INSTRUCTION:

This section consists of **FOUR (4)** structured questions. Answer **ALL** questions.

ARAHAN:

*Bahagian ini mengandungi **EMPAT (4)** soalan berstruktur. Jawab **SEMUA** soalan.*

QUESTION 1

SOALAN 1

CLO1 C1

a) Define Newton's Second Law of Motion and give **ONE (1)** example.
*Takrifkan Hukum Newton Kedua bagi gerakan dan berikan **SATU (1)** contoh.*

[4 marks]
[*4 markah*]

CLO1 C2

b) Express a vector with magnitude of 2.24 N directed at 63.4°, counterclockwise from the x-axis in unit vector form.

Nyatakan suatu vektor dengan magnitud 2.24 N dan arah 63.4 °, arah lawan jam dari paksi-x dalam bentuk vektor unit.

[5 marks]
[*5 markah*]

CLO1 C3

c) Calculate the magnitude and angular directions represented by forces $\mathbf{F_1}$ below:
Kirakan magnitud dan arah sudut yang ditunjukkan oleh daya F_1 seperti di bawah:

$$\mathbf{F_1} = (60\mathrm{i} - 50\mathrm{j} + 40\mathrm{k})\ \mathrm{N}$$

[10 marks]
[*10 markah*]

CLO1 C4

d) Draw the model for all forces in **Question 1(c)** with the aid of a diagram on an x, y, z axis.
*Lukiskan model bagi semua daya dalam **Soalan 1(c)** dengan bantuan gambarajah pada paksi x,y, z.*

[6 marks]
[*6 markah*]

QUESTION 2

SOALAN 2

CLO1
C1

a) Describe 'Equilibrium of a Particle'.

Huraikan berkenaan Keseimbangan Zarah.

[4 marks]
[*4 markah*]

CLO1
C2

b) The sphere in **Figure 2(b)** has a mass of 6 kg. Express the force with the aid of a free-body diagram of the system.

*Sfera di dalam **Rajah 2(b)** mempunyai jisim 6 kg. Nyatakan daya dengan bantuan gambarajah badan bebas bagi sistem tersebut.*

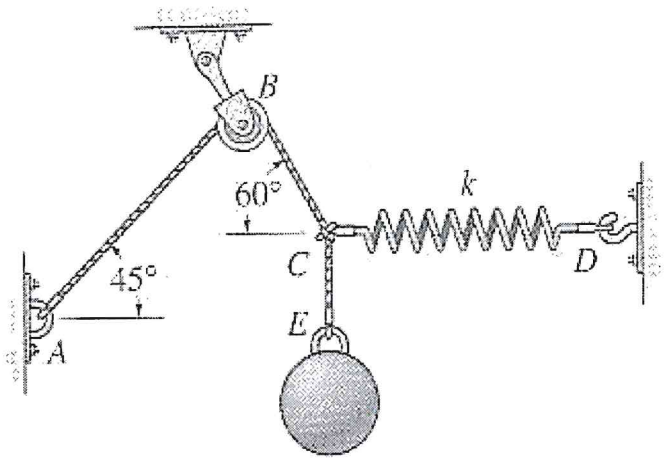


Figure 2(b) / R*ajah 2(b)*

[9 marks]
[*9 markah*]

CLO1
C3

c) Calculate the force of each member at BC, CF and EF of the truss as shown in **Figure 2(c)** and state whether the members are in tension or compression.

*Kirakan daya setiap anggota di BC, CF dan EF bagi kekuda seperti yang ditunjukkan dalam **Rajah 2(c)** dan nyatakan keadaan kekuda sama ada berada dalam keadaan tegangan atau mampatan.*

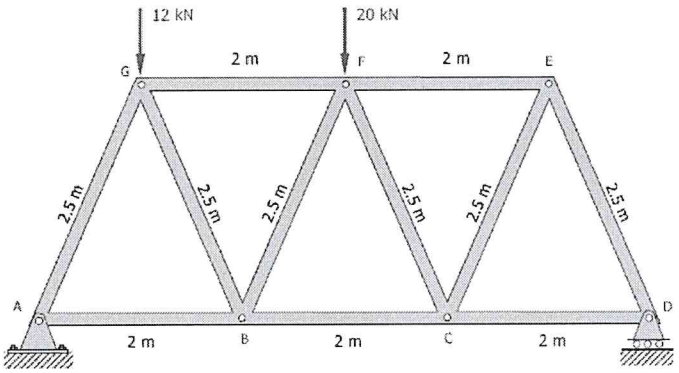


Figure 2(c) / R*ajah 2(c)*

[12 marks]
[*12 markah*]

QUESTION 3

SOALAN 3

a) Define:

Takrifkan:

i. Velocity

Halaju

[2 marks]
[*2 markah*]

ii. Angular velocity

Halaju Sudut

[2 marks]
[*2 markah*]

b) A car with wheels of 500 mm in diameter each is travelling at 64 km/h. Determine the angular velocity of the wheels in rad/s.

Sebuah kereta mempunyai roda berdiameter 500 mm setiap satunya, bergerak dengan halaju 64 km/h. Tentukan nilai halaju sudut roda tersebut dalam unit rad/s.

[5 marks]
[*5 markah*]

c) The coordinate of a car which is confined to move along a straight line is given by equation, $s = 2t^3 - 24t + 6$, where ***s*** is the distance travelled by the car measured in meter from an origin and ***t*** is the duration of travel in seconds. Calculate:

Koordinat sebuah kereta yang bergerak pada satu garis lurus diberikan dalam persamaan $s = 2t^3 - 24t + 6$, *di mana jarak perjalanan,* ***s*** *diukur dalam meter dari titik asal dan masa pergerakan* ***t*** *dalam saat. Kirakan:*

i. The time required for the car to reach the velocity of 72 m/s from its initial condition at $t = 0$.

Masa yang diperlukan untuk kereta mencapai halaju 72 m/s dari titik awal pada $t = 0$.

[4 marks]

[*4 markah*]

ii. The acceleration of the car when the velocity is 30 m/s.

Pecutan kereta itu apabila halaju 30 m/s.

[4 marks]

[*4 markah*]

iii. The net displacement of the car during the interval from t = 1 sec to t = 4 sec.

Anjakan kereta itu di antara selang masa $t = 1$ *saat hingga* $t = 4$ *saat.*

[2 marks]

[*2 markah*]

d) A ball is thrown vertically upward as shown in **Figure 3(d)** with a speed of 15 m/s. Predict the time when it returns to its original position.

Sebiji bola seperti ***Rajah 3(d)*** *dibaling secara menegak ke atas dengan halaju 15 m/s. Jangkakan masa apabila ia kembali ke kedudukan asalnya.*

[6 marks]

[*6 markah*]

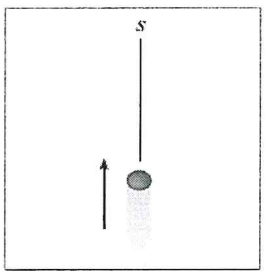


Figure 3(d) / ***Rajah 3(d)***

QUESTION 4

SOALAN 4

a) State the Newton's Second Law of motion.

Nyatakan Hukum Newton Kedua bagi gerakan.

[4 marks]
[*4 markah*]

b) Determine the velocity of the 105 kg crate as shown in **Figure 4(b)** when it reaches the bottom of the chute at B. The initial velocity of the crate is 6 m/s at A and the friction force is 35 N.

Tentukan halaju bagi sebuah peti 105 kg seperti yang ditunjukkan pada ***Rajah 4(b)*** *apabila mencecah penahan pada B. Halaju awal bagi peti adalah 6 m/s menurun dari A dan daya geseran adalah 35 N.*

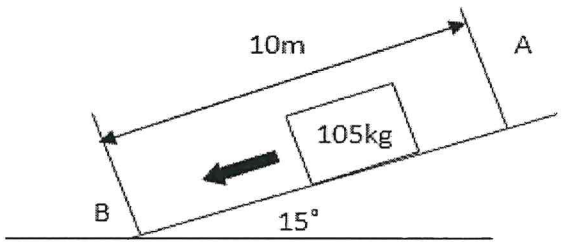


Figure 4(b) / *Rajah 4(b)*

[9 marks]
[*9 markah*]

c) An object weight 2 kg falling down from 10 m height. Calculate :
Satu objek seberat 2 kg jatuh dari ketinggian 10 m. Kirakan :

i. Gravitational potential energy and the kinetic energy possessed by the object before it fall.
Tenaga keupayaan graviti dan tenaga kinetik terhasil dari objek sebelum jatuh.

[4 marks]
[*4 markah*]

ii. Gravitational potential energy and the kinetic energy possessed by the object right after it have touched the ground.
Tenaga Keupayaan Graviti dan Tenaga Kinetik terhasil dari objek selepas menyentuh tanah.

[8 marks]
[*8 markah*]

SOALAN TAMAT

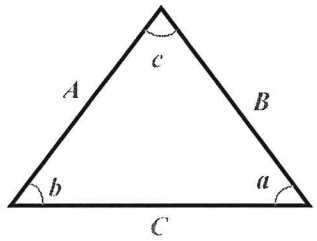
POLITEKNIK MALAYSIA

LIST OF FORMULA

DJJ3053 – ENGINEERING MECHANICS

STATICS

1. TRIANGLE RULE



Sine law:

$$\frac{A}{\sin a} = \frac{B}{\sin b} = \frac{C}{\sin c}$$

Cosine law:

$$C = \sqrt{A^2 + B^2 - 2AB\cos c}$$

2. ADDITION OF SYSTEM OF COPLANAR FORCE

$$(\overset{+}{\rightarrow})\ \Sigma F_x = F_{1x} + F_{2x} - F_{3x}$$

$$(+\uparrow)\ \Sigma F_y = F_{1y} - F_{2y} + F_{3y}$$

$$F_R = \sqrt{(\Sigma F_x)^2 + (\Sigma F_y)^2}$$

$$\theta = \tan^{-1}\left|\frac{\Sigma F_y}{\Sigma F_x}\right|$$

3. CARTESIAN VECTOR

$$\mathbf{A} = A_x\mathbf{i} + A_y\mathbf{j} + A_z\mathbf{k}$$

$$\mathbf{u}_A = \frac{\mathbf{A}}{A} = \frac{A_x}{A}\mathbf{i} + \frac{A_y}{A}\mathbf{j} + \frac{A_z}{A}\mathbf{k}$$

$$cos^2\alpha + cos^2\beta + cos^2\gamma = 1$$

$$\mathbf{F}_R = \Sigma\mathbf{F} = \Sigma F_x\mathbf{i} + \Sigma F_y\mathbf{j} + \Sigma F_z\mathbf{k}$$

$$\mathbf{r} = (x_B - x_A)\mathbf{i} + (y_B - y_A)\mathbf{j} + (z_B - z_A)\mathbf{k}$$

$$\mathbf{F} = F\mathbf{u} = F\frac{\mathbf{r}}{r}$$

4. EQUILIBRIUM OF PARTICLE

$$\Sigma\mathbf{F} = 0$$

$$F = ks$$

DYNAMICS

1. RECTILINEAR MOTION OF PARTICLES

$$v = {ds}/{dt}$$

$$a = {dv}/{dt}$$

2. UNIFORM RECTILINEAR MOTION

- *a* constant

$$v = u + at$$

$$v^2 = u^2 + 2as$$

$$s = ut + \frac{1}{2}at^2$$

$$s = \frac{1}{2}(v+u)t$$

$$v = r\omega$$

$$a = r\alpha$$

3. WORK OF FORCE

$$U_{1\rightarrow 2} = (F\cos\alpha)\Delta x$$

4. KINETIC ENERGY OF PARTICLE

$$KE = \tfrac{1}{2}mv^2$$

$$U_{1\rightarrow 2} = T_2 - T_1$$

5. POTENTIAL ENERGY

$$PE = mgh$$