Bandaranayake College - Gampaha

General Certificate of (Adv. Level) Examination - 2022

First Term Test - 2022 - June

Grade **13**

Combined Maths II

10	E	II

Three hours

Name : ..... Class : .....

Instructions :-

★ This question paper comprises Part **A (1 - 10)** and Part **B (11 - 17)**.
The time allotted for **both parts** is **three hours**.

PART A (page 2 - 6)

★ Answer all questions on this paper itself.
★ Write your answers in the space provided for each question.

PART B (page 7 - 10)

★ Answer **five** questions only. Use the papers supplied for this purpose.
At the end of the time allotted for this paper , tie the two parts together so that Part A is on the top of Part B before handing over to the supervisor.

For Examiner's Use only

Part	Q. No.	Marks
A	1	
	2	
	3	
	4	
	5	
	6	
	7	
	8	
	9	
	10	
B	11	
	12	
	13	
	14	
	15	
	16	
	17	
Total		
Percentage		

Paper I	
Paper II	
Total	

Part - A

★ **Answer all questions**

(01) A train is moving along a straight track with a velocity u. On a certain day, it comes to with a uniform retadation f, due to repairs of the track. Subsequantly it starts to trvels with a uniform acceleration $2f$ and then aquired its usual velocity u again. Draw the velocity time graph and hence show that the delay occured due to repairs of the track is $\frac{3u}{4f}$.

(02) O is a point at a height H from the horizontal ground. A particle is projected from O with a velocity u inclined at an angle θ to the horizontal. After time T it reached the ground. If the initial velocity and the velocity which it hits the ground is perpendicular to each other then show that $T = \frac{u}{g\sin\theta}$ and $H = \frac{u^2\cos 2\theta}{2g\sin^2\theta}$

(03) The possition of a particle moving on a plane in a time t is given by $\underline{r} = (t^2 - 2t)\underline{i} + 3t\underline{j}$

(i) Possition vector

(ii) Magnitude and direction of the velocity.

(iii) Magnitude and direction of the accleration after 5 seconds.

(iv) අංශුවේ පථයේ කාටිසීය සමීකරණයක් සොයන්න.

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(04) A ලක්ෂ්‍යයකට 150 m දුරින් නැගෙනහිර දිශාවේ B ලක්ෂය පිහිටයි. එක්තරා මොහොතක දී P අංශුව A හි දී $10\sqrt{3}\ ms^{-1}$ ප්‍රවේගයෙන් දකුණු දිශාවට ගමන් කරයි. Q අංශුව B හි දී දකුණින් 30^0 ක් බටහිර දිශාවට $20\ ms^{-1}$ ප්‍රවේගයෙන් ගමන් කරයි. අංශු දෙක ගැටෙන බව පෙන්වා ඒ සඳහා ගතවන කාලය 15 s බව පෙන්වන්න.

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(05) A smooth hemispherical bowl of radius a is fixed wit its edge horizontal. A heavy rod is in equilibrium in a vertical plane through the centre of the bowl with one end touching a point inside the bowl and with the other end extending outside the edge. If the length of the rod inside the bowl is $\sqrt{3}\,a$, then show that the inclination of the rod with the horizontal is $\frac{\pi}{6}$.

(06) $\underline{a}$, $\underline{b}$ and $\underline{c}$ are non zero , non colliner vectors. The vector ($\underline{a}$ + $\underline{b}$) is paralleal to $\underline{c}$ and ($\underline{b}$ + $\underline{c}$) is paralle to $\underline{a}$. Show that $\underline{a}$ + $\underline{b}$ + $\underline{c}$ = 0.

(07) The weights of two rods are 2W and W respectively. The ends B and C are connected to the light rod and the framework is suspended from A. If $BCA = 60^0$, The show that the rod AB inclined at an angle with the verticle is $\tan^{-1}\left(\frac{2}{3\sqrt{3}}\right)$. Further that show that the stress of the rod is $\frac{\sqrt{3}\,W}{\sqrt{31}}$.

(08) The forces of magnitudes 4 , 6 , 10 , 8 , P and Q are act along the sides $\vec{AB}$, $\vec{BC}$, $\vec{CD}$, $\vec{ED}$, $\vec{EF}$ and $\vec{AF}$ of a regular hexagon ABCDEF. If the system of forces reduced to a single force passing through its centre , then find the value of P and Q.

(09) A and B are two events such that, $P(A) = \frac{3}{5}$ $P(B) = \frac{3}{10}$ and $P(A \cup B) = \frac{7}{10}$

Find (i) $P(A \cap B)$ (ii) $P(A / B')$

Are A and B independent ? Justify your answer.

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(10) A uniform rod AB of length $2a$ and weight W is in equilibrium with end A resting on a rough horizontal floor and the end B touching a smooth vertical wall. If the coefficient of friction between the rod and the floor is $\sqrt{\frac{3}{2}}$ then find the inclination of the rod with the horizontal when the rod is in limiting equilibrium.

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Bandaranayake College - Gampaha

10 | E | II

First Term Test - **2022** - June

Grade 13

Combined Maths II

Part - B

★ **Answer only 5 questions.**

(11) (a) A motor car B strating from rest from a poing O on a straight line travels with a uniform acceleration f. At the same instant, another car A beings to move from a point which is at a distance d apart from O, with a velocity u and uniform retardation f. It (B) comes to rest and after resting a time t, starts to move with an acceleration $2f$ in the same direction. Draw the velocity time graphs for the motions of A and B on the same diagram.

Hence show that the condition for B can't overtakes A is $\frac{u^2+ 4ftu + 2f^2t^2}{2f} \leq d$.

(b) A motor car of weight 1200 kg is moving along a rectilinear path with a uniform acceleration $a\,ms^{-2}$.

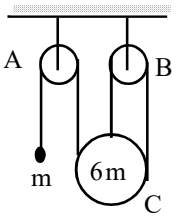
(i) If the velocity of the car increases $10\,ms^{-1}$ to $25\,ms^{-1}$ after travelling a distance of 525 m, then find the value of a.

(ii) Given that the tractive force of the car is 900N and the constant resistant force is RN, find the value of R.

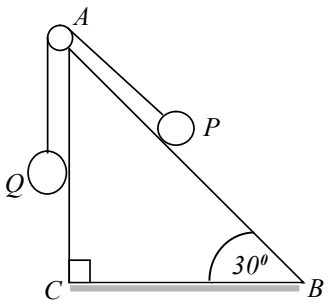
(12) (a) A ship sails with a uniform velocity $u\,km\,h^{-1}$. A is the point on the path of the ship which is the shortest distance from a harbour to the ship and this shortest distance is a km. The ship before reaches to A, when the ship at a distance $b(>a)$km from the harbour, another boat starts to sail from the harbour to meet the ship.
Show that the minimum velocity should have the boat to reaches the ship is $\frac{au}{b}\ km\,h^{-1}$.
Sketch the path of the boat.

If the boat can sail with a velocity $v\,km\,h^{-1}$ $(u > v > \frac{au}{b})$, then shsow that there are two possible positions that can be meet the ship and show that the time difference between above two positions is $\frac{2\sqrt{b^2v^2 - a^2u^2}}{u^2 - v^2}$

(13) (a) A and B are fixed pulleys in same horizontal level, and C is a moveble pulley of mass 6m. As shown in the figure a light inextensible string passes over the pulleyes and mass m attached to the one end and the other end attached to C. When the system is released from rest, find the tension in the string and the acceleration of the mass m.



(b) ABC is a vertical cross section of a wedge of mass $2m$ and the face in BC touches the smooth horizontal table. $A\hat{B}C = 30^0$ and $A\hat{C}B = 90^0$. A smooth light pulley fixed at vertex A. A light inextensible string passes over the pulley at A and as shown in the figure two masses P and Q each of weight $4m$ and m attached the two ends of the string respectively.



(i) Show that the vertical component of the acceleration of Q is $\frac{7g}{23}$ and find the horizontal component.

(ii) Find the reaction between Q and the wedge.

(14) (a) A and B are two points such that $\vec{OA} = \underline{a}$ and $\vec{OB} = \underline{b}$. M is a mid point of OA and X and Y are the points on OB and AX such that OX : XB = 3 : 1 and AY : YX = 4 : 1.

(i) Express $\vec{OM}$, $\vec{OX}$ and $\vec{OY}$ interms of $\underline{a}$ and $\underline{b}$.

(ii) Show that $\vec{BY} = \frac{1}{5}(\underline{a} - 2\underline{b})$

(iii) Show that B, Y, M are collinear and find the ratio of BY : YM.

(b) *If* $|\underline{a}| = 3$, $|\underline{b}| = 2$ and $|\underline{a} - \underline{b}| = 4$ then

Find (i) $\underline{a} \cdot \underline{b}$

(ii) angle between $\underline{a}$ and $\underline{b}$

(iii) $|\underline{a} + \underline{b}|$

(15) (a) $\underline{i}$ and $\underline{j}$ are unit vectors along OX and OY. The forces $\underline{i} + \underline{j}$, $-4\underline{i} + 3\underline{j}$, $-\underline{i} - \underline{j}$ and $x\underline{i} + y\underline{j}$ are act the points with position vectors $-4\underline{i}$, $3\underline{i} + \underline{j}$, $-\underline{i} + 4\underline{j}$ and $5\underline{i} + 3\underline{j}$. (The units measured by M and m)

(i) If the system of forces reduced to a couple G, then find the values of x and y.

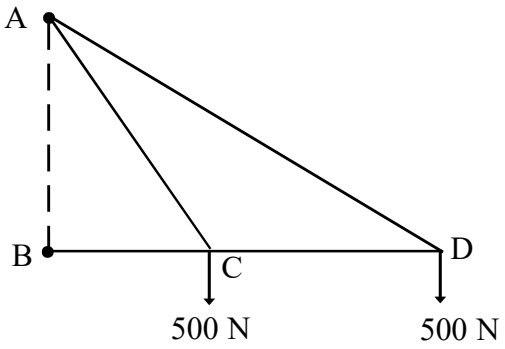
(ii) If the system of forces reduced to a single force $a\underline{i}$ then find the values of x, y and a.

(iii) If $x = 7$ and $y = 1$ then find the equation of line of action of the resultant force of the system.

(b) A sphere formed by two hemispheres such that one is the solid hemisphere of mass 8w and the other one is hollow hemisphere of mass 2w. Sphere held in equilibrium by the solid part touching the smooth vertical wall and rough horizontal floor. If the coefficient of friction between the sphere and the floor is μ, then show that there should be $\frac{1}{5} \leq \mu$ for equilibrium.
(The centre of gravity of solid hemisphere is $\frac{3a}{8}$ the hollow hemisphere is $\frac{a}{2}$, where a is the radius)

(16) (a) Three uniform rods AB , BC and CD are each of equal length and equal weights joined at B and C. BC is horizontal. The system is in equilibrium by the means of the two rods AB and CD touch the two pegs in same horizontal line. If the inclination of each rod AB and CD to the horizontal is α and the reaction at B makes an angle β with the vertical , then show that $\tan\alpha \tan\beta = 3$.

(b)



A framework ABCD as shown in the figure formed by four light rods and it hinged at A and B. AB is vertical. $AB = 2a$ and $BD = 4a$. C is a mid point of BD. Using the Bow's notation draw the stress diagram. State wheather they are tension or thrust.

(17) (a) Define "independence of two events A and B".
Define " two events A and B are mutually exclusive".

(b) Given that two events A and B such that , $P(A) = \frac{5}{12}$, $P(A/B') = \frac{7}{12}$, $P(A \cap B) = \frac{1}{8}$
Find $P(B)$, $P(A/B)$, $P(B/A)$, $P(A \cup B)$, $P(A'/B)$, $P(B/A')$

(c) State wheather,
Are A and B mutually exclusive ?
Are A and B independent ?

(d) Four A , B , C , D competitors play a ball throwing game. Out of the cards numbered from 1 to 10 in a box, the judge decides the turn of the player , based on the randomly selected card number

A takes the opportunity when the number is 7 , B is a multiple of 3 or 3 and C is a multiple of 5 or 5. When the number of the card in geometric series with 1 st term is and the common ratio is 2 , D is also given the opportunity to compete.
The probability of throwing of the correct target according to past performance A , B , C , D are $\frac{1}{6}$, $\frac{1}{4}$, $\frac{1}{2}$, $\frac{1}{12}$ respectively.

(i) Find the probability of competitors, throwing the ball at the target.
(ii) If the thrown ball is aimed at the target correctly , find the probability that the ball will be thrown by C.