First Semester Examination
2023/2024 Academic Session

February 2024

EMM 101 – Engineering Mechanics
(Mekanik Kejuruteraan)

Duration: 3 hours
(Masa: 3 Jam)

Please check that this examination paper consists of SIX (6) pages of printed material before you begin the examination.

[Sila pastikan bahawa kertas peperiksaan ini mengandungi ENAM (6) muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]

Instructions: Answer ALL **FOUR (4)** questions.

*[**Arahan**: Jawab **EMPAT (4)** soalan]*

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1. (a) Figure 1 (a) shows a pole that is acting by two forces.

(i) Express each of the forces in Cartesian vector form

(ii) Determine the magnitude and coordinate angles of the resultant force.

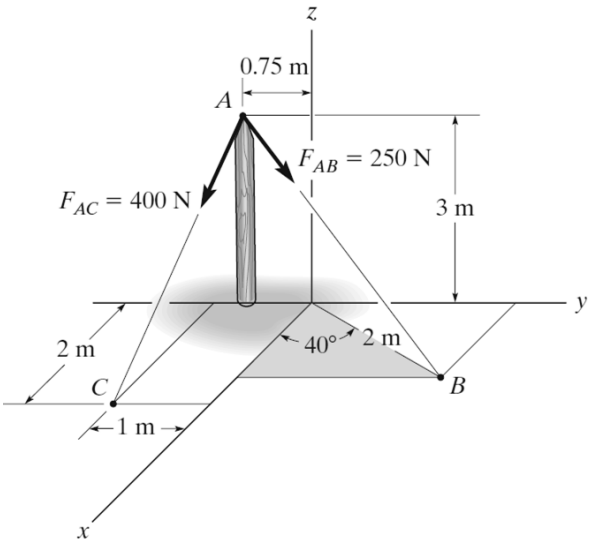

Figure 1 (a)

(50 marks)

(b) Figure 1 (b) shows the wire AE is stretched between the corners A and E of a bent plate. Knowing that the tension in the wire is 435 N,

(i) determine the moment about point *O* by assuming the force is exerted by the wire on corner A.

(ii) determine the moment about point *O* by assuming the force exerted by the wire on corner E.

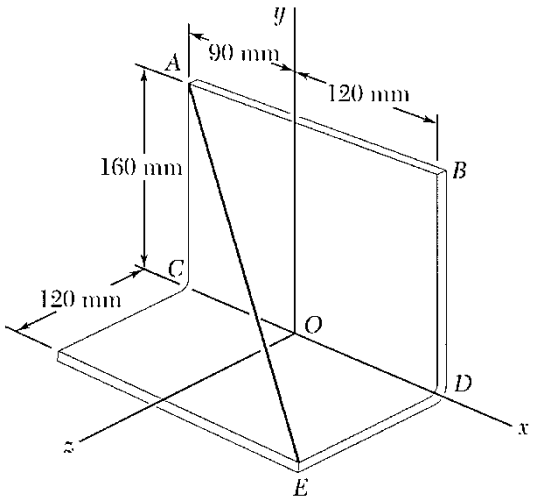

Figure 1 (b)

(50 marks)

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2. (a) Determine the centroid $\bar{x}$ of the shaded area shown in Figure 2 (a).

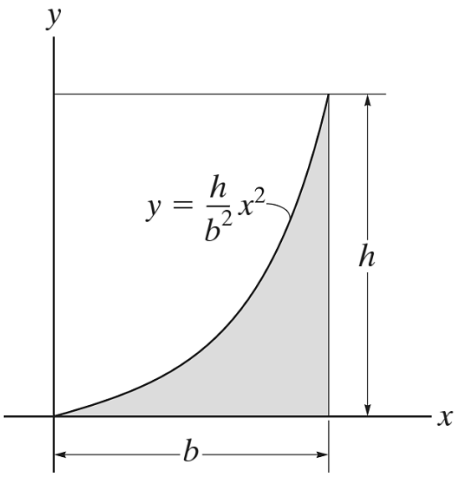

Figure 2 (a)

(40 marks)

(b) Figure 2 (b) shows the composite cross-sectional area of a U-channel beam. Consider that the cross sectional area is separated into three segments such illustrated in the figure inset.

(i) Determine the distance $\bar{y}$ to the beam's cross-sectional area.

(ii) Determine the moment of inertia of the area about the centroidal *x'* axis.

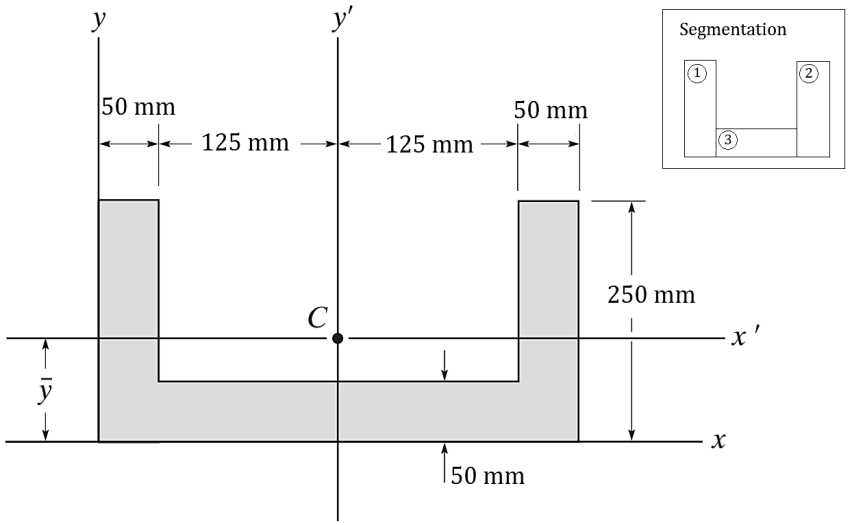

Figure 2 (b)

(60 marks)

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3. (a) (i) Figure 3 (a) shows a pickup truck has a mass of 2 Mg. By itself, the truck accelerates from 0 to 90 km/h in 10 s along the level road. Determine the corresponding time when the truck towing the 1 Mg boat as shown in Figure 3 (a). Assume constant acceleration.

(ii) If the truck towing the boat accelerates from rest to 20 m/s in a distance of 100 m, determine the tension in the coupling C and the truck driving force F.

(60 Marks)

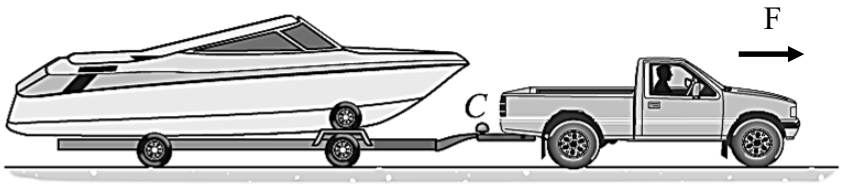

Figure 3 (a)

(b) Figure 3 (b) shows a 65 kg woman holds a 10 kg package as she stands within an elevator. When the elevator moving upward, the force R which the elevator exert on her feet is 900 N,

(i) determine the velocity of the elevator when it has moved upward 6 m starting from rest.

(ii) determine the lifting force L which she exerts on the package.

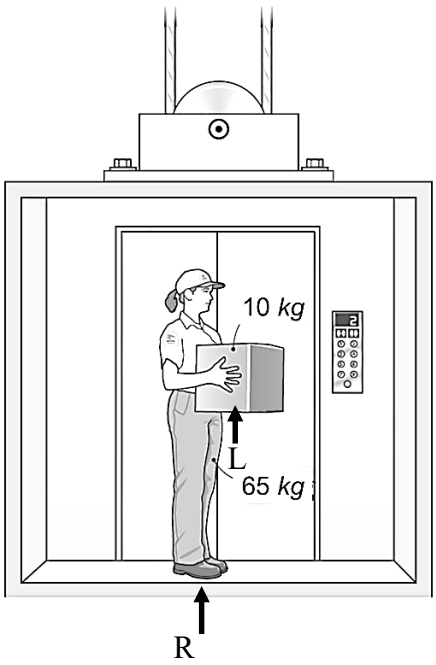

Figure 3 (b)

(40 Marks)

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4. (a) Ball A has mass of 2.5 kg and ball B has mass of 2 kg are connected to cords of length $\frac{L}{2}$ and *L*, respectively as shown in Figure 4 (a). Ball A is released from rest when $\emptyset = 0^o$ and swings down to $\emptyset = 90^o$, where it collides with ball B. The coefficient of restitution between the two balls is *e* = 0.3. Ignoring air drag and *L* = 1.5 m, determine,

(i) the speed of ball B right after the collision

(ii) the maximum angle θ

(iii) the tension of the cord holding ball B when the ball is momentarily stopped at the maximum angle θ

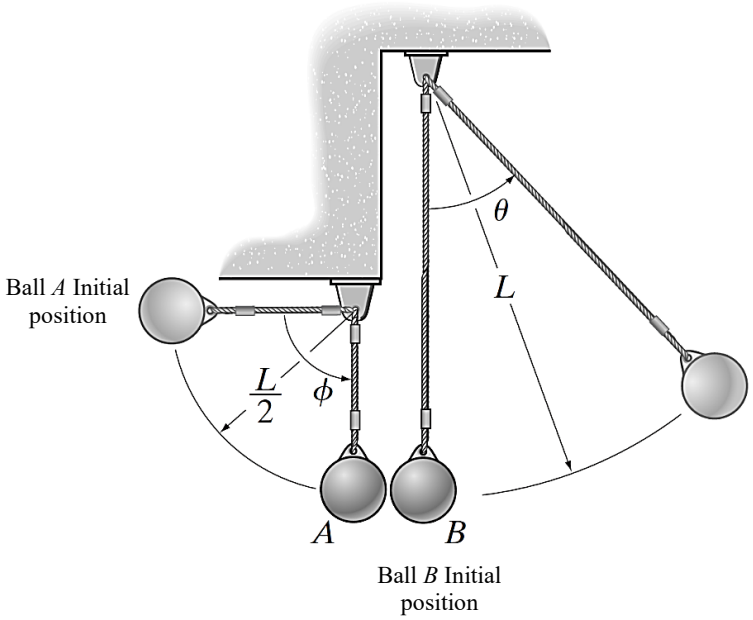

Figure 4 (a)

(50 marks)

(b) Figure 4 (b) shows a 0.45 kg ball rolling on an irregular and frictionless loop. The radius of curvature, ρ, at the top of the loop (T) is 1.2 m.

(i) Determine the minimum initial velocity of the ball ($V_{initial}$) at position A such that the ball could stay on the loop without falling.

(ii) Determine the final velocity of the ball at B if the initial velocity at A is $V_{initial}$ = 13 m/s.

(iii) Determine the normal force N of the loop against the ball at T if the initial velocity at A is $V_{initial}$ = 15 m/s.

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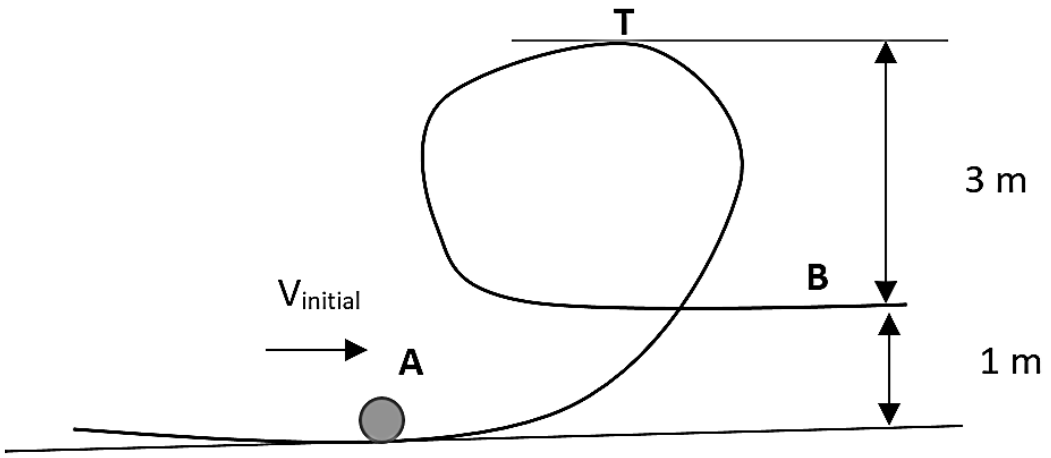

Figure 4 (b)

(50 marks)

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