

## නව නිර්දේශය/புதிய பாடத்திட்டம்/New Syllabus

NEW

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2020  
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2020  
General Certificate of Education (Adv. Level) Examination, 2020

සංයුක්ත ගණිතය I  
இணைந்த கணிதம் I  
Combined Mathematics I

10 E I

පැය තුනයි  
மூன்று மணித்தியாலம்  
Three hours

අමතර කියවීම් කාලය - මිනිත්තු 10 යි  
மேலதிக வாசிப்பு நேரம் - 10 நிமிடங்கள்  
Additional Reading Time - 10 minutes

Use additional reading time to go through the question paper, select the questions you will answer and decide which of them you will prioritise.

Index Number

## Instructions:

- \* This question paper consists of two parts;  
**Part A** (Questions 1 - 10) and **Part B** (Questions 11 - 17).
- \* **Part A:**  
Answer **all** questions. Write your answers to each question in the space provided. You may use additional sheets if more space is needed.
- \* **Part B:**  
Answer **five** questions only. Write your answers on the sheets provided.
- \* At the end of the time allotted, tie the answer scripts of the two parts together so that **Part A** is on top of **Part B** and hand them over to the supervisor.
- \* You are permitted to remove **only Part B** of the question paper from the Examination Hall.

## For Examiners' Use only

(10) Combined Mathematics I		
Part	Question No.	Marks
A	1	
	2	
	3	
	4	
	5	
	6	
	7	
	8	
	9	
	10	
B	11	
	12	
	13	
	14	
	15	
	16	
	17	
	<b>Total</b>	

Total

In Numbers	
In Words	

Code Numbers

Marking Examiner	
Checked by:	1
	2
Supervised by:	





5. Show that  $\lim_{x \rightarrow \frac{\pi}{3}} \frac{\sin\left(x - \frac{\pi}{3}\right)}{\left(\sqrt{3x} - \sqrt{\pi}\right)} = \frac{2\sqrt{\pi}}{3}$ .

More Past Papers at  
[tamilguru.lk](http://tamilguru.lk)

6. The region enclosed by the curves  $y = \frac{e^x}{1+e^x}$ ,  $x=0$ ,  $x=\ln 3$  and  $y=0$  is rotated about the  $x$ -axis through  $2\pi$  radians. Show that the volume of the solid thus generated is  $\frac{\pi}{4}(4\ln 2 - 1)$ .

7. Show that the equation of the normal line to the ellipse  $\frac{x^2}{25} + \frac{y^2}{9} = 1$  at the point  $P \equiv (5 \cos \theta, 3 \sin \theta)$  on it, is  $5 \sin \theta x - 3 \cos \theta y = 16 \sin \theta \cos \theta$ .

Find the  $y$ -intercept of the normal line drawn to the above ellipse at the point  $\left(\frac{5}{2}, \frac{3\sqrt{3}}{2}\right)$  on it.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

8. Let  $m \in \mathbb{R}$  and  $l$  be the straight line passing through the point  $A \equiv (1, 2)$  with gradient  $m$ . Write down the equation of  $l$  in terms of  $m$ . It is given that the perpendicular distance from the point  $B \equiv (2, 3)$  to the line  $l$  is  $\frac{1}{\sqrt{5}}$  units. Find the values of  $m$ .

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....





13.(a) Let  $A = \begin{pmatrix} a+1 & 0 \\ 1 & 1 \\ 0 & 1 \end{pmatrix}$ ,  $B = \begin{pmatrix} 1 & 0 \\ 0 & 1 \\ a & 2 \end{pmatrix}$  and  $C = \begin{pmatrix} a & 1 \\ a & 2 \end{pmatrix}$ , where  $a \in \mathbb{R}$ .

Show that  $A^T B - I = C$ ; where  $I$  is the identity matrix of order 2.

Show also that  $C^{-1}$  exists if and only if  $a \neq 0$ .

Now, let  $a = 1$ . Write down  $C^{-1}$ .

Find the matrix  $P$  such that  $CPC = 2I + C$ .

(b) Let  $z, w \in \mathbb{C}$ . Show that  $|z|^2 = z\bar{z}$  and applying it to  $z - w$ ,

$$\text{show that } |z - w|^2 = |z|^2 - 2\operatorname{Re}z\bar{w} + |w|^2.$$

Write a similar expression for  $|1 - z\bar{w}|^2$  and show that  $|z - w|^2 - |1 - z\bar{w}|^2 = -(1 - |z|^2)(1 - |w|^2)$ .

Deduce that if  $|w| = 1$  and  $z \neq w$ , then  $\left| \frac{z - w}{1 - z\bar{w}} \right| = 1$ .

(c) Express  $1 + \sqrt{3}i$  in the form  $r(\cos \theta + i \sin \theta)$ , where  $r > 0$  and  $0 < \theta < \frac{\pi}{2}$ .

It is given that  $(1 + \sqrt{3}i)^m (1 - \sqrt{3}i)^n = 2^8$ , where  $m$  and  $n$  are positive integers.

Applying De Moivre's theorem, obtain equations sufficient to determine the values of  $m$  and  $n$ .

14.(a) Let  $f(x) = \frac{x(2x-3)}{(x-3)^2}$  for  $x \neq 3$ .

Show that  $f'(x)$ , the derivative of  $f(x)$ , is given by  $f'(x) = \frac{9(1-x)}{(x-3)^3}$  for  $x \neq 3$ .

Hence, find the interval on which  $f(x)$  is increasing and the intervals on which  $f(x)$  is decreasing.

Also, find the coordinates of the turning point of  $f(x)$ .

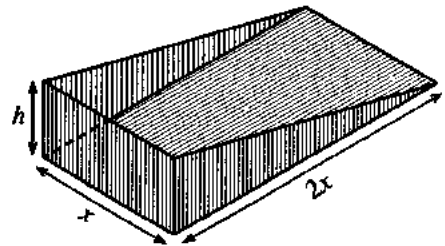
It is given that  $f''(x) = \frac{18x}{(x-3)^4}$  for  $x \neq 3$ .

Find the coordinates of the point of inflection of the graph of  $y = f(x)$ .

Sketch the graph of  $y = f(x)$  indicating the asymptotes, the turning point and the point of inflection.

(b) The adjoining figure shows the portion of a dust pan without its handle. Its dimensions in centimetres, are shown in the figure. It is given that its volume  $x^2 h \text{ cm}^3$  is  $4500 \text{ cm}^3$ .

Its surface area  $S \text{ cm}^2$  is given by  $S = 2x^2 + 3xh$ . Show that  $S$  is minimum when  $x = 15$ .





15.(a) It is given that there exist constants  $A$  and  $B$  such that

$$x^3 + 13x - 16 = A(x^2 + 9)(x + 1) + B(x^2 + 9) + 2(x + 1)^2 \text{ for all } x \in \mathbb{R}.$$

Find the values of  $A$  and  $B$ .

Hence, write down  $\frac{x^3 + 13x - 16}{(x + 1)^2 (x^2 + 9)}$  in partial fractions and

$$\text{find } \int \frac{x^3 + 13x - 16}{(x + 1)^2 (x^2 + 9)} dx .$$

(b) Using integration by parts, evaluate  $\int_0^1 e^x \sin^2 \pi x dx$ .

(c) Using the formula  $\int_0^a f(x) dx = \int_0^a f(a - x) dx$ , where  $a$  is a constant,

$$\text{show that } \int_0^\pi x \cos^6 x \sin^3 x dx = \frac{\pi}{2} \int_0^\pi \cos^6 x \sin^3 x dx.$$

$$\text{Hence, show that } \int_0^\pi x \cos^6 x \sin^3 x dx = \frac{2\pi}{63}.$$

16. Let  $A \equiv (1, 2)$  and  $B \equiv (3, 3)$ .

Find the equation of the straight line  $l$  passing through the points  $A$  and  $B$ .

Find the equations of the straight lines  $l_1$  and  $l_2$  passing through  $A$ , each making an acute angle  $\frac{\pi}{4}$  with  $l$ .

Show that the coordinates of any point on  $l$  can be written in the form  $(1 + 2t, 2 + t)$ , where  $t \in \mathbb{R}$ .

Show also that the equation of the circle  $C_1$  lying entirely in the first quadrant with radius  $\frac{\sqrt{10}}{2}$ , touching both  $l_1$  and  $l_2$ , and its centre on  $l$  is  $x^2 + y^2 - 6x - 6y + \frac{31}{2} = 0$ .

Write down the equation of the circle  $C_2$  whose ends of a diameter are  $A$  and  $B$ .

Determine whether the circles  $C_1$  and  $C_2$  intersect orthogonally.

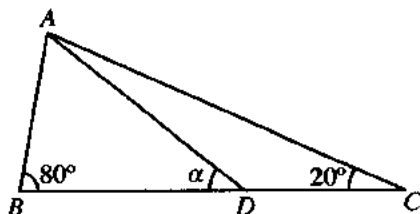
17.(a) Write down  $\sin(A-B)$  in terms of  $\sin A$ ,  $\cos A$ ,  $\sin B$  and  $\cos B$ .

**Deduce that**

(i)  $\sin(90^\circ - \theta) = \cos \theta$ , and

(ii)  $2 \sin 10^\circ = \cos 20^\circ - \sqrt{3} \sin 20^\circ$ .

(b) In the usual notation, state the **Sine Rule** for a triangle  $ABC$ .



In the triangle  $ABC$  shown in the figure,  $\hat{A}BC = 80^\circ$  and  $\hat{A}CB = 20^\circ$ . The point  $D$  lies on  $BC$  such that  $AB = DC$ . Let  $\hat{A}DB = \alpha$ .

Using the **Sine Rule** for suitable triangles, show that  $\sin 80^\circ \sin(\alpha - 20^\circ) = \sin 20^\circ \sin \alpha$ .

Explain why  $\sin 80^\circ = \cos 10^\circ$  and hence, show that  $\tan \alpha = \frac{\sin 20^\circ}{\cos 20^\circ - 2 \sin 10^\circ}$ .

Using the result in (a)(ii) above, deduce that  $\alpha = 30^\circ$ .

(c) Solve the equation  $\tan^{-1}(\cos^2 x) + \tan^{-1}(\sin x) = \frac{\pi}{4}$ .

\*\*\*

**புதிதான பாடத்திட்டம்/புதிய பாடத்திட்டம்/New Syllabus**

**NEW**

Sri Lanka Department of Examinations, Sri Lanka

**අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2020**  
**கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2020**  
**General Certificate of Education (Adv. Level) Examination, 2020**

සමස්ත ගණිතය **II**  
 இணைந்த கணிதம் **II**  
**Combined Mathematics II**

**10 E II**

පැය තුනයි  
 மூன்று மணித்தியாலம்  
**Three hours**

අමතර කියවීමේ කාලය - මිනිත්තු 10 යි  
 மேலதிக வாசிப்பு நேரம் - 10 நிமிடங்கள்  
**Additional Reading Time - 10 minutes**

Use additional reading time to go through the question paper, select the questions you will answer and decide which of them you will prioritise.

Index Number

--	--	--	--	--	--	--	--

**Instructions:**

- \* This question paper consists of two parts;  
**Part A** (Questions 1 – 10) and **Part B** (Questions 11 – 17)
- \* **Part A:**  
 Answer **all** questions. Write your answers to each question in the space provided. You may use additional sheets if more space is needed.
- \* **Part B:**  
 Answer **five** questions only. Write your answers on the sheets provided.
- \* At the end of the time allotted, tie the answer scripts of the two parts together so that **Part A** is on top of **Part B** and hand them over to the supervisor.
- \* You are permitted to remove **only Part B** of the question paper from the Examination Hall.
- \* In this question paper,  $g$  denotes the acceleration due to gravity.

**For Examiners' Use only**

(10) Combined Mathematics II		
Part	Question No.	Marks
<b>A</b>	1	
	2	
	3	
	4	
	5	
	6	
	7	
	8	
	9	
	10	
<b>B</b>	11	
	12	
	13	
	14	
	15	
	16	
	17	
	<b>Total</b>	

**Total**

In Numbers	
In Words	

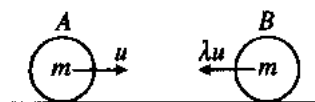
**Code Numbers**

Marking Examiner	
Checked by:	1
	2
Supervised by:	

More Past Papers at  
**tamilguru.lk**

## Part A

1. Two particles  $A$  and  $B$  each of mass  $m$ , moving in the same straight line on a smooth horizontal floor, but in opposite directions collide directly. The velocities of  $A$  and  $B$  just before collision are  $u$  and  $\lambda u$ , respectively. The coefficient of restitution between  $A$  and  $B$  is  $\frac{1}{2}$ .

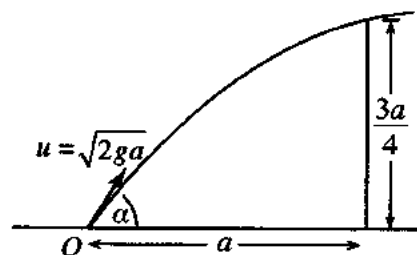


Find the velocity of  $A$  just after collision and show that if  $\lambda > \frac{1}{3}$ , then the direction of motion of  $A$  is reversed.

2. A particle is projected from a point  $O$  on a horizontal floor with initial velocity  $u = \sqrt{2ga}$  and at an angle  $\alpha$  ( $0 < \alpha < \frac{\pi}{2}$ ) to the horizontal. The particle just clears a vertical wall of height  $\frac{3a}{4}$  located at a horizontal distance  $a$  from  $O$ .

Show that  $\sec^2 \alpha - 4 \tan \alpha + 3 = 0$ .

Hence, show that  $\alpha = \tan^{-1}(2)$ .









9. Let  $A$  and  $B$  be two events of a sample space  $\Omega$ . In the usual notation, it is given that  $P(A) = \frac{3}{5}$ ,  $P(B|A) = \frac{1}{4}$  and  $P(A \cup B) = \frac{4}{5}$ . Find  $P(B)$ .  
Show that the events  $A$  and  $B$  are not independent.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

10. A set of 5 observations of positive integers, each less than or equal to 10, has mean, median and mode each equals to 6. The range of the observations is 9. Find these five observations.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....



සියලු ම හිමිකම් ඇවිරිණි / முழுப் பதிப்புரிமையுடையது / All Rights Reserved

**නව නිර්දේශය/புதிய பாடத்திட்டம் / New Syllabus**

**NEW** Department of Examinations, Sri Lanka

**අධ්‍යයන පොදු ශක්තික පන්ත (උසස් පෙළ) විභාගය, 2020**  
**கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2020**  
**General Certificate of Education (Adv. Level) Examination, 2020**

සංයුක්ත ගණිතය **II**  
 இணைந்த கணிதம் **II**  
**Combined Mathematics II**

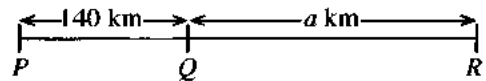
**10 E II**

**Part B**

\* Answer five questions only.

(In this question paper,  $g$  denotes the acceleration due to gravity.)

11. (a) Three railway stations  $P$ ,  $Q$  and  $R$  located in a straight line such that  $PQ = 140$  km and  $QR = a$  km, as shown in the figure. At time  $t = 0$ , a train  $A$  starts from rest



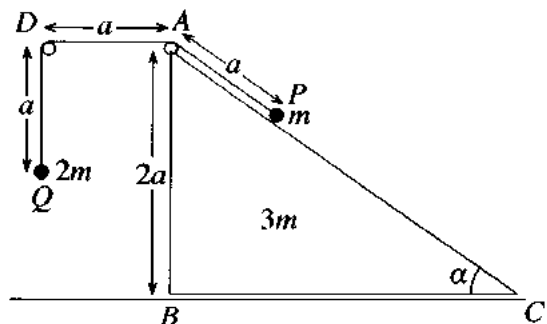
at  $P$  and moves towards  $Q$  with constant acceleration  $f$  km h<sup>-2</sup> for half an hour and maintains the velocity it had at time  $t = \frac{1}{2}$  h for three hours. Then it moves with constant retardation  $f$  km h<sup>-2</sup> and comes to rest at  $Q$ . At time  $t = 1$  h, another train  $B$  starts from rest at  $R$  and moves towards  $Q$  with constant acceleration  $2f$  km h<sup>-2</sup> for  $T$  hours and then with a constant retardation  $f$  km h<sup>-2</sup> and comes to rest at  $Q$ . Both trains come to rest at the same instant. Sketch velocity-time graphs for the motions of  $A$  and  $B$  in the same diagram.

Hence or otherwise, show that  $f = 80$  and find the values of  $T$  and  $a$ .

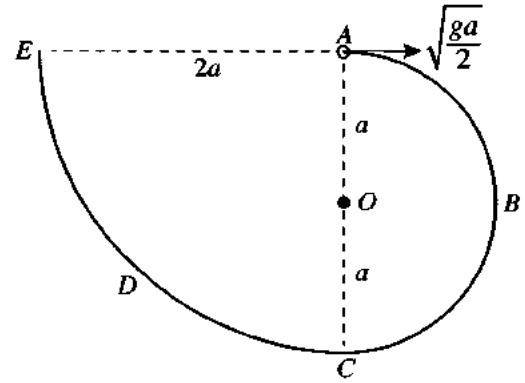
(b) A ship is sailing due west with uniform speed  $u$  relative to earth and a boat is sailing in a straight line path with uniform speed  $\frac{u}{2}$  relative to earth. At a certain instant, the ship is at a distance  $d$  at an angle  $\frac{\pi}{3}$  east of north from the boat.

- (i) If the boat is sailing relative to earth in the direction making an angle  $\frac{\pi}{6}$  west of north, show that the boat can intercept the ship and that the time taken by the boat to intercept the ship is  $\frac{2d}{\sqrt{3}u}$ .
- (ii) If the boat is sailing relative to earth in the direction making an angle  $\frac{\pi}{6}$  east of north, show that the speed of the boat relative to the ship is  $\frac{\sqrt{7}u}{2}$  and that the shortest distance between the ship and the boat is  $\frac{d}{2\sqrt{7}}$ .

12. (a) The triangle  $ABC$  in the figure is the vertical cross-section through the centre of gravity of a smooth uniform wedge of mass  $3m$  with  $\hat{ACB} = \alpha$ ,  $\hat{ABC} = \frac{\pi}{2}$  and  $AB = 2a$  such that the face containing  $BC$  is placed on a smooth horizontal floor. The line  $AC$  is a line of greatest slope of the face containing it. The point  $D$  is a fixed point in the plane of  $ABC$  such that  $AD$  is horizontal. Two particles  $P$  and  $Q$  of masses  $m$  and  $2m$ , respectively are attached to the two ends of a light inextensible string of length  $3a$  passing over smooth small pulleys fixed at  $A$  and  $D$ . The system is released from rest with the particle  $P$  held on  $AC$  and the particle  $Q$  hanging freely such that  $AP = AD = DQ = a$ , as shown in the figure. Obtain equations sufficient to determine the time taken by the particle  $Q$  to reach the floor.



(b) A smooth thin wire  $ABCDE$  is fixed in a vertical plane, as shown in the figure. The portion  $ABC$  is a semicircle with centre  $O$  and radius  $a$ , and the portion  $CDE$  is a quarter of a circle with centre  $A$  and radius  $2a$ . The points  $A$  and  $C$  lie on the vertical line through  $O$  and the line  $AE$  is horizontal. A small smooth bead  $P$  of mass  $m$  is placed at  $A$  and is given a velocity  $\sqrt{\frac{ga}{2}}$  horizontally, and begins to move along the wire.

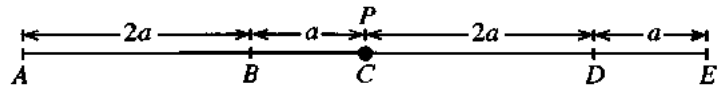


Show that the speed  $v$  of the bead  $P$  when  $\overrightarrow{OP}$  makes an angle  $\theta$  ( $0 \leq \theta \leq \pi$ ) with  $\overrightarrow{OA}$  is given by  $v^2 = \frac{ga}{2}(5 - 4\cos\theta)$ .

Find the reaction on the bead  $P$  from the wire at the above position and show that it changes its direction when the bead  $P$  passes the point  $\theta = \cos^{-1}\left(\frac{5}{6}\right)$ .

Write down the velocity of the bead  $P$  just before it leaves the wire at  $E$  and find the reaction on the bead  $P$  from the wire at that instant.

13. The points  $A, B, C, D$  and  $E$  lie on a straight line in that order, on a smooth horizontal table such that  $AB = 2a$ ,  $BC = a$ ,  $CD = 2a$  and  $DE = a$ , as shown in the figure. One end of a light elastic string of natural length  $2a$  and modulus of elasticity  $kmg$  is attached to the point  $A$  and the other end to a particle  $P$  of mass  $m$ . One end of another light elastic string of natural length  $a$  and modulus of elasticity  $mg$  is attached to the point  $E$  and the other end to the particle  $P$ . When the particle  $P$  is held at  $C$  and released, it stays in equilibrium. Find the value of  $k$ .



Now, the string  $AP$  is pulled until the particle  $P$  reaches the point  $D$  and released from rest. Show that the equation of motion of  $P$  from  $D$  to  $B$  is given by  $\ddot{x} + \frac{3g}{a}x = 0$ , where  $CP = x$ .

Using the formula  $\dot{x}^2 = \frac{3g}{a}(c^2 - x^2)$ , where  $c$  is the amplitude, show that the velocity of particle  $P$  when it reaches  $B$  is  $3\sqrt{ga}$ .

An impulse is given to the particle  $P$  when it reaches  $B$  so that the velocity of  $P$  just after the impulse is  $\sqrt{ag}$  in the direction of  $\overrightarrow{BA}$ .

Show that the equation of motion of  $P$  after passing  $B$  until it comes to instantaneous rest is given by  $\ddot{y} + \frac{g}{a}y = 0$ , where  $DP = y$ .

Show that the total time taken by the particle  $P$ , started at  $D$ , to reach  $B$  for the second time is

$$2\sqrt{\frac{a}{g}} \left( \frac{\pi}{3\sqrt{3}} + \cos^{-1}\left(\frac{3}{\sqrt{10}}\right) \right).$$

More Past Papers at  
**tamilguru.lk**

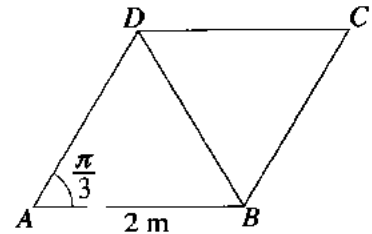
14. (a) Let  $\mathbf{a}$  and  $\mathbf{b}$  be two unit vectors.

The position vectors of three points  $A, B$  and  $C$  with respect to an origin  $O$ , are  $12\mathbf{a}$ ,  $18\mathbf{b}$  and  $10\mathbf{a} + 3\mathbf{b}$  respectively. Express  $\overrightarrow{AC}$  and  $\overrightarrow{CB}$  in terms of  $\mathbf{a}$  and  $\mathbf{b}$ .

Deduce that  $A, B$  and  $C$  are collinear and find  $AC : CB$ .

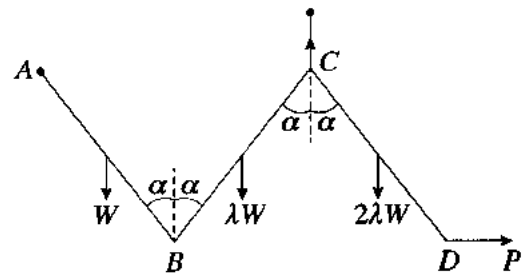
It is given that  $OC = \sqrt{139}$ . Show that  $\angle AOB = \frac{\pi}{3}$ .

(b) Let  $ABCD$  be a rhombus with  $AB = 2$  m and  $\hat{BAD} = \frac{\pi}{3}$ . Forces of magnitude  $10$  N,  $2$  N,  $6$  N,  $P$  N and  $Q$  N act along  $AD, BA, BD, DC$  and  $CB$  respectively, in the directions indicated by the order of the letters. It is given that the resultant force is of magnitude  $10$  N and its direction is in the direction parallel to  $BC$  in the sense from  $B$  to  $C$ . Find the values of  $P$  and  $Q$ . Also, find the distance from  $A$  to the point where the line of action of the resultant force meets  $BA$  produced.



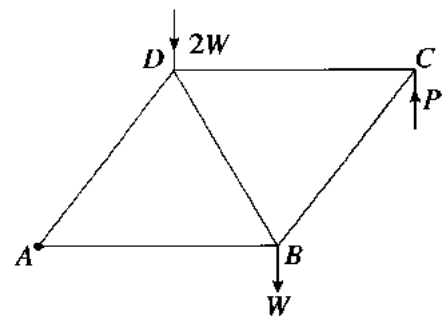
Now, a couple of moment  $M$  Nm acting in the counterclockwise sense and two forces, each of magnitude  $F$  N acting along  $CB$  and  $DC$  in the directions indicated by the order of the letters, are added to the system so that the resultant force passes through the points  $A$  and  $C$ . Find the values of  $F$  and  $M$ .

15. (a) Three uniform rods  $AB, BC$  and  $CD$ , each of length  $2a$  are smoothly joined at the ends  $B$  and  $C$ . The weights of the rods  $AB, BC$  and  $CD$  are  $W, \lambda W$  and  $2\lambda W$ , respectively. The end  $A$  is smoothly hinged to a fixed point. The rods are kept in equilibrium in a vertical plane by a light inextensible string attached to the joint  $C$  and to a fixed point vertically above  $C$  and by a horizontal force  $P$  applied to the end  $D$  such that  $A$  and  $C$  are at the same horizontal level and each of the rods making an angle  $\alpha$  with the vertical, as shown in the figure. Show that  $\lambda = \frac{1}{3}$ .



Show also that the horizontal and vertical components of the force exerted on  $AB$  by  $CB$  at  $B$  are  $\frac{W}{3} \tan \alpha$  and  $\frac{W}{6}$ , respectively.

(b) The framework shown in the adjoining figure is made from light rods  $AB, BC, CD, DA$  and  $BD$ , each of length  $2a$ , freely jointed at  $A, B, C$  and  $D$ . There are loads of  $W$  and  $2W$  at  $B$  and  $D$ , respectively. The framework is smoothly hinged at  $A$  to a fixed point and kept in equilibrium with  $AB$  horizontal by a vertical force  $P$  applied to it at  $C$ , as shown in the figure. Find the value of  $P$  in terms of  $W$ .

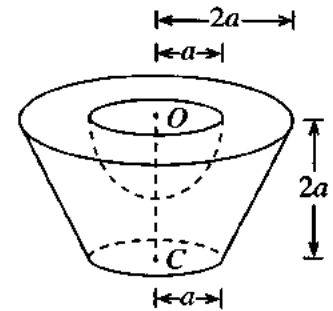


Draw a stress diagram using Bow's notation and hence, find the stresses in the rods stating whether they are tensions or thrusts.

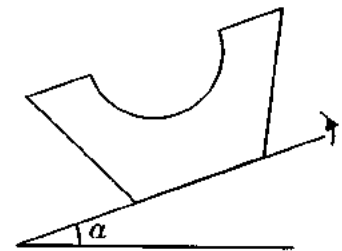
16. Show that the centre of mass of

- (i) a uniform solid right circular cone of base radius  $r$  and height  $h$  is at a distance  $\frac{h}{4}$  from the centre of the base,
- (ii) a uniform solid hemisphere of radius  $r$  is at a distance  $\frac{3r}{8}$  from its centre.

The adjoining figure shows a mortar  $S$  made by removing a solid hemisphere from a frustum of a solid uniform right circular cone having base radius  $2a$  and height  $4a$ . The radius and the centre of the upper circular face of the frustum are  $2a$  and  $O$ , respectively, and those for the lower circular face are  $a$  and  $C$ , respectively. The height of the frustum is  $2a$ . The radius and the centre of the removed solid hemisphere are  $a$  and  $O$ , respectively. Show that the centre of mass of mortar  $S$  lies at a distance  $\frac{41}{48}a$  from  $O$ .



Mortar  $S$  is placed on a rough horizontal plane with its lower circular face touching the plane. Now, the plane is tilted upwards slowly. The coefficient of friction between the mortar and the plane is 0.9. Show that if  $\alpha < \tan^{-1}(0.9)$ , then the mortar stays in equilibrium, where  $\alpha$  is the inclination of the plane to the horizontal.



- 17.(a) In a certain factory, machine  $A$  makes 50% of the items and the rest are made by machines  $B$  and  $C$ . It is known that 1%, 3% and 2% of the items made by  $A$ ,  $B$  and  $C$  respectively are defective. The probability that a randomly selected item is defective is given to be 0.018. Find the percentages of items made by the machines  $B$  and  $C$ .  
Given that a randomly selected item is defective, find the probability that it was made by the machine  $A$ .

- (b) The time taken (in minutes) to travel to work from their homes of 100 employees of a certain factory are given in the following table:

Time taken	Number of employees
0 – 20	10
20 – 40	30
40 – 60	40
60 – 80	10
80 – 100	10

Estimate the mean, standard deviation and the mode of the distribution given above.

Later, all of the employees in the class interval 80–100 moved closer to the factory. It has changed the frequency of the class interval 80–100 from 10 to 0 and the frequency of the class interval 0–20 from 10 to 20.

Estimate the mean, standard deviation and the mode of the new distribution.

\*\*\*