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Department of Education - North Western Province

පළමු වාර පරීක්ෂණය - 2019
First Term Test - 2019

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|---|---|---|---|---|---|---|---|
| ශ්‍රේණිය Grade | 12 | විෂයය Subject | Physics | පත්‍රය Paper | II | කාලය Time | 3 hours |


- This paper consists of two parts A and B allowed time for both parts is 3 (three) hours.
- Answer all the questions of **part A** on this paper itself. You must use th given space to answer. No lengthy answers are expected.
- **Part B** consists of 6 questions. Answer only four of them. After the exam, attach part A and part B and hand over to the staff.
- Use of calculators is not allowed.



## Part - A (Structured Essay)

$(g = 10\ N\ kg^{-1})$

01. A student plans to determine the density of a small metal ball using a laboratory micrometer screw gauge.

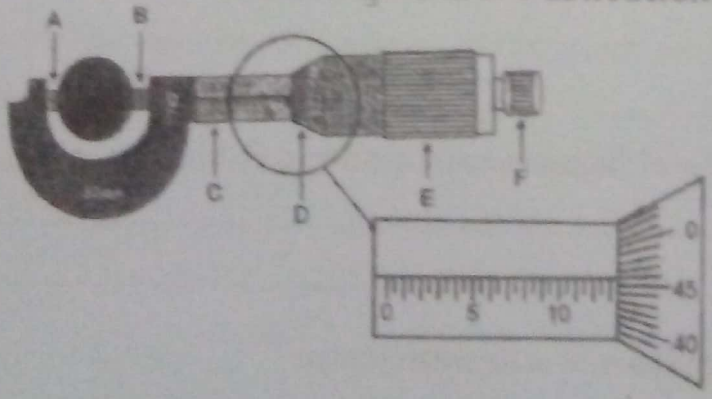
a) What is the other physical quantity you should measure for this purpose except the quantity measured using the micrometer screw gauge?

b) What is the measuring instrument used to measure it?

c) Write down an expression for the density of the metal ball in terms of the measurements you obtained.

d) The following diagram shows the micrometer screw gauge used by the student. Name the parts of it labelled as A, B, C, D, E and F.





A - .....  D - .....

B - .....  E - .....

C - .....  F - .....

e) How would you identify whether the object is fixed between the anvil and spindle in the correct manner?

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.....Knowledge Bank Publication.....

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f) i. What is meant by screw pitch?

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ii. What is the screw pitch in the given instrument above.

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g) Find the least count of the instrument?

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h) What is the reading shown above?

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i) i) How would you find the zero error of the instrument?

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ii) The following figure shows a situation in which the micrometer screw gauge is adjusted to determine the zero error. Find the value of the zero error.

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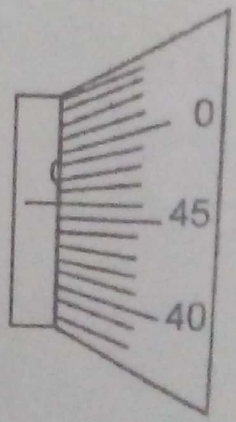


iii) State the correct value of the measurement mentioned in (h) above.

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iv) Write down the fractional error of the measurement.

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j) i) How would you increase the accuracy of the measurement?

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ii) What is the name given for the error which can be minimized by taking the above step?

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k) If the mass of the metal ball is 8.624g, calculate its density in $kg\ m^{-3}$.

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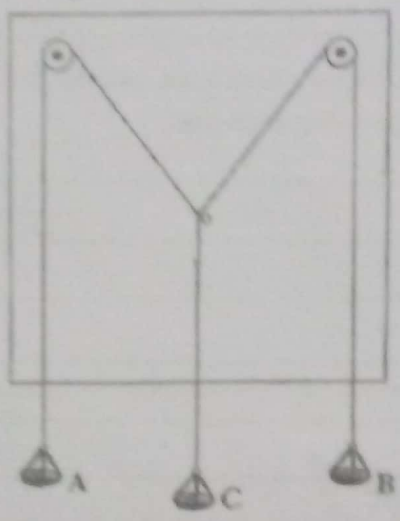
02. The following diagram shows the apparatus setup used in the school laboratory to determine the mass of a stone using the principle of parallelogram of forces.




a) State the parallelogram law of forces.

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b) Which scale pan is used to keep the unknown mass?

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c) Show a $A_4$ sized white paper pinned on the vertical drawing board.

d) Give a list of other items needed to carry out this experiment accurately.

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e) How do you test whether the pulleys have friction.

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f) In order to carry out this experiment light strings should be used. What is the reason for this?

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g) If the scale pans are not light, what should you do in order to carry out the experiment correctly?

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h) To mark the positions of the strings, you can use two items (item- 1 and item - 2). How would you mark the positions of the strings using each item.

Item - 1 .....

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Item - 2 .....

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i) The white paper is pinned on the drawing board after the system has come to rest. What is the reason for this?

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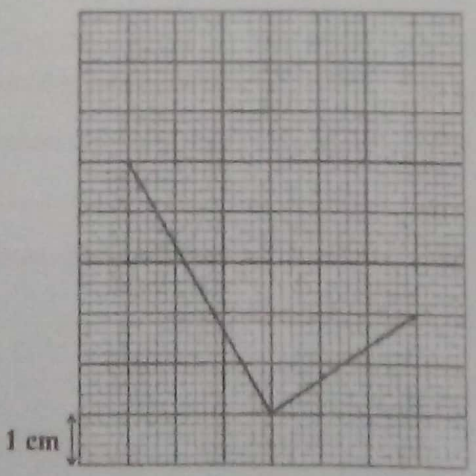
j) The set-up is used by a student to find the mass of a stone. The relevant sides of the force parallelogram are shown in the figure. (1cm = 20g)



i) Evaluate the mass of the stone.

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ii) After completing the parallelogram correctly, if the direction of the relevant diagonal is not exactly vertical, what is the reason for that?

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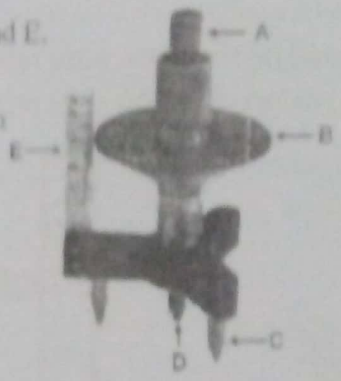
03. You are supplied a spherometer used in the laboratory and a flat glass plate to determine the radius of curvature of a watch glass.

a) Name the parts of the given spherometer labelled as A,B,C,D and E.




A - .....



B - .....

C - .....

D - .....

E - .....

b) Number of divisions in the circular scale is 100 and the screw pitch is 1mm. Find the least count of the instrument.

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c) The radius of curvature ($R$) can be determined by the following formula.

$R = \frac{a^2}{6h} + \frac{h}{2}$

i) Identify $a$ and $h$ .

$a$ .....

$h$ .....



ii) What measuring instrument would you use to determine $a$ ?

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iii) What experimental steps would you follow in order to determine $a$ ?

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d) i) For measuring $h$, before placing the spherometer on the curved surface, you have to bring the tip of the screw and tips of the legs of the spherometer to one plane. Explain how you do this experimentally.

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ii) What experimental difficulty would you expect if the instrument is placed on a plane mirror when taking the first reading?



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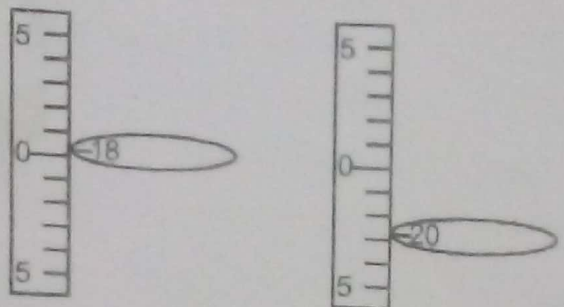
e) Figure (a) shows the scale reading when the tip of the screw just touches the flat glass plate. Figure (b) shows the scale reading when the tip of the screw just touches the curved surface.




i) Find the value of $h$

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ii) If $a = 3.0\ cm$ , substitute the values of $a$ and $h$ to calculate $R$.

R = ____ + ____ cm

iii) Find the value of $R$.

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f) Can the spherometer be used to determine the radius of curvature of the eye piece of the travelling microscope? Give the reason for your answer.

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04. a) i) Define the force according to the Newton's first law.

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ii) Define the standard SI unit of measuring force.

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iii) What is meant by the inertia?

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iv) What is an inertial frame?

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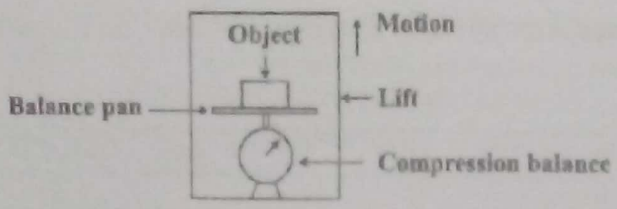
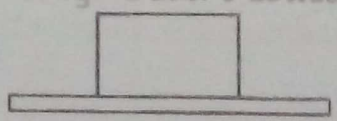
b) The figure shows an object of mass $10kg$ resting on a compression balance placed inside a lift. The lift starts its vertical upward motion from rest. In the first 8 seconds it accelerates with $2\ ms^{-2}$. It then maintains a constant speed for $20s$. In the next $10s$, it comes to rest.

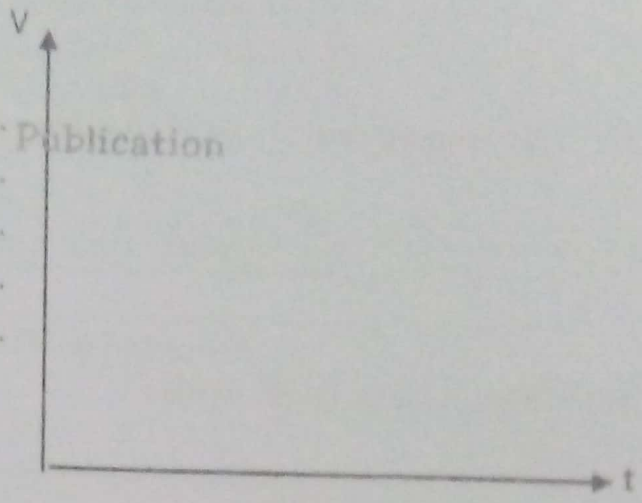



i) Mark the force exerted by the object on the pan.





ii) Find the total displacement of the lift by using a velocity - time graph






iii) What is the reading of the balance when the lift accelerates upward?

iv) What is the reading of the balance when it moves with a constant velocity?

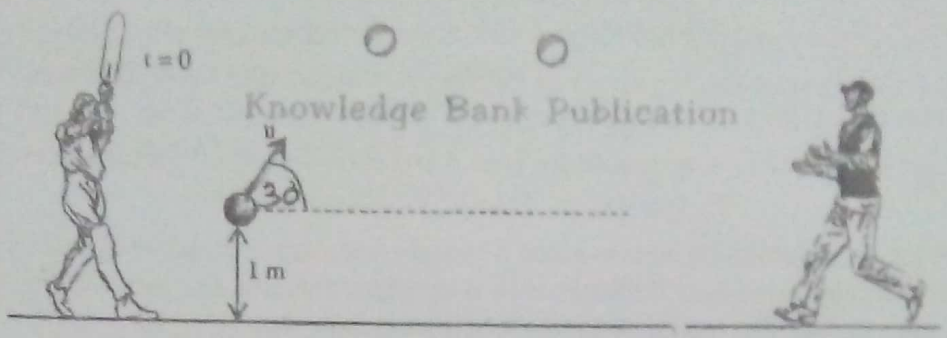
v) Find the reading when the lift decelerates upwards assuming deceleration is uniform.

vi) What is the reading of the balance when the lift falls under gravity?

## Part B (Essay)

- **Answer only four questions.**

05.






In a cricket match, A batsman strikes a ball at a height of $1m$ above the ground. The ball leaves the bat at a speed of $20\ ms^{-1}$ making an angle $30^0$ with the horizontal. At the same instance, a fielder at rest starts running with an acceleration of $4\ ms^{-2}$ towards the ball to catch it. He catches the bell at a vertical height of $0.5m$ from the ground. Neglect the air resistance through out the whole motion and calculate the followings.

i) The maximum height reached by the ball from the ground.

ii) The vertical and horizontal components of velocity of the ball at the instance the fielder catches it. $\sqrt{1.1} = 1.05$, $\sqrt{3} = 1.73$

iii) The velocity (magnitude and direction) of the ball when it hits the palms of the fielder.
$\sqrt{4.1} = 2.03$, $\tan^{-1} 0.6055 = 31^0 11'$

iv) The time taken by the ball to reach the fielder after releasing from the bat $\sqrt{4.4} = 2.1$

v) The horizontal distance travelled by the ball.

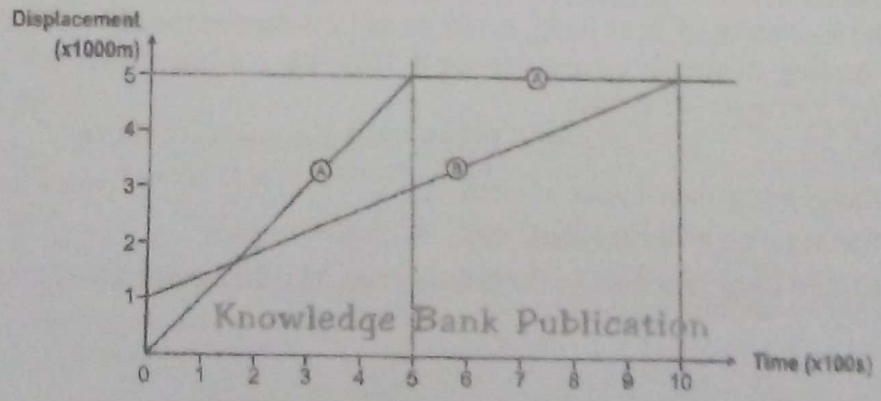
vi) The initial distance from the fielder to the batsman.

vii) The velocity of the fielder at the instance he catches the ball.

viii) Can the fielder catch the ball at the same position mentioned above if the ball leaves the bat at the same position with the velocity of $20\ ms^{-1}$ making an angle of $60^0$ with the horizontal?

ix) Plot the velocity - time graphs for the vertical and horizontal components of velocity of the ball.

06. a) A and B are two short train engines moving on two straight parallel close tracks. Their displacement - time graphs are shown below.



i) What is the delayed engine for stopping ? Give the delayed time in seconds.
ii) Which one of the two engines comes to rest first? When it comes to rest, find the distance to the late engine.
iii) At what time from $t = 0$ does one engine pass the other ?
iv) What is the engine that has a higher velocity, when passing the other. What is that velocity ?
v) At a certain instance, the driver of the engine $A$ sights the engine $B$ moving at a distance of 100m ahead. What is the time taken by the engine $A$ to reach closer to engine $B$ ?
vi) Draw the velocity - time graphs for both $A$ and $B$ on the same calibrated axes.



(b) A particle at rest starts its motion along a straight line path. It travels a distance of $50m$, with a constant acceleration, next $300m$ with a constant velocity and last $25m$ with a constant retardation to rest. The total time for the whole motion is 4.5s.

Find
i) draw the velocity - time graph for the above motion.
ii) the average velocity.
iii) the maximum velocity.
iv) the acceleration.
v) the deceleration of the particle.

07. a) A disk of mass $10\,kg$ is hanging by a light inextensible cable attached to a helicopter of mass 1000 kg.

When the helicopter is moving

i) upward with a constant velocity.
ii) Upward with a constant acceleration of $1\,ms^{-2}$
iii) Downward with a constant acceleration of $1\,ms^{-2}$.

Calculate the followings for the above three situations,

a) Forces acting on the disk.
b) The upward force generated by the helicopter itself using the mechanism of the helicopter engine.

iv) For the situation (*iii*), draw the free body force diagrams for the disk and the helicopter.
v) The disk is an electro magnet. When an electric current is supplied, it shows magnetic properties. Assume that the helicopter is free from the influence of the magnetic property of the disk. When the helicopter in air is at rest relative to the earth, the disk is directed towards a piece of metal of mass 100kg at rest on earth. After that the disk is converted to a magnet by passing an electric current through it. If the piece of metal rises upward accelerating at $1\,ms^{-2}$ relative to the earth.

**Calculate,**

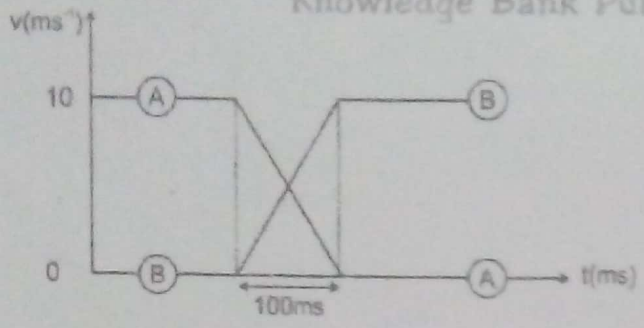


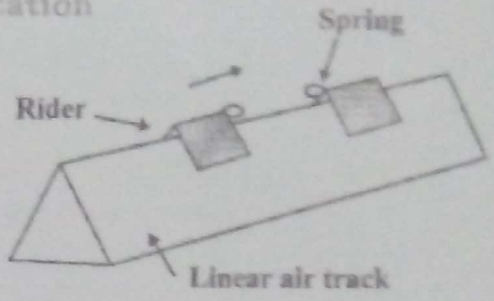
(a) the forces acting on the piece of metal.
(b) the forces acting on the magnetic disk.
(c) the upward force generated by the helicopter on it by the mechanism of the helicopter engine.

08. a) i) Write down the dimensions and *SI* units of linear momentum.
ii) State the principle of conservation of linear momentum.

b) The linear air track, shown in the figure below is a fixed horizontal straight line path with negligible friction and resistive forces. Two riders *A* and *B* each of mass $100g$, fitted with two elastic, circular springs having horizontal planes at the colliding ends are free to move on the track.
The graphs below show the variation of velocities of A and B with time before the impact, at the impact and after the impact of them. The time duration of the collision is 0.1s.

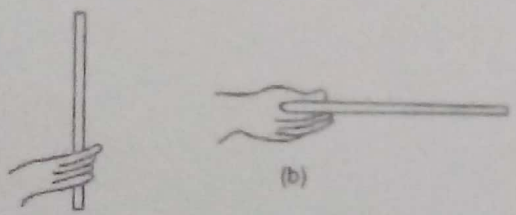





i) Find the amount of kinetic energy of the system before impact.
ii) Find the amount of kinetic energy of the system after impact.
iii) Is the collision perfectly elastic? Give the reason for your answer.
iv) At the instance that the kinetic energy is minimum, what is the maximum amount of elastic potential energy stored in springs.
v) Calculate the mean force acting on a spring by the other.
vi) Draw the shape of the springs at the above occasion.
vii) Before the impact a spider of mass $10g$ on the rider 'A' moving with $10ms^{-1}$ jumps on to the rider *B*. If the horizontal component of velocity of spider is $15\ ms^{-1}$ relative to the earth, find the respective final velocities of *A* and *B*.

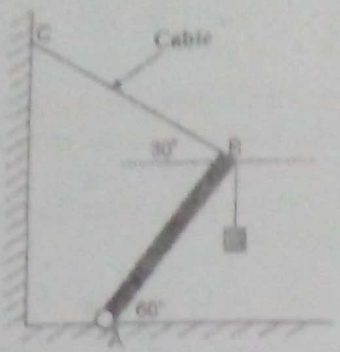
09. a i) State the general conditions necessary for an object to be in equilibrium under the action of a set of coplanar forces.




The figures (a) and (b) shows a uniform rod of weight *W* and length $1m$ held by a child in two different ways. The rod is in equilibrium and the coefficient of friction between the hand and the rod is $\mu$ .



ii) Mark the forces *R* (the force exerted by the child on the rod), *W* (weight of the rod) and *F* (frictional force) acting on the rod when the rod is in equilibrium according to the figure (a). (Draw only the rod)
iii) Obtain the relation between *R* and *W*.
iv) When the rod is in equilibrium according to the figure (b), mark the forces acting on it. Arrange the magnitudes of these forces in ascending order.



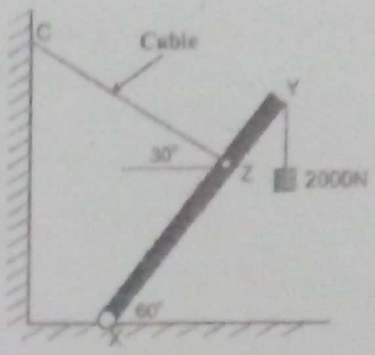

b) As shown in the figure, one end A of a uniform rod AB of length $4m$ and mass $200kg$ is smoothly pivoted to a fixed point on the ground. The end $B$ of the rod carries a heavy load of mass $1000kg$. The rod is held in the given position by a cable joining the end $B$ of the rod to a point $C$ on the wall.

i) Calculate the tension in the cable.

ii) Find the horizontal and vertical components of the force exerted on the rod at $A$ by the hinge.



c) As shown in the figure, the cable is used to raise a uniform concrete post of mass $1200\,kg$ and length $L$. The post is hinged at X. The cable is attached to the post such that $\frac{XZ}{ZY} = 3$. Find the tension in the cable.



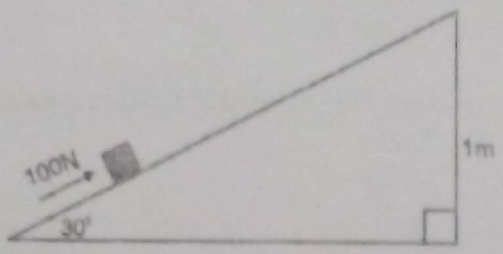

10 A) a) A weight of $100N$ is placed on a horizontal plane. The weight is on the verge of slipping when a horizontal force of $75N$ is applied. After that to maintain a constant velocity for the weight, a horizontal force of $70N$ is required.

Find, i) the coefficient of static friction, $\mu_s$

ii) the coefficient of dynamic friction, $\mu_D$

iii) How much work is required to move the weight with a constant velocity through a distance of $2m$ along the plane.

b)




A weight of $100N$ is placed on an inclined plane of inclination $30^0$ to the horizontal. The weight moves up the plane very slowly with a constant velocity under the action of a force of $100N$.

Find, i) the dynamic frictional force.

ii) the coefficient of dynamic (kinetic) friction.

iii) the work done on the weight to move it through a distance of $2m$ up the plane.

iv) Calculate the increase in potential energy of the weight.

v) What is the reason for the difference between the increase in potential energy and the work done on the weight?



c) Consider the following two situations.

(A) Only the weight is moved up the plane by a man without getting on to the inclined plane.

(B) A man is carrying the weight up the plane.

At what situation does the man do more work? Explain your answer.