Second Term Examination - 2024

E | I, II

Physics – I, II

GRADE 12

Three hours

- **Answer all the questions**

1. What is the group of different dimension if seen as (A+B)x +Cy = D ?
(1) A, B (2) Cy, D (3) Ax, Cy (4) Bx, D (5) A, C

2. Consider the following statements about dimensions.
A) Only physical quantities having the same dimensions can be added or subtracted.
B) All physical quantities with units have dimension.
C) All physical quantities with dimensions have unit.
Which of the above statements is / are true?
1) Only A 2) Only A, C 3) Only A, B 4) Only B, C 5) All A, B, C

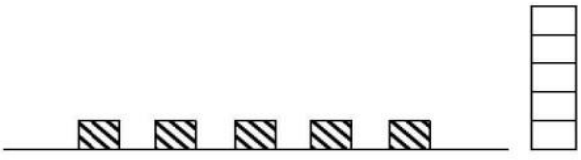
3. What would be the error minimized by taking the period of 20 oscillations instead of one oscillation in the experiment of determining the period of simple pendulum?
1) Random error 2) Systematic error 3) Percentage error
4) No parallax error 5) Absolute error

4. Which measurement cannot be obtained using vernier caliper, micrometer screw gauge, travelling microscope and meter ruler?
(1) 3.51mm (2) 100.5mm (3) 875mm (4) 501.25mm (5) 2.06mm

5. A solid block is on the smooth horizontal table, a bullet collides and embeds itself in the solid block. In the meantime conserves.
(1) only kinetic energy (2) Only momentum (3) Only momentum
(4) momentum (5) momentum and total energy

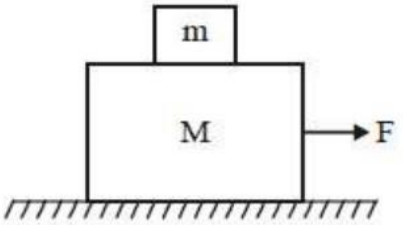
6. An object moves 4m in 4 s on a smooth horizontal plane under the exertion of 20 N force. What i the power of the system during this period?
(1) 5 W (2) 10W (3) 2 5W (4) 3 5W (5) 4 5W

7. What is the minimum work required to stack five cubes of side length a and mass m on top of each other?
(1) 8mga (2) 12.5mga (3) 10mga
(4) 12mga (5) 6mga



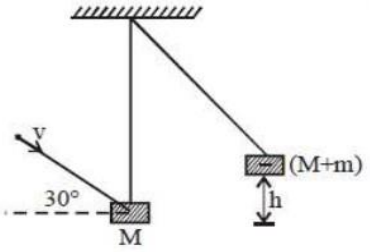
8. Consider the following statements regarding an object at equilibrium when three forces act
A - Their lines of action should meet at one point.
B - Sum of magnitudes of two forces should be equal to the third force.
C - They should be in same plane.
(1) Only C is true (2) Only A is true (3) Only A, B are true
(4) Only A, C are true (5) All are true

9. The coefficient of static friction between the two blocks shown in figure is μ and the table is smooth. What maximum horizontal force F can be applied to the block of mass M so that the blocks move together?



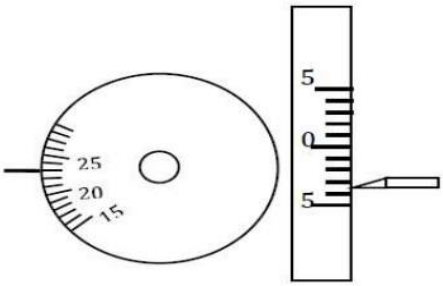
(1) μg (M + m) (2) μg (M – m) (3) 2μg (M + m)
(4) μg (M + 2m) (5) μg (M - 2m)

10. A bullet of mass 20 g hits a block of mass 1.98 kg suspended from a massless string of length 100 cm and sticks to it. The bullet flies down at an angle of 30° to the horizontal with a velocity of 200 m/s. Through what height the block will rise-



(1) 0.15 m (2) 0.2 m v (3) 0.45 m
(4) 0.75 m (5) 0.8 m

11. Circular scale of spherometer consists of 50 divisions. If main scale moves 1mm distance during two complete turns of circular scale, what is the reading in shown instance?



(1) 3.23mm (2) 4.23mm (3) 2.23mm
(4) 2.27mm (5) 3.77mm

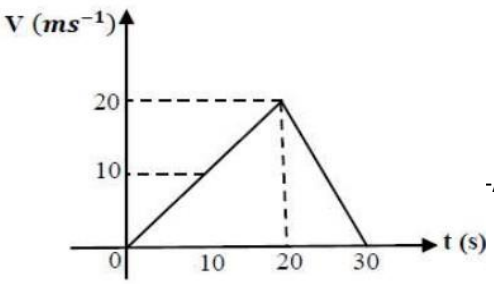
12. A ball is thrown from an open vehicle travelling on a horizontal road with a constant velocity 30 ms^{-1} and after it travelled 180 m what is the initial velocity and horizontal angle at which the ball must be thrown if the ball returns to the thrower's hand?

(1) 20 ms^{-1} $\tan^{-1}(4/3)$ (2) 30 ms^{-1}, $\tan^{-1}(1)$ (3) 40 ms^{-1}, $\tan^{-1}$ (4/3)
(4) 20 ms^{-1}, 90^{o} (5) 30 ms^{-1}, 90^{o}

13. Which of the following statement(s) is/are true?
(A) When the momentum of a system is unchanged, its kinetic energy can change.
(B) When the particles of a system are in motion, the center of mass of this system can be stationary
(C) When a resultant external force is being exerted in a system, the angular momen tum of this system can remain unchanged.
(1) (A) only (2)(B) only; (3)(C) only `
(4) All (A),(B),(C) (5)All are wrong

14. A box of mass 5 kg is kept on a horizontal surface. The coefficient of static friction between the surface and box is 0.3. If a horizontal force of 10 N is applied on the box, the frictional force acting on the box is
(1) 1.5 N (2) 3 N (3) 4.5 N (4) 10 N (5) 15 N

15. The graph given in the figure shows the variation of velocity V of a body of mass 1kg with time t. Which one of the following statements is faulty?

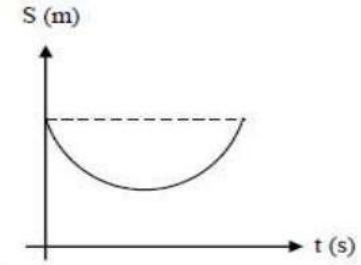


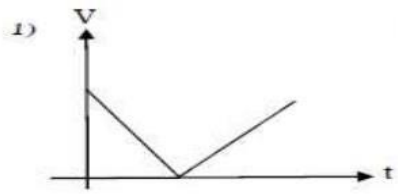
1) The amount of work done on the body up to 30 s is zero.
2) The mean acceleration of the body is zero.
3) The mean velocity of the body is zero.
4) The mean value of force acted on the body is zero.
5) The mean value of impulse acted on the body is zero.

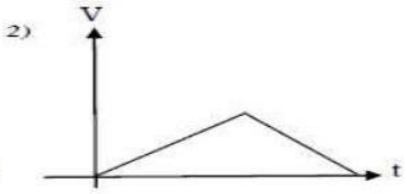
-August

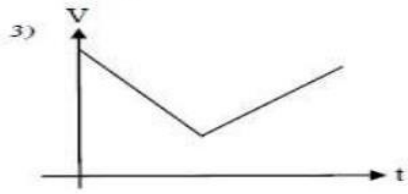
16. Pascal's principle of pressure transmission in fluids is not applied in which of the following case?
1) Hydraulic break system in the vehicles.
2) For washing vehicles, hydraulic lift used to raise the vehicles at service station.
3) A stream of fluid flowing downwards from higher hill.
4) Adjusting the patient seat in dental clinic.
5) Hydraulic pressure system used to raise the trailor.

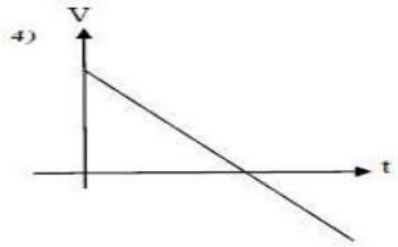
17. The velocity (v) – time (t) graph corresponding to the displace ment – time graph. shown beside is.

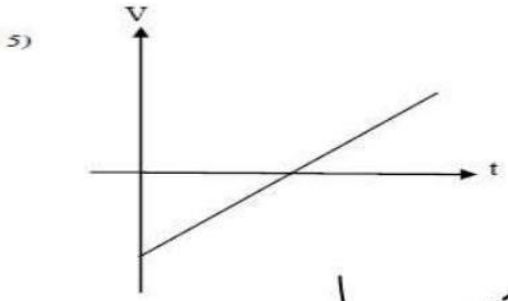




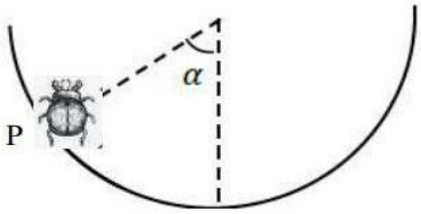








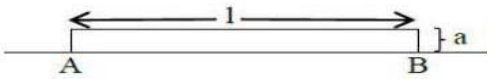
18. A small insect P travels upward along the inner surface of a stable spherical container. The coefficient of friction between the inner surface of the container and the legs of the insect is μ . The maximum value of α can be,



1) $\tan^{-1}\mu$ 2) $\tan^{-1}\frac{1}{\mu}$ 3) $\cos^{-1}\mu$ 4) $\cos^{-1}\frac{1}{\mu}$ 5) $\sin^{-1}\frac{1}{\mu}$

19. A projectile is thrown at a certain angle with the horizontal. Which of the following statements is wrong when it is at its highest point of its trajectory?
1) Its speed is zero
2) Its speed is minimum
3) Its kinetic energy is minimum
4) Its potential energy is maximum
5) The magnitude of its acceleration is g.

20. The minimum work that has to be done against gravity to bring this rod vertical while the floor the end A touching the floor is twice the minimum work that has to be done against gravity to bring this rod vertical while the end B touching the floor . If the length of the rod is l, the inter distance between end A and centre of gravity?

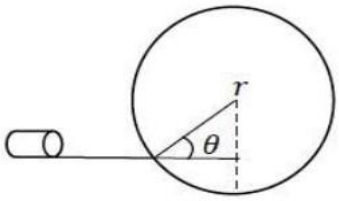


1) $\frac{l-2a}{3}$ 2) $\frac{l-a}{3}$ 3) $\frac{2l}{3}$ 4) $\frac{3l}{2}$ 5) $\frac{(2l-a)}{3}$

21. A projectile has a range R on the surface of the earth. For the same initial speed and angle of projection, its range on a planet where the acceleration due to gravity is one-fourth of that on the earth, is

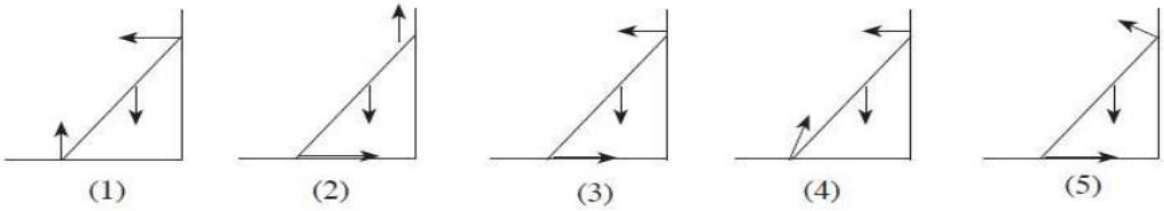
(1) $\frac{R}{4}$ (2) $4R$ (3) $\frac{R}{16}$ (4) $16R$ (5) $\frac{R}{3}$

22. A cylindrical wheel of mass nm is able to rotate freely about a smooth vertical axisis. A bullet of mass m and velocity V hits on the circumference and get dipped inside the cylindrical wheel as shown in the figure.The angle between velocity of bullet and its radius is r. If then angular velocity of system ?
(moment of inetia of wheel= ½ mr2)

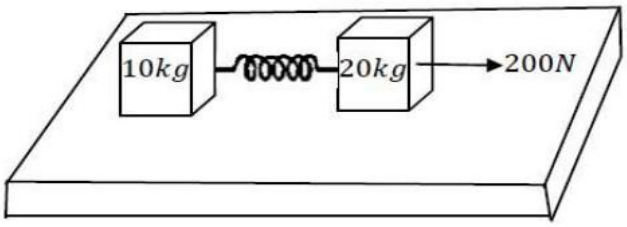


1) $\frac{2V \sin\theta}{(n+2)r}$ 2) $\frac{2V \cos\theta}{(n+2)r}$ 3) $\frac{2V}{(n+2)r}$ 4) $\frac{V\sin\theta}{(n+2)r}$ 5) $\frac{2V\tan\theta}{(n+2)r}$

23. A Ladder is in an equilibrium on a vertical plane which is perpendicular to the wall as shown in the figure below. One end of the ladder is on the rough horizontal ground and the other end is resting against a smooth vertical wall. The correct free body diagram for the forces acting on the ladder is,

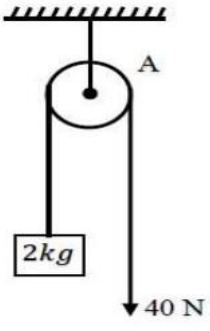


24. masses are connected by a light spring and placed on a smooth horizontal plane. As show in the figure a force of 200 N is applied horizontally on the mass 20 kg. At a certain instant the acceleration of 10 kg is , the acceleration of 20 kg will be.



1) Zero 2) 4 m s^{-2} 3) 7 m s^{-2}
4) 10 m s^{-2} 5) 12 m s^{-2}

25. A box of mass 2kg is attached to a light string which passes over a light smooth pulley and pulled by applying a 40 N force at the other end of the string. If the kinetic energy of the box is increased in a certain interval of time by 40 J. Which of the following statements is wrong?

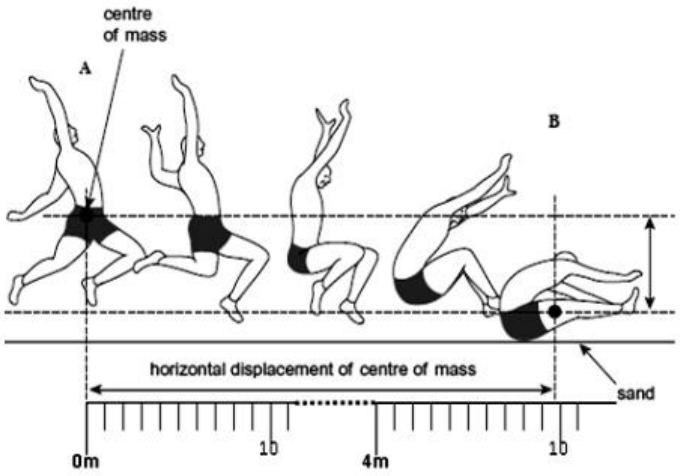


1) The tension in the string 40 N
2) The displacement of the box in the given interval of time is 2 m
3) The work done by the gravitational force is (-) 20 J
4) The work done by the pulling force is (-) 80 J
5) In the given interval of time the increase in potential energy is 40 J.

Part II

- **Answer the Part A (structure essays in the paper itself. Part B (essays questions) in separate paper**
- **Answer all the questions**

1) The motion of a long jumper during a jump is similar to that of a projectile moving under gravity. The figure shows an athlete's path above the ground during a long jump from halfway through the jump at position A, to position B at which contact is made with sand on the ground. The athlete is traveling horizontally at A and the horizontal displacement of the center of mass from A to B is measured by a measuring tape calibrated in cm scale as shown in the figure. (Neglecting the air resistance).



a) i. What is the horizontal displacement of the center of mass of the athlete from A to B?

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ii. What is the estimated error of the measurement?

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b) i. During this part of the jump, the center of mass of the athlete falls 1.25m, calculate the time taken for the center of mass to move from A to B.

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ii. Find the velocity of the athlete at A.

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iii. Find the horizontal and vertical velocities of the athlete at the point of jumping.

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c) i. The athlete slides horizontally through the sand a distance of 0.41m before stopping. Calculate the time taken for the athlete to stop sliding. (Assume that the horizontal component of the resistive force from the sand is constant)

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ii. The mass of the athlete is 75 kg. Calculate the horizontal component of the resistive force from the sand.

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iv. Why did the athlete stretch his legs and hands while landing on the sand?

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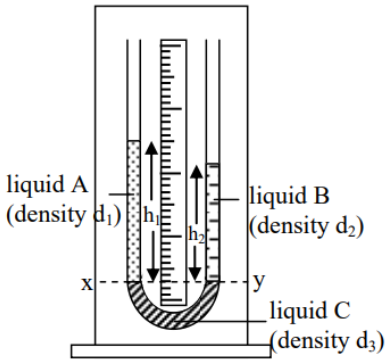
2) Figure shows a modified U tube experimental setup to compare the densities of two liquids A and B, employing a third liquid C which is immiscible with both A and B. The level XY of the liquid C in the two arms of the U tube is horizontal.



a) Write down the inequality relationship among the densities of these liquids (d1, d2 and d3)

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b) Suppose that the levels of liquids A and B above XY are h1 and h2 respectively. Write down an equation relating h1, h2, d1 and d2

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c) Why is it necessary to maintain XY horizontal?

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d) i. State the experimental procedure to determine the ratio of the densities of d1 and d2 using a graphical method (a sufficient amount of liquids are available).

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ii. Comment on the accuracy the measurements of h1 and h2 when the density of C differs very much than that of A or B.

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e) i. Draw a rough sketch of the straight-line graph denoting h1 and h2 on the x and y axis respectively.

ii. The gradient of the straight line is as 0.8 when A, B and C are chosen as water (density 1000Kgm-3), copper sulphate solution and mercury (density 13600kgm-3) respectively. Find the density of the copper sulphate solution.

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iii. If it is desired to measure the height of the liquid column with an accuracy less than 1% what will be the minimum height of the liquid column.

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Part B

03)

a) A car ,A, of total weight 1.2×10^4 N is travelling up an inclined road of length 4.8 km and of vertical height 0.3 km with a uniform speed of 16 ms^{-1}. The average frictional force acting on the car is 5.0×10^2 N.

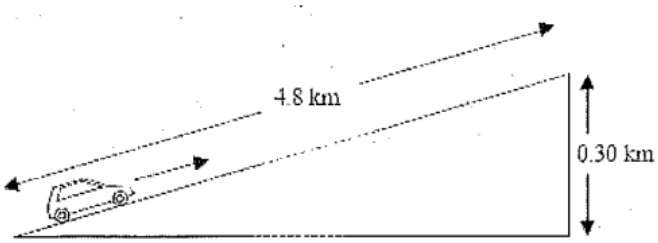


Fig I

i) What is the time taken by the car, A, to reach the top of the inclined road.

ii) Calculate the work done by the car, A, against the gravity.

iii) From your answer for a(i) and a(ii) , find the minimum power delivered by the car, A, to reach the top of the inclined road.

b) The car, A, after reaching the top of the inclined road it is brought to rest. It then continue its journey, down an inclined road of length 6.4 km as shown in the figure below. For the sake of saving fuel, the engine is shutdown and the car is allowed to travel down the road. The average value of resistance on the car during this motion is 5.0×10^2 N.

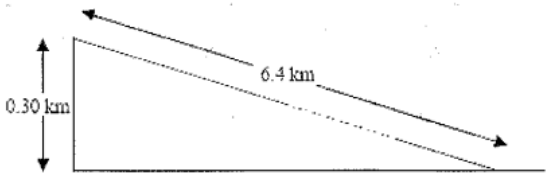


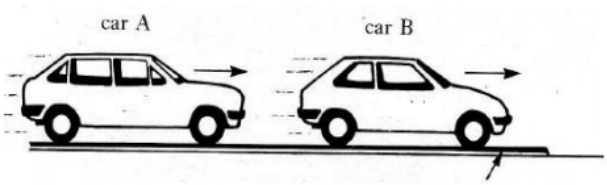
Fig II

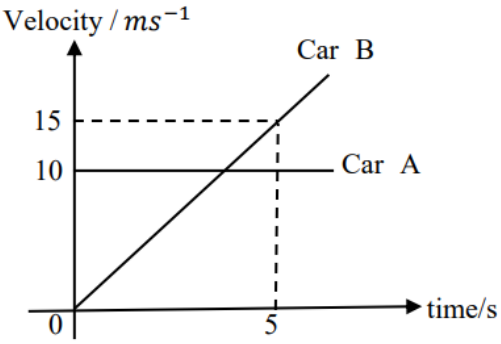
i) What is the acceleration of the car?

ii) What will be the speed of the car when it reaches the bottom of the road?

iii) In fact, the car is moving through the last 100 m down the inclined road with uniform speed. Calculate the frictional force acting on the car at this stage.

c) The car A, is travelling on a straight level road with uniform speed. It passes another car B parked by the side of the road. At the moment the car A, passes the car B, the car B start moving in the same direction as car A. The velocity – time graph given here shows the motion of car A and car B, right from the time car A is passing the car B





i) Find the initial acceleration of the car B.

ii) Find the distance between the car A and the car B at the end of 5.0 s

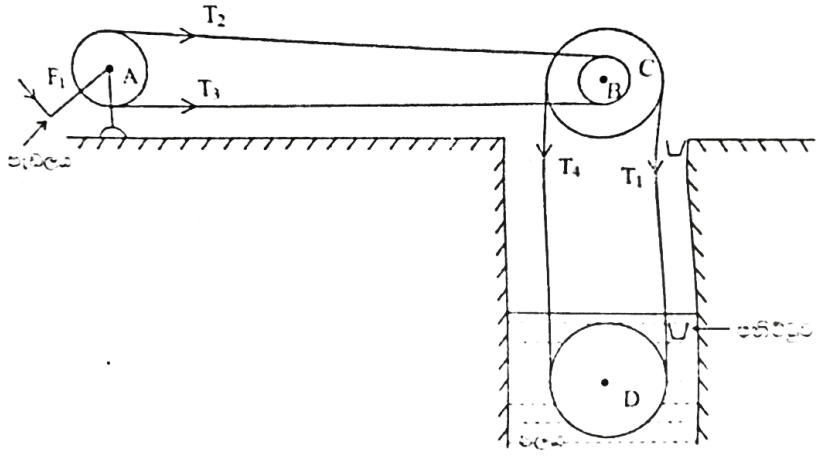
iii) The total weight of the car B is 1500 kg. At time 2.0 s, the tractive force exerted by the car B is 9000N

1) What is the frictional force acting on car B at this moment?

2) To maintain a constant acceleration, the tractive force exerted should be increased with time. Explain the reason behind this.

3) At the end of 6.0 s, the tractive force exerted by the car B reaches its maximum value and then it maintains it. Draw the velocity – time graph for the car B.

02) The figure shows a system of equipment designed to convert the energy waist in riding a bicycle to useful work done. Riding the exercise bike (by pedals) pulls water from a well. Applying a uniform tangential force F_1 on the pedal causes all wheels and belts to rotate. The weight of the belt can be neglected. The buckets attached to the Y belt, used to bring the water from well to the ground level. The water is pumped out by another method and collected in the tank, above ground.



The length of the pedal arm is 50cm, and the radii of the wheels A, B, C, and D are 40cm, 10cm, 50cm and 50cm respectively. The height above the water level is 20m and the distance between two adjacent buckets is also 20m. The mass of the bucket with water is 1 kg. wheels B and C are rigidly mounted concentrically. The work done against water resistance in bringing the bucket from water level to ground level is 100J. Answer the following questions considering that the bucket moves with uniform speed and it takes 2Seconds, to reach the ground level.

a) i. Find the speed of the Y belt
   ii. Find the angular velocity of wheel C
   iii. Find the speed of the X-belt
   iv. Find the angular velocity of wheel A
   v. Find the angular displacement of wheel A in bringing the bucket from water level to ground level

b) i. Calculate the total energy received by the bucket in bringing it from water level to ground level.
   ii. Find the power acting on the pedal, if the friction force between the wheel and axle is zero
   iii Find the average force against the water-resistive force.
   iv. If the tension forces T_3 and T_4 are negligible. Find the tension force T_1 and T_2 in the belt and the tangential force F_1 on the pedal.
   v. What is the angular acceleration of the wheel when the tangential force is increased by 20N? (Moment of inertia of A is $2Kgm^2$)

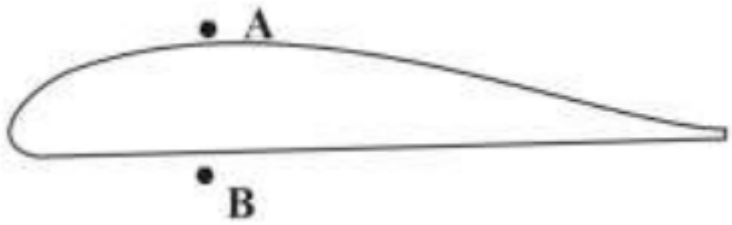
02) The wings of the aircraft are specially shaped to provide the upward lifting force to lift and aircraft. A cross-section of a plan is shown in the figure.

A)

i) Draw the streamlines near the wing, when the plane moves in the given direction

ii) Write the equation of the Bernoulli theorem and name all the terms.

The upstream and downstream pressures of the wing are P_a and P_b. The velocities of points A and B are V_a and V_b. Density of air is Þ



iii) Write the Bernoulli theorem for the Point A

iv) Write the statement about $P_a - P_b$

At takeoff, the velocity of air flowing below the lower surface of its wings is $50ms^{-1}$. The velocity of air passing above the top surface is $100ms^{-1}$. The density of air is 1.2 kgm^{-3} The effective surface area of the wings is $1500m^2$.

v) Calculate the pressure difference above and below the wings.

vi) Calculate the lifting force applied on the wings.

vii) Copy the given diagram, mark the lifting force and weight acting on the wings

viii) The mass of the lane is 6×10^5 kg. Calculate the upward acceleration of the plane.

B) The fan blade installed in the wings of the plane provides the necessary power to move the plane forward. The length of the one fan blade is 50cm. 4 such fans are installed on the wings of the aircraft.

i) A fan rotates with an angular velocity of 2000rps. It takes a time of 200 seconds to attain t the start, calculate the angular acceleration of the fan ($\pi = 3$)

ii) The speed of air flows through the fan is $100ms^{-1}$ Density of the air is $1.2kgm^{-3}$. Calculate the mass of air drawn by one fan in one second.

iii) Calculate the force exerted by the gas which is calculated (ii) on the plane

iv) Calculate the thrust exerted on the plane by all 4 fans.

v) as the plane moves forward, a drag force is created by the air due to the viscosity. Copy the given diagram figure and mark the thrust force, friction force, lifting force and weight.

C)

i) The aircraft must be tilted slightly to the horizontal to make a turn in the sky. Copy the diagram and mark the weight and lifting force acting on it.

ii) Calculate the angle at which the plane must be slanted to travel on a curved path of radius 500cm, when the plane is traveling at a speed of 720 Kmh^{-1}