UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2016/2017

COURSE NAME	:	MECHANICAL SCIENCES
COURSE CODE	:	BEF 25903
PROGRAMME CODE	:	BEV
EXAMINATION DATE	:	JUNE 2017
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FIVE (5)** QUESTIONS **ONLY**

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

Q1 (a) Explain the following terms:

(i) Friction.

(ii) Dry Friction.

(iii) Impending motion.

(iv) Free body diagram.

(8 marks)

(b) The refrigerator in **Figure Q1(b)** has a weight of 900 N and rests on a tile floor for which $\mu_s = 0.25$. If the man pushes horizontally on the refrigerator in the direction shown,

(i) Calculate the smallest magnitude of horizontal force needed to move it.

(6 marks)

(ii) Also, if the man has a weight of 750N, determine the smallest coefficient of friction between his shoes and the floor so that he does not slip.

(6 marks)

Q2 (a) Explain the definition and give the example of its :

(i) Particle.

(ii) Rigid body.

(iii) Kinematics.

(iv) Kinetics.

(v) Relative position.

(10 marks)

(b) The dragster starts from rest and has a velocity as shown in **Figure Q2(b)**. Knowing that $s = 0$ m at $t = 0$ s:

(i) Sketch the s–t graph for the given time interval.

(5 marks)

(ii) Calculate total distance travelled until the dragster stops.

(2 marks)

(c) A baseball is thrown downward from a 12.5 m tower with an initial speed of 4.5m/s. Determine the speed at which it hits the ground and the time of travel.

(3 marks)

Q3 (a) **Figure Q3(a)** shows car A has a weight of 25 kN and is travelling to the right at 1 m/s. Meanwhile a 15 kN car B is travelling at 2 m/s to the left. If the cars crash head on and become entangled, estimates their velocity just after the collision. Assume that the brakes are not applied during collision.

(5 marks)

(b) **Figure Q3(b)** shows Circuit used by racing car A and B for training before the actual championship event. Racing cars A and B are travelling on circular portions of a race track. At the instant shown, the speed of racing car A is decreasing at the rate of 8 m/s^2, while the speed of racing car B is increasing at the rate of 3 m/s^2. For the position shown, calculate:

(i) The velocity of racing car B relative to racing car A, $v_{B/A}$.

(7 marks)

(ii) Sketch the magnitude and direction for $v_{B/A}$.

(4 marks)

(c) Consider the trajectory of the cannonball shown in **Figure Q3 (c).** Take up as positive and down as negative. State:

(i) Where is the magnitude of the vertical-velocity component largest?

(ii) Where is the magnitude of the horizontal-velocity component largest?

(iii) Where is the vertical-velocity smallest?

(iv) Where is the magnitude of the acceleration smallest?

(4 marks)

Q4 (a) Define the following terms:

(i) Density.

(ii) Specific weight.

(iii) Specific gravity.

(iv) Dynamic viscosity.

(v) Kinematic viscosity.

(5 marks)

(b) Discuss about manometer and explain the working principle of manometer with the help of suitable sketch.

(8 marks)

(c) An inverted 0.1 m diameter circular cylinder is partially filled with water and held in place as shown in **Figure Q4(c)**. A force of 20 N is needed to pull the flat plate from the cylinder. Calculate the air pressure within the cylinder. The plate is not fastened to the cylinder and has negligible mass.

(7 marks)

Q5 (a) Define and explain the stagnation pressure.

(3 marks)

(b) With the help of suitable sketch, explain how flow rate is measured using a static Pitot tube.

(7 marks)

(c) A static Pitot tube is used to measure air velocity. If a manometer connected to the instrument indicates a difference in pressure head between the tappings is 15 mm of water and the pipe diameter is 90 mm, calculate the air flow rate assuming the coefficient of the Pitot tube to be unity. Take the density of air = 1.2 kg/m^3.

(10 marks)

Q6 (a) List down **two (2)** types of turbines and state the head and flow rate requirement needed to run the turbines.

(4 marks)

(b) Explain the working principle of centrifugal pump with the help of suitable sketch. Label the main pump components on the sketch.

(8 marks)

(c) The suction line of a piping system pumping seawater (SG=1.04) at a rate of 80 liter/s. At a suction pipe line with a diameter of 200 mm, a pressure gauge located at 2 m below the centreline of the pump reads –15 kPa. Another pressure gauge is tapped in the discharge line with a pipe diameter of 150 mm. This pressure gauge which is located 3 m above the centerline of the pump, reads 120 kPa. With a pump efficiency 60%, calculate the power input to the pump if the head loss between the two gauges is 5 m.

(8 marks)

- END OF QUESTIONS –

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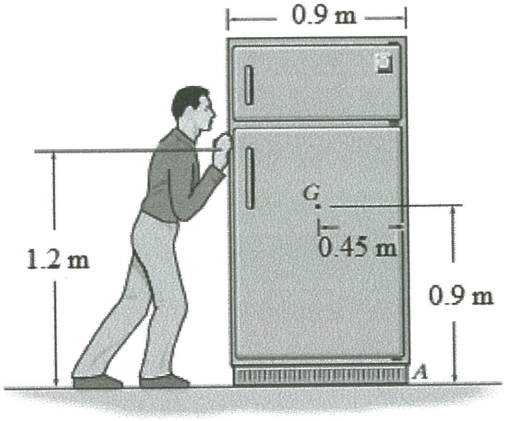

Figure Q1(b)

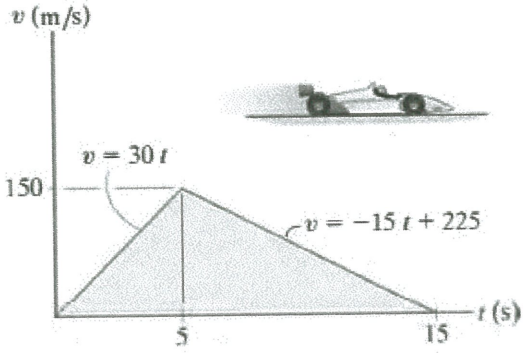

Figure Q2(c)

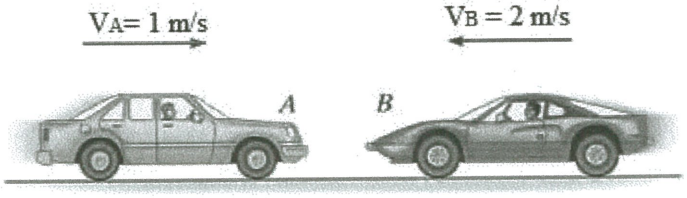

Figure Q3(a)

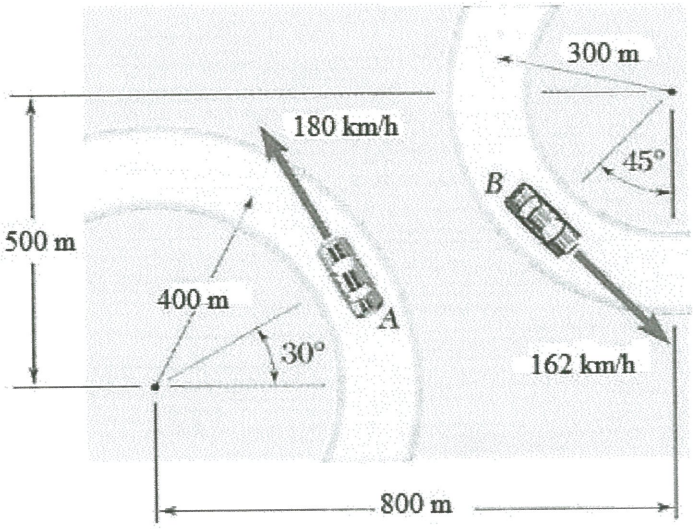

Figure Q3(b)

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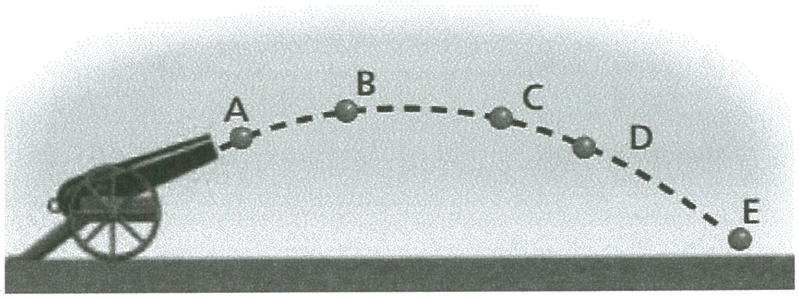

Figure Q3(c)

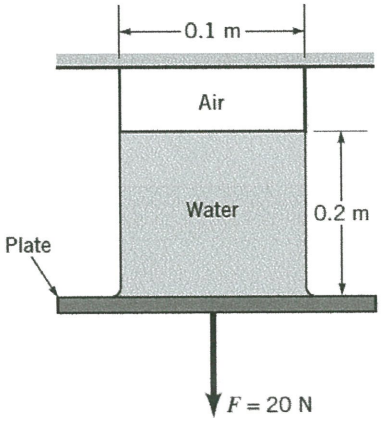

Figure Q4(c)

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Formula:

$$s = s_0 + v_0 t + \frac{1}{2} a t^2$$

$$v = v_0 + at$$

$$v^2 = v_0^2 + 2as$$