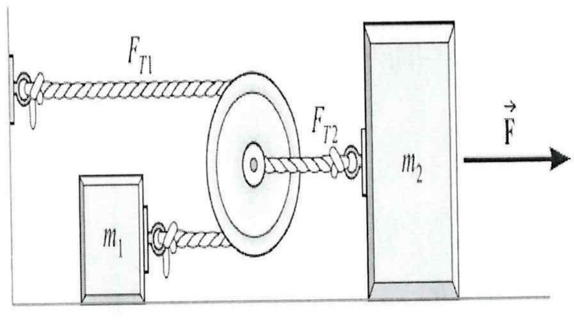

Figure Q6(a)

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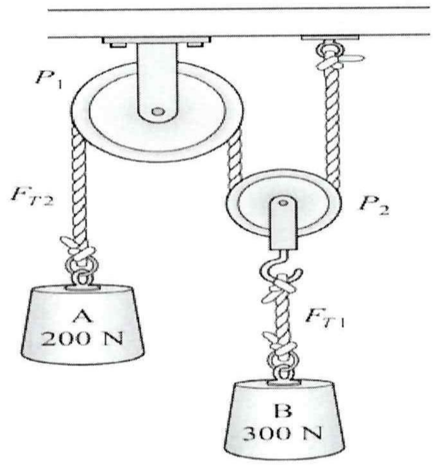

Figure Q6(b)

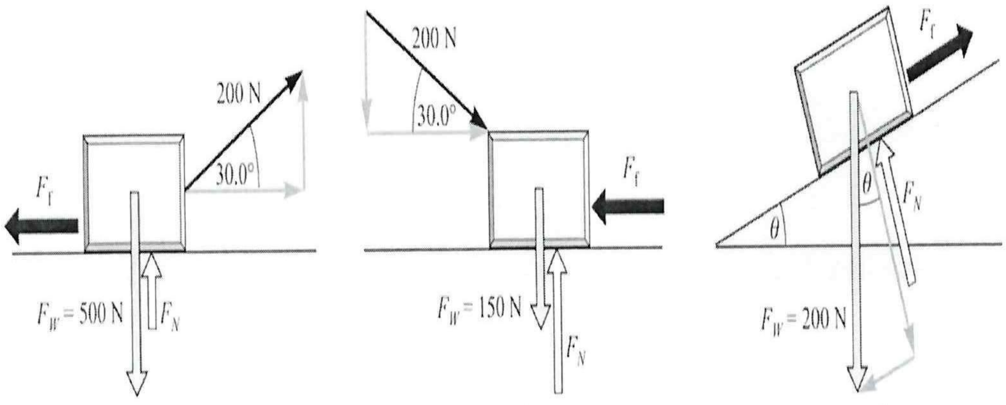

Figure Q6(c)

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LIST OF CONSTANTS AND FORMULA

Gravity acceleration, g = 9.81 m/s^2	1 feet = 12 in 1 feet =30.48cm=0.3048 m 1 mi = 1.609 km	$P = m \cdot v$
$W = F{\cdot}s = Fs\cos\theta$	$E_u = \frac{1}{2}kx^2 = \frac{1}{2}m\omega^2x^2$	$s = r\theta$
$K = \frac{1}{2}mv^2$	$E_J = E_k + E_u = \frac{1}{2}m\omega^2A^2$	$v = r\omega$
$U = mgh$	$R = \sqrt{R_x^2 + R_y^2}$	$a = r\alpha$
$\Delta K = -\Delta U$	$\theta = \tan^{-1}\left(\frac{R_y}{R_x}\right)$	$\omega = \frac{d\theta}{dt}$
$W_n = \Delta K$	$v = u + at$	$\alpha = \frac{d\omega}{dt}$
$\frac{1}{2}mv_2^2 - \frac{1}{2}mv_1^2 = -(mgh_2 - mgh_1)$	$s = ut + \frac{1}{2}at^2$	$a_c = \frac{v^2}{r} = \omega^2 r$
$a = -\omega^2 \cdot x$	$v^2 = u^2 + 2as$	$a = r\sqrt{\omega^4 + \alpha^2}$
$f = \frac{1}{T} = \frac{\omega}{2\pi}$	$\sum F = ma$	$\omega = \omega_o + \alpha t$
$v = \omega\sqrt{A^2 - x^2}$	$W = mg$	$\theta = \omega_o t + \frac{1}{2}\alpha \cdot t^2$
$E_k = \frac{1}{2}mv^2 = \frac{1}{2}m\omega^2(A^2 - x^2)$	$f_k = \mu_k . N$ $f_s = \mu_s . N$	$\omega^2 = \omega_o^2 + 2\alpha \cdot \Delta\theta$