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**Second Term Examination - 2019**

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**COMBINED MATHEMATICS – II**

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**Answer all the questions of part A and any five questions of part B.**

**Part A**

1. A lift performs first part of its ascent with uniform acceleration **f** and the remainder with

uniform retardation **2f**. If **h** is the depth of the shaft and **t** the time of ascent then show that

**h = f t2**

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2. The resultant of two unequal forces **P** and **Q** is **Q** and makes an angle of **30o** with the

direction of **P**. Prove that **P = 2Q**

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3. **P** and **Q** are two ports on the same coast of a river which flows uniformly. A steam boat takes

**t1** seconds to move from **P** to **Q** and **t2 (> t1)**,Seconds to move from **Q** to **P**. Show that

the time taken by a log of wood to float freely from **P** to **Q** is,

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A

3m

B

2m

4. One end of a light inextensible string which passes over

a smooth fixed pully **A**, carries a particle of mass **3m**. The

string passes under a smooth light pully **B**, which carries a

particle of mass **2m**. The other end of the string is attached to

a ceiling as shown in the figure. The system moves freely under

gravity. Show that the tension in the string is

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5. The position vectors of the points **A**, **B** and **C** with respect to the origin **O**, are  **= 3 +** ,

**= –** and  **= 3 – 2** Show that the vector is perpendicular to

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6. A heavy ball drops from the celling of a room and after rebounding twice from the floor,

reaches a height equal to the one half of the ceiling. Show that the coefficeut of restitution of

the ball is

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7. Let **R** be the horizontal range and **H** be the greatest height of a projection. If **U** is the initial

velocity of the projection then show that **U =**

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8. Forces **3P**, **7P** and **5P** act at a point parallel to the sides **AB**, **BC** and **CA** of an equilateral

triangle **ABC**. Find the inclination of the resultant to **BC**.

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9. A uniform ladder of length **2*a*** and weight **W** is leaning against a smooth vertical wall, at an

angle to the horizontal. A man of weight **W** climbs up the ladder. Show that if **> Cot**

reaches the top of the ladder. Where is the coetticent of the friction.

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10. The length of a uniform rod **AB** is **12 *a*** and weight **W**. It is kept with its end **A** touching a

smooth plane inclined at an angle  **,** with the horizontal by means of a smooth

peg at a point **C** on it if the rod is held in equilibrium inclined an angle 45o with the horizontal,

then find the position of **C**.

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**Second Term Examination – 2019**

**COMBINED MATHEMATICS – II**

**Part B**

**Answer any five questions.**

11. (a). A motor car is travelling on a level road, passes a point A with a speed of **7U kmh-1**

and constant retardation **f1 ms-2** over a distance **5d** **m** and reacher point **B**. At the point

**B**, the speed of the car suddenly drops from **5U** **kmh-1** to **3U** **kmh-1** due to defected

of the engine. The car then moves the uniform speed **3U** **kmh-1** over a distance. **3d**

**m**, reaches point **C**. If then travels with a uniform refardation over a distance **2d m** unil

if comes to rest.

Draw a velocity – time curve for the motion of the car. Hence show that total time taken

is min.

Find the values of **f1** and **f2** in terms of **U** and **d**.

(b). **A** port **B** is **d km** east of port **A**. At **t = 0** , a ship **P**, starts with uniform velocity **U** in

the direction an angle , North of east, from **A**, and another ship **Q** starts with uniform

velocity **2 U** in the direction, an angle west of north, from **B**.

i. Show the relative velocity of **Q** relative to **P** is  **U** in the direction an angle , west

of Notrth, where

ii. If the ships P and **Q** meet each other, find tan and show that the time taken is  **d**

12. (a). A wedge of mass **M** with an inclination to the horizontal is placed on a smooth

horizontal surface. Two masses **m** and **2m** are attached to the ends of a light

inextensible string and placed on the face of an inclined plane of the wedge passing

over a light pulley fixed at the highest point of the wedge. When system is released from

rest, show that the acceleration of the wedge is,

Find also the accelerations of the two masses relative to the wedge.

(b). A particle of mass **m** is attached to one end of a light inextensible string of length **a**,

and the other end is attached to a fixed point **O**. When the particle hanging in

equilibrium position a horizontal velocity of **U** is given to the particle. When the string

makes an angle with the downward vertical the velocity of the particle is **V** and the

tension is **T**.

Show that  **= – 2 *ag* (1 – Cos )** and

**T = [ - *ag (2 – 3 Cos )*]**

If  **< 2 *ag*** then show that the particle describes an arc of a circle

ii. When the speed of the particle is, show the inclination of the string is

**2**

with the downward verticle.

13. (a). A particle aimed at a mark wich is in a horizontal plane through the point of projection,

falls ***x*** meters short of it, when the elevation is and goes **b** meters too far, when the

elevation is . If the velocity of the projection is same in all cases then show that the

proper elevation is

(b). A car of **1000 kg** moves with its engine shut off down a slope of inclination , where

***Sin*  =**  at a steady speed of **15** . Show that the resistance to the motion

of the car is **100 N**.

Find the power of the engine when the car ascends the same slope at the same steady

speed **(g = 10 )**

14. (a). and are non-zero and non-parallel vectors. If  **+ = 0**. Where and are

scalars then prove that  **= 0** and  **= 0**

If and are non-zero and non-parallel vectors and **2 + t ( - )** and

**(2 + + t)** are parallel, then find the value of **t**.

(b). If **( + ) ( - ) = 0** then show that **| | = | |**

(c). Forces of magnitude **2P, P, 2P, 3P, 2P** and **P** newtons act along the sides  **, ,**

**, ,**  and respectively of the regular hexagon **ABCDEF**.

Prove that system of forces can be reduced to a single force of magnitude **2 P**

Newtons, act along **AC** together with a couple. Find the magnitude of the couple. Also

show that the system can be reduced to single force without a couple. If the line of

action of this force cuts **FA** produced at **X**, calculate the length **AX**.

15. (a). A regular hexagon **ABCDEF** is made of six equal uniform rods jointed freely. The

hexagon rests in a verticle plane having **AB** in contact with a given horizontal plane

and **C, F** are connected by a light inextensible string. Show that the reaction at the joint

is , Where **W** is the weight of a rod and find the tension in the string.

(b). The diagram shows the frame work consisting five equal light rods equal in length.

B

Q

D

C

A

P

100 N

Forces **P** and **Q** act at **A** and **B**. **100 N** weight

is suspended at **C**. Find the value of **P** and **Q**

by drawing stress diagram for the joints **A, B**

only find the stress in the rods **AD**, **AB**, **BC**,

**BD** and state whether thrust or tension.

16. (a). Two uniform rods **AB**, **BC** rigidly joined at **B** so that angle **ABC** is right angle, hang

freely in equilibrium from a fixed point **A**. The length of the rods are **a** and **b** and their

weights are **aw** and **bw**. Prove that, If **AB** makes an angle with the verticle then

**=**

(b). The end of a uniform rod of weight **W** is attached to a hinge and the other is supported

by a string attached to the extremity of the rod. The rod and the string are inclined at

the same angle to the horizontal. Show that the reaction at the hinge is

Find also the tension in the string.

17. (a). Two equal uniforme rods **AC**, **CB** are freely jointed at **C** and rest in a verticle plane

with end **A** and **B** in contact with a rough horizontal plane. If the equilibrium is limiting

and the coefficient of the friction is and **AB = 2**. Then show that

i.  **= tan**

ii. **Sin AB =**

(b). A uniform rod is placed within a fixed rough verticle circular hoop. If the rod subtends

an angle of **60o** at the centre of the hoop and the coefficient of friction is , show that

in the position of limiting equilibrium the inclination of the rod to the horizon is