General Certificate of Examination (Adv.Level)

First Term School Based Assessment –January 2026

பௌதிகவியல் Physics	Three Hour 10 Min.	01	T	I
	Grade - 12 (2027)			

Part I

Instructions :

- This question paper consists of 06 pages and 25 questions
- **Answer** all the questions.
- Write your index number in the given cage.
- In each of the question $01 — 25$, pick one of the alternatives $(1), (2), (3), (4)\ and\ (5)$ which is correct or most appropriate and mark your response on the answer sheet accordance with the instruction given therein.

Using Calculators is prohibited

$(\boldsymbol{g = 10\ ms^{-2}})$

01) Which of the following is not a unit of power?

(1) W *(2)* $J\ s^{-1}$ *(3)* $Kg\ m^2\ s^{-3}$ *(4)* $Nm\ s^{-1}$ *(5)* Kwh

02) $y = \frac{a-bc}{d+e}$ where y does not have dimension. Which of the following is/are correct?

A - $abc, ad\ \ and\ \ de$ are having same dimensions.

B - $\frac{bc}{ae+de}$ does not have dimension

C - $de + be$ can be addded

D - $\sqrt{\frac{ad}{c^2}}$ have the dimension of b

(1) $A, and\ B$ Only *(2)* $A, B\ and\ C$ Only *(3)* $B\ and\ C$ only

(4) $A\ and\ D$ only *(5)* $B, C\ and\ D$ only

03) One main division of the vernier caliper is designed as 0.5 mm. It has 25 vernier divisions. 25 vernier divisions coincide with 12 main divisions. Find the least count ot the vernier caliper.

(1) $0.01\ mm$ *(2)* $0.02\ mm$ *(3)* $0.04\ mm$ *(4)* $0.05\ mm$ *(5)* $0.01\ mm$

04) A boy is at the top of a tallest building. He has two identical particles A and B. He releases the particle A from his hand at first and then 3 s later he releases the particle B. What will be the time taken for the separation between particles A and B to be 20 meters from the time at which the particle A is released?

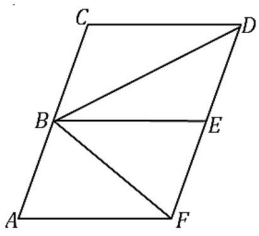
(1) $0.5\ s$ *(2)* $1\ s$ *(3)* $1.5\ s$ *(4)* $2\ s$ *(5)* $4\ s$

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05) The diameter of a sphere is measured as 10.00 mm by using an instrument which has least count of 0.01 mm. The maximum error percentage for the volume measurement is ,

(1) 3% (2) 0.3% (3) 0.1% (4) 0.03% (5) 0.01%

06) If BD denotes the vector $a+b$ and BF denotes the vector $a-b$ then AD denotes



(1) $2a+2b$ (2) $2a-2b$ (3) $a-2b$

(4) $b-2y$ (5) $a+2b$

07) When zero error is measured the position of the division is shown in the figure (1) and when the diameter of a wire is measured the position of the division is shown in the figure (2). If the least count of the micrometer screw gauge is 0.01 mm then the diameter is

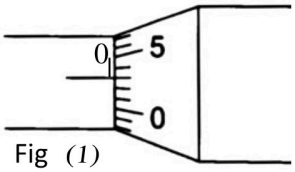


Fig (1)

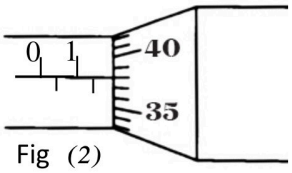


Fig (2)

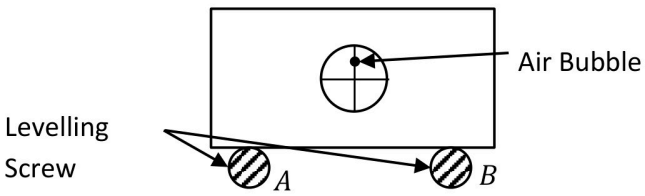
(1) 1.85 mm (2) 1.87 mm (3) 1.89 mm

(4) 1.95 mm (5) 1.97 mm

08) An object moves from rest with an uniform acceleration and it attains the velocity V in (n - $\frac{1}{2}$) seconds. The distance travelled in n^{th} second is,

(1) $\frac{V}{2}$ (2) V (3) $\frac{V}{2}(2n-1)$ (4) $\frac{V}{2}(2-\frac{1}{n^2})$ (5) $\frac{V}{2}(2-\frac{1}{n})$

09)



The air bubble is to be adjusted to the centre of the spirit level when the the travelling microscope is levelled

(1) A and B should be rotated in anticlockwise by same amount.

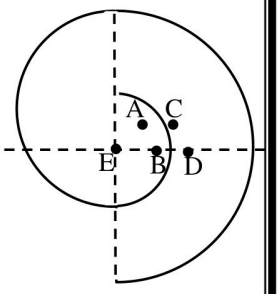
(2) A and B should be rotated in clockwise by same amout.

(3) A and B should be rotated clockwise but B should rotated more than the A.

(4) A and B should be rotated clock wise but A should be rotated more than B.

(5) B only should be rotated in anti clockwise while A remains unchanged

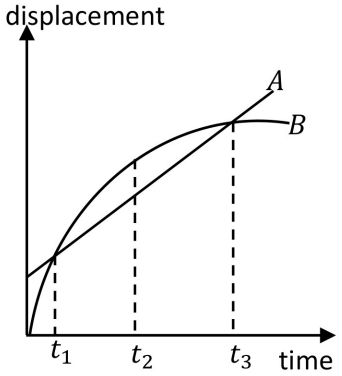
10) The shape shown in the figure is made by uniform rigid wire. Three semi circles each radii are r, 2r and 3r, are in this shape. The centre of gravity of the shape is,



(1) A (2) B (3) C

(4) D (5) E

11) The displacement – time graph of car A and car B is shown.



A - At the time t_2 the velocity of the two cars are equal.

B - At the time t_1 the car B overtakes the car A

C - The car B travels with deceleration

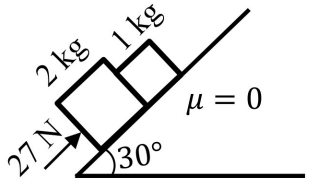
D - The initial velocity of the car B is zero.

The correct statement (s) is / are?

(1) $A\ and\ B$ only (2) C only (3) $A, B\ and\ C$ only

(4) $A, B\ and\ D$ only (5) $C\ and\ D$ only

12) Two blocks 2 kg and 1 kg are held on an incline of angle of slope 30°. A force 27 N is applied upwards on the 2 kg block as shown in the figure. The reaction between 1kg and 2 kg is,

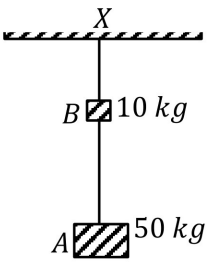


(1) $4\ N$ (2) $9\ N$ (3) $10\ N$ (4) $11\ N$ (5) $20\ N$

13) A particle of mass m is projected from ground at an angle of elevation to attain its maximum horizontal range. The linear momentum of the particle at its maximum height is P. The kinetic energy of the particle at the point of projection is ,

(1) 0 (2) $\frac{P}{m}$ (3) $\frac{P^2}{m}$ (4) $\frac{P^2}{2m}$ (5) $\frac{P}{2m}$

14) One end of a light string is tied at the point X and a 50 kg mass is hung at its other end. A small engine of mass 10 kg moves with an acceleration of 12 ms^{-2} downwards. The tension along the string at the point X is,

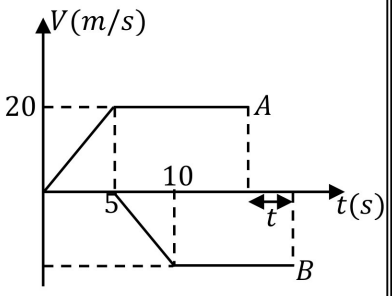


(1) $100\ N$ (2) $120\ N$ (3) $480\ N$ (4) $500\ N$ (5) $600\ N$

15) $X\ and\ Y$ are two stations along a straight line. A vehicle A travels from X towards Y and another vehicle B travels from Y towards X. The corresponding velocity – time graph is shown in the figure. B starts its motion 5 s later than A. B initially travels with an acceleration of 4 ms^{-2} and attains a velocity, and then travels with this constant velcity. The difference between the times of A and B to reach their destination is,

(1) $5\ S$ (2) $4\ S$ (3) $3\ S$

(4) $2\ S$ (5) $1\ S$



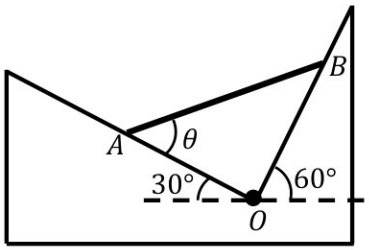
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16) A rod AB is in equilibrium on the smooth inclines of inclinations $60\ and\ 30°$ as shown in the figure. The normal reactions on A and B are R_A and R_B. Which of the following statement(s) is / are correct ?

A - $R_B = \sqrt{3}\, R_A$

B - The rod AB is uniform.

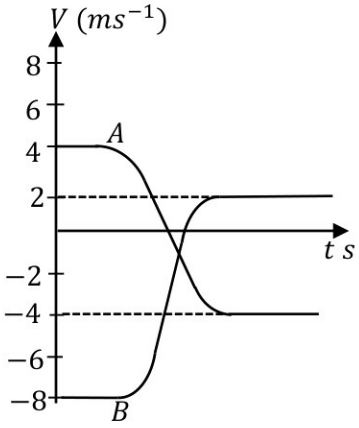
C - The rod AB is in unstable equilibrium.



(1) $A\ and\ B$ only (2) $B\ and\ C$ only (3) C only

(4) $A\ and\ C$ only (5) $A, B\ and\ C$ all

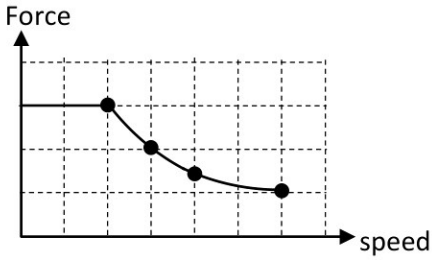
17) The velocity – time graph of two particles A and B is shown in the figure. The graph expressess the variation before and after the collision between them on smooth horizontal plane. The ratio of $\frac{M_A}{M_B}$

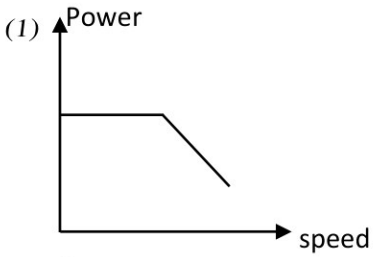


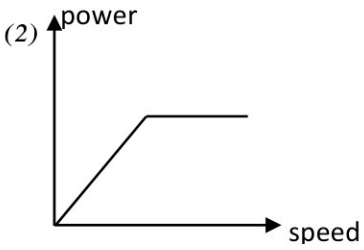
(1) $\frac{1}{2}$ (2) $\frac{3}{2}$ (3) $\frac{4}{3}$

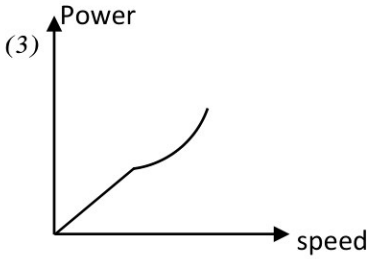
(4) $\frac{3}{5}$ (5) $\frac{5}{4}$

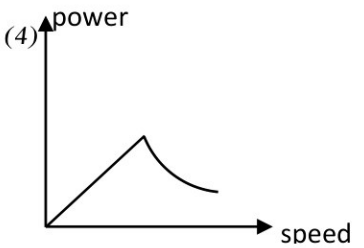
18) The variation of Force – speed graph of a particle is shown in the figure. The corresponding variation of instanataneous power – speed relatioship is represenetd by

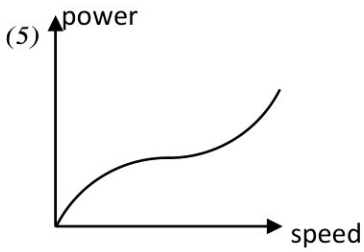


(1)


(2)


(3)


(4)


(5)


19) Consider the following statements regarding the forces.

A - Forces can be produced in pairs, not as single force.

B - Frictional force always acts opposite to the direction motion.

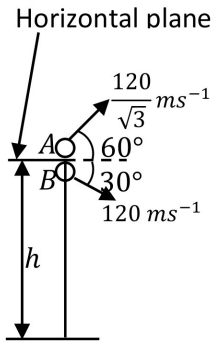
C - Force can be produced when two objects are in contact each other only.

The correct statement(s) is / are ,

(1) A only (2) B only (3) $A\ and\ \ B$ only

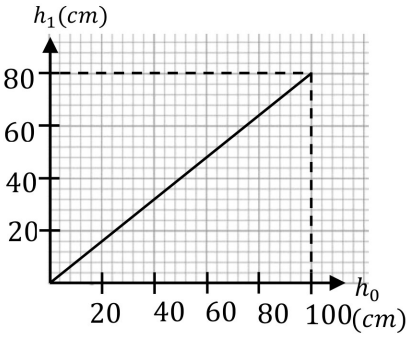
(4) B and C only (5) $A, B\ and\ C$ all

20) Two objects A and B are thrown from a horizontal palne which is at a height of h (m) from the ground. The object A is thrown with $\frac{120}{\sqrt{3}}(ms^{-1})$ at angle of elevation of 60^0 while the object B is thrown with $120\ (ms^{-1})$ at an angle of depression 30^0. The time taken to reach the ground are t_1 and t_2 respectively.The difference $t_1 - t_2$ is,



(1) $0\ S$ (2) $4\ S$ (3) $8\ S$ (4) $12\ S$ (5) Data is not enough

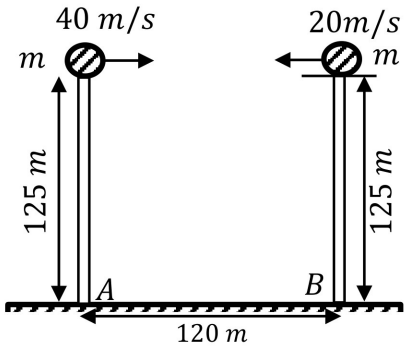
21) A particle is released at a height of h_0 , it strikes the ground and bounces back to a height of h_1. A graph for the released height (h_0) - bouncing height (h_1) is given. A particle of mass 1 kg is released from the height of 100 cm from the ground. What is the approximate energy loss of the particle after three collisions ?



(1) $3.4\ J$ (2) $2.3\ J$ (3) $2.12\ J$

(4) $4.88\ J$ (5) $6.12\ J$

22) Two identical particles are thrown horizontally towards each other with velocities of 40 ms^{-1} and 20 ms^{-1} at the equal heights of 125 m as shown in the figure. They strike and combine each other in air and then falls on to the ground. The distance of the point from A at which the combination strikes the ground is ,

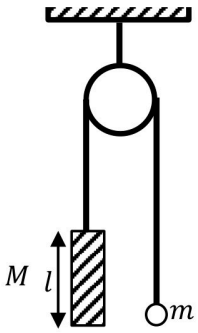


(1) $60\ m$ (2) $80\ m$ (3) $90\ m$

(4) $110\ m$ (5) $140\ m$

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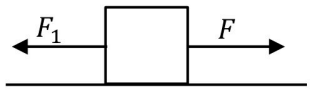
23) A light string which goes over a light and smooth pulley carries a rod of mass M and length l at its one end and the other end it carries a point object of mass m. (M > l) . The system is released at the position shown in the figure. The time taken by the point object to pass over the rod is ,

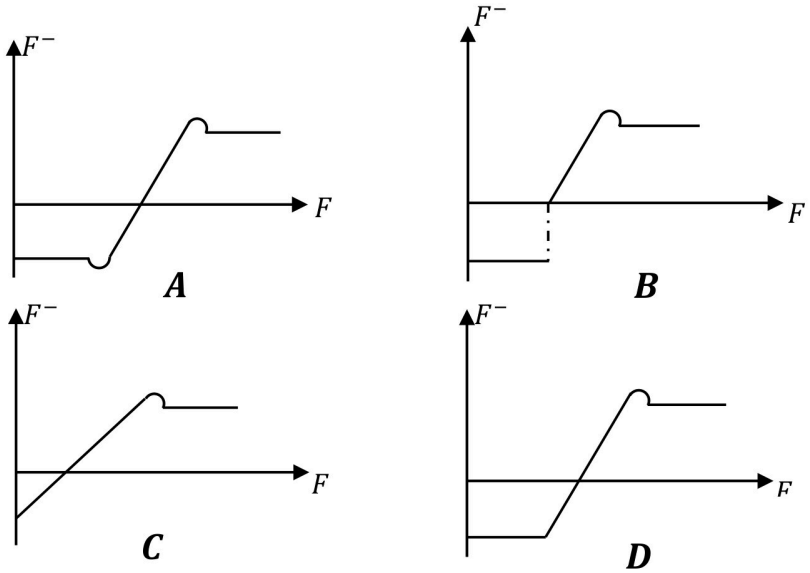


(1) $t = \sqrt{\frac{l}{g}\left(\frac{M+m}{M-m}\right)}$ (2) $t = \sqrt{\frac{2l}{g}\left(\frac{M-m}{M+m}\right)}$ (3) $t = \sqrt{\frac{2l}{g}\left(\frac{M+m}{M-m}\right)}$

(4) $t = \sqrt{\frac{l}{g}\left(\frac{M-m}{M+m}\right)}$ (5) $t = \sqrt{\frac{l}{2g}\left(\frac{M+m}{M-m}\right)}$

24) A block is held on a rough horizontal plane and a constant force F_1 acts on it. A Force which increases uniformly from zero (F) also acts on the block . Which of the following graph (s) correctly shows the variation of the frictional force F^- with the variying force F ?

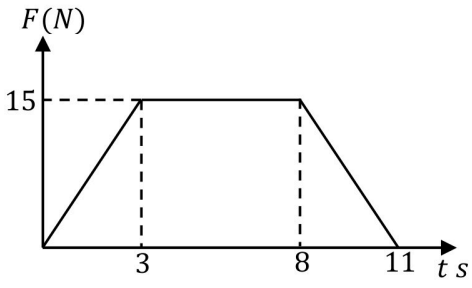




(1) A and B only (2) B and C only (3) C and D only

(4) A and D only (5) A and C only

25) The figure shows the variation of the force F with the time t which acts on a mass of 2 kg which is held on a rough horizontal plane. The coefficient of friction between the mass and the plane is 0.25 . The approximate velocity of the mass at 10 s is ,



(1) $60\ ms^{-1}$ (2) $50\ ms^{-1}$ (3) $10\ ms^{-1}$

(4) $15\ ms^{-1}$ (5) $35\ ms^{-1}$

General Certificate of Examination (Adv.Level)

First Term School Based Assessment –January 2026

பௌதிகவியல் Physics	Grade - 12 (2027)	01	E	II (A)

Index No:.....

Use Additional reading time to go through the question paper, select the questions and decide on the questions that you give priority in answering

Importance :

- This paper consists 12 Pages
- This question paper comprises part A and part B. The time allocated for both parts is three hours
- Calculator using is prohibited

Part A (Structure)

Pages : 8- 14

Answer all four questions in this paper itself. Answer each question in the given space. Please note that the space provided is sufficient for answer and that extensive answers are not expected.

Part B (Essay)

Pages : 15 -- 18

Answer the two questions . Use the papers supplied for this purpose. At the end of the time allocated for this paper, tie the answer script to the parts A and B together so that part A is on top and hand over them to the supervisor . You are permitted to take with you only parts B of the exam paper from the examination hall

For examiner use only

Part	Question No	Marks
A	01	
	02	
	03	
	04	
B	05	
	06	
	07	
Total		

Part – II (A) Structured Essay

Gravitational Acceleration $g = 10\ m\ s^{-2}$

01) A micrometer shown in the figure (1) is used to measure the diameter of a thin wire of approximate length 15 cm .

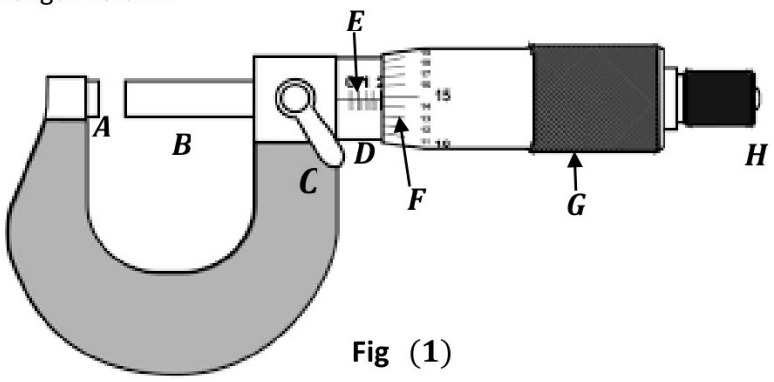


Fig (1)

(a) i. Name the parts $D, G, and\ A$ (D and G are not scales)

A: .....

D: .....

G: .....

ii. Name the two scales $E\ and\ F$.

E: – .....

F: – .....

iii. Give the usages of the parts C and H .

C: – .....

H: – .....

(b) One main division is half of 1 mm and total number of circular division is 50. For one complete rotation of G , the separation between A and B increases or decreases by the value which is equal to one main division.

i. What is pitch (mm)?

.....

ii. Calculate least count (mm).

.....

(c) When A and B gently touch each other , the position of the scale F is shown in the figure (2) . Find zero error.

.....

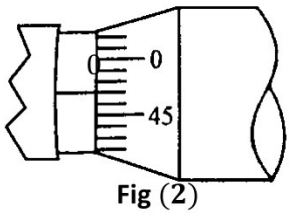


Fig (2)

(d) i. After the zero error is determined, give the experimental steps to find out the diameter of the thin wire.

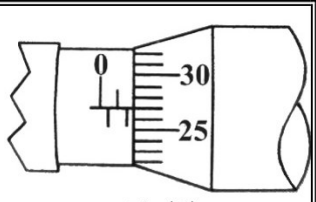
1) .....

.....

2) .....

.....

ii. The figure (3) shows the position of the division when the diameter of the wire is measured. What is the reading for this ?



Fig(3)

.....

iii. What is the radius of the wire?

.....

.....

iv. Calculate the area of cross section (in mm²) of the wire by using the value obtained in part d(iii) ($\pi = 3$)

.....

.....

(e) What is the additional measurement needed to determine the volume of the wire ? Name the instrument which is required to measure the measurement?

1) Measurement : .....

2) Instrument : .....

02) Figure (1) shows a spherometer.

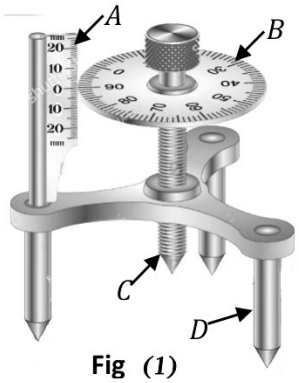


Fig (1)

(a) Name the parts A, B, C and D

A - .....

B - .....

C - .....

D - .....

(b) Explain why zero error is not considered in this instrument.

.....

.....

(c) The circular division is scaled such as for two complete rotations it moves 2mm distance along linear scale and it has 100 equal circular divisions. Calculate the least count of this instrument.

.....

(d) i. Then the spherometer is placed on a glass block and adjusted to obtain its initial reading. Draw the image of the centre screw at the right position in the figure (2).

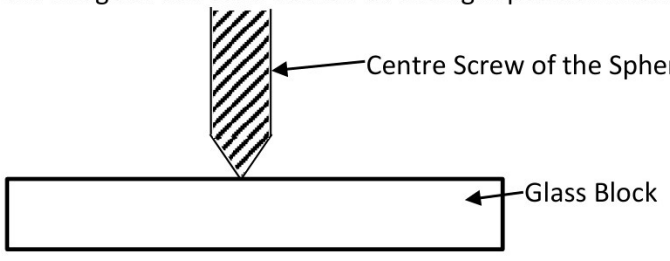


Fig (2)

ii. The position of the division is shown in the figure (3) for the above adjustment mentioned in the part d(i). Give the reading.

Reading : .....

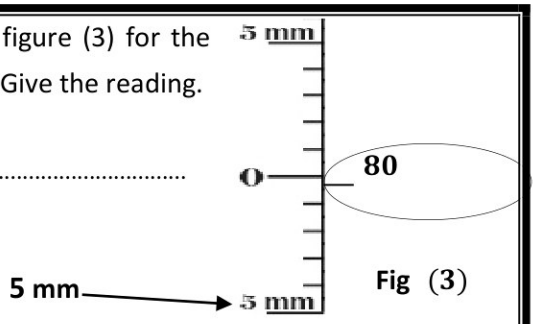


Fig (3)

(e) The equation $R = \frac{a^2}{6h} + \frac{h}{2}$ can be used to find out the radius of curvature (R) of a sphere.

i. To find R, the spherometer is placed on the sphere and the required adjustment is made. The position of the division of the spherometer is shown in the figure (4). What is the reading?

.....

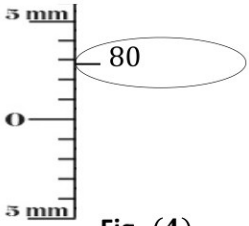


Fig (4)

ii. Find the value of the required measurement which is used to find out the radius of curvature R by using the readings obtained in the parts $d(ii)$ and $e(i)$.

.....

iii. To find the value for a which is used in the equation mentioned in the part (e) , the following measurements are obtained as follows $2.90\ cm, 3.00\ cm$ and $3.10\ cm$ Find the value for (a)

.....

.....

iv. What is the instrument used to measure "a" ? Write the experimental steps.

.....

.....

.....

v. Calculate the value of R in cm.

.....

.....

.....

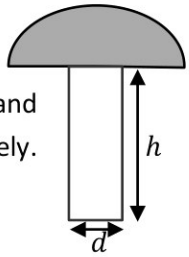
vi. Find the volume of the sphere in SI unit. $(\pi = 3\ and\ 10.3^3 = 1092.73\ )$

.....

.....

.....

(f) The shape of a paper weight is shown in the figure. It has a part of solid sphere and a solid cylinder combined altogether. The volume of the part sphere is one third of the total volume calculated in part e(vi). The height h and the diameter d of the cylinder are approximately 5 cm and 1.5 cm respectively.



i. If vernier caliper is given to you to find out volume of the solid cylinder , which part(s) of the vernier caliper are used to measure h and d .

h: .....

d: .....

ii. The readings obtained for the above mentioned measurement are given in the table below. When the two jaws of the vernier touch each other the 4th vernier division coincides with the 3rd main division. Complete the table.

	Instrument reading	Actual measurement	Name of the measurement
(1)	0.06 cm		
(2)	49.4 mm		
(3)	1.4 mm		

iii. Find the volume of the cylinder .($\pi = 3$)

.....

.....

iv. Find the total volume of the paper weight.

.....

.....

03) The figure (1) shows travelling microscope used in physics laboratory. A student palns to measure internal diameter of a capillary tube by using this travelling microscope.

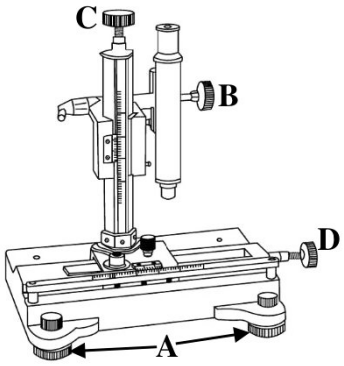


Fig (1)

(a) What are the usage of the parts A, B, C *and* D?

A - .....

B - .....

C - .....

D - .....

(b) How do you know whether the eye piece is adjusted or not?

.....

.....

(c) The vernier scale in the travelling microscope is designed as 50 vernier divisions coincides with 49 main divisions. One main division is 0.5 mm.

i. What is the length of one vernier division?

.....

ii. Find the least count of the instrument.

.....

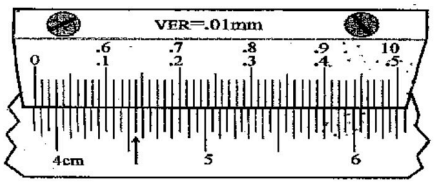
(d) How would the capillary tube be mounted to find out its internal diameter?

.....

.....

.....

(e) The following two readings are obtained as shown in the figures (2) and (3) for the horizontal internal diameter measurement



fig(2)

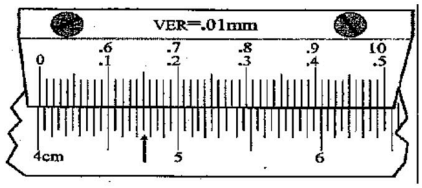


fig (3)

i. What is the reading in figure (2) ?

.....

ii. What is the reading in figure (3)

.....

iii. Find the horizontal internal diameter of the capillary tube.

.....

(f) Figures (4) and (5) are obtained to measure vertical internal diameter.

i. What is the reading in figure (4) ?

.....

ii. What is the reading in figure (5)?

.....

iii. Find the vertical internal diameter of the capillary tube.

.....

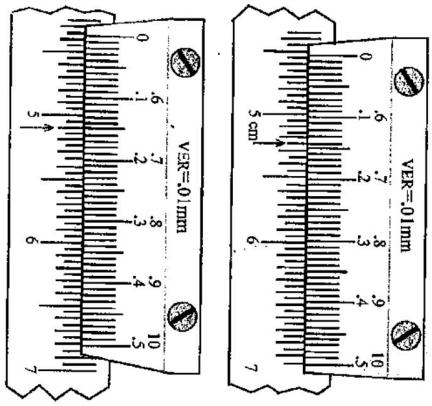


Fig (4) Fig (5)

(g) Find the fractioanl error for the internal diameter measurement of the capillary tube?

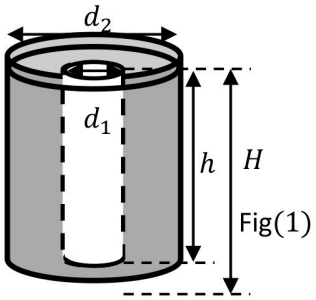
.....

(h) What are the measurements which can be measured by using travelling microscope but not by other instrument in physics laboratory?

.....

.....

04) You are asked to find out the volume of the clindrical shaped glass (Shaded portion) shown in the figure (1). The external and ineternal diameter of this shape are d_2 and d_1 respectively. The height of this cylinder is H and the depth of the hole is h. The hole portion of the glass is removed.



Fig(1)

(a) i. You are provided a vernier caliper to find out the volume of the glass. Its vernier scale has 10 vernier divisions and 10 vernier divisions coincide with 9 main divisions. One main division is 1 mm.

measurement	Parts of the vernier caliper
d_1	.....
d_2	.....
h	.....
H	.....

ii. Vernier caliper does not have zero error. When d_1 is measured 10th vernier division coincides with 29th main division. Give value of the measuement d_1.

.....

(b) i. Write down an expression for the volume of the hole (V') in terms of d_1 and h.

.....

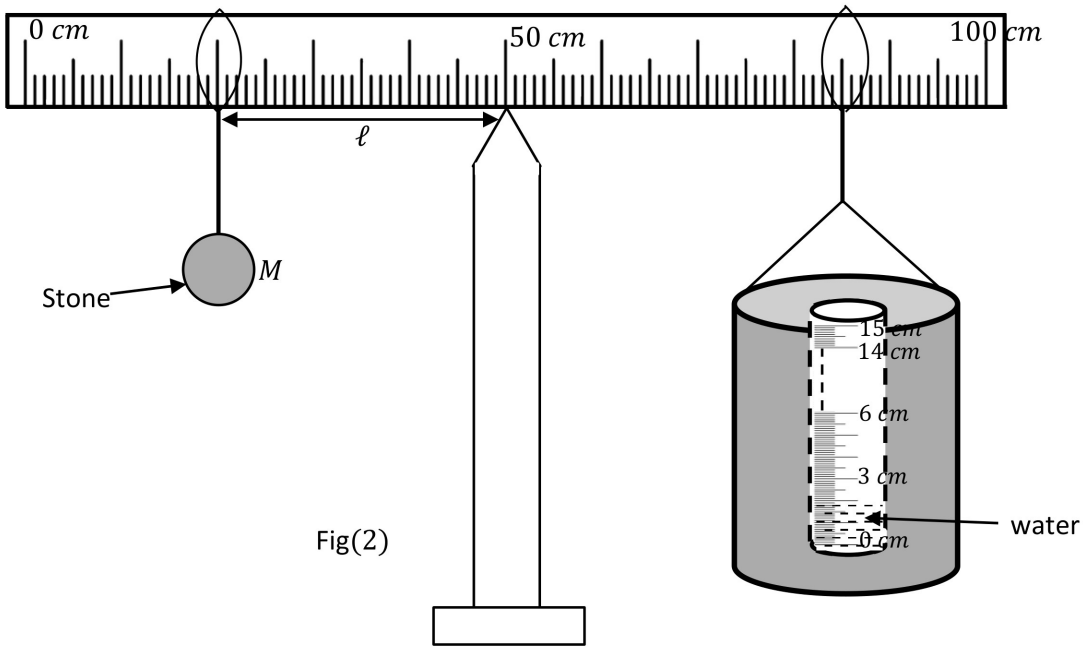
ii. Write down an expression for the volume (V) of the galss in terms of d_1 d_2, H and h

.....

iii. If the density of the glass is ρ , write down an expression for the mass of the glass (M_G) in terms of V and ρ.

.....

(c) Mass of a stone (M) has to be measured by using principle of moment. For this mm/cm scale is inserted into the hole of the cylinder as shown in the figure. The experimental setup with uniform meter rod , stone , glass with scale, light strings and knife edge are shown in the figure (2).



Fig(2)

Water is poured into the hole of the glass and the glass system hangs at the position 85 cm of meter rod. Horizontal equilibrium is obtained by moving the string which is connected to the stone along the meter rod. The position of the Knife edge and the Glass cylinder remains unchanged at the positions 50 cm and 85 cm respectively. The density of the water is ρ_w and the water level in the hole can be changed.

i. At first , the meter rod should be adjusted on the knife edge to obtain horizontal equilibrium. Give the reason for this.

.....

.....

.....

ii. At the horizontal equilibrium the distance of the stone from the knife edge is l (m) and the height of the water in the cylinder hole is $h_0(m)$. Write down an expression which relates l, h_0, M, M_G, ρ_w and d_1.

.....

.....

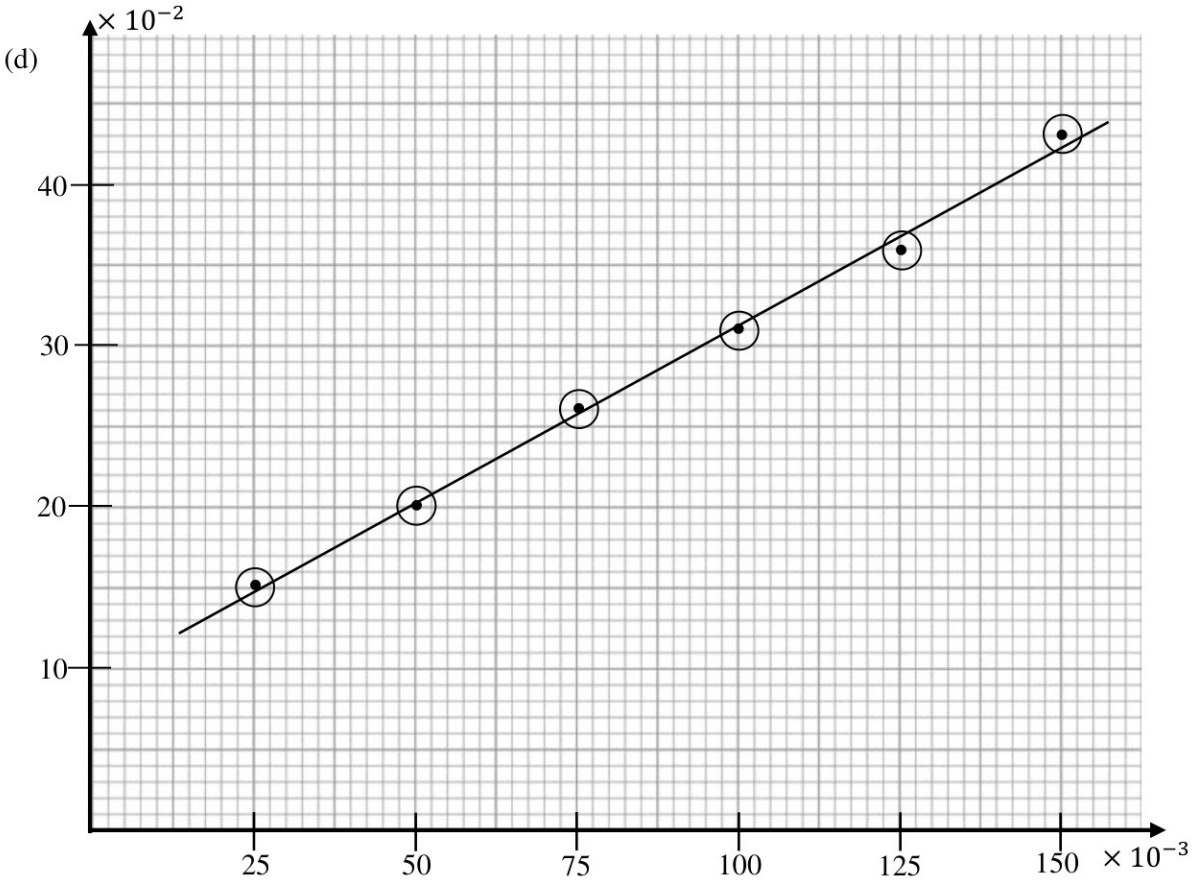
iii. Arrange the equation obtained in part c(ii) for a linear graph. When the water height h_0 is changed then the length l changes. A set of value is obtained for the measurements h_0 and l by varying h_0.

.....

.....

.....

(d)



i. Label the axes with SI unit.

ii. Calculate gradient of the graph.

.....

.....

.....

.....

iii. Determine the mass of the stone $\left(\pi = \frac{22}{7}, \rho_w = 1000kgm^{-3}\right)$

.....

.....

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General Certificate of Examination (Adv.Level)

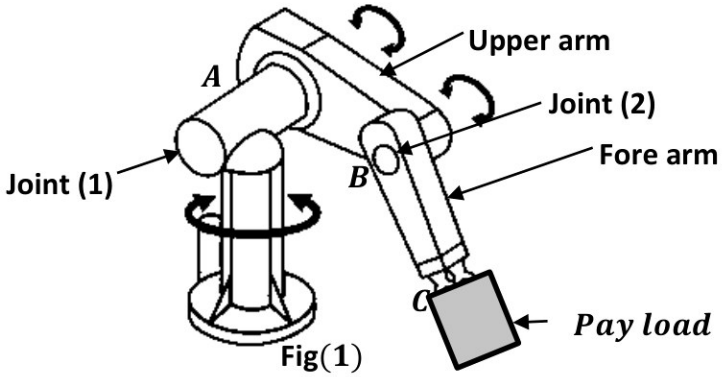
First Term School Based Assessment –January 2026

பௌதிகவியல் Physics	Grade - 12 (2027)	01	E	II (B)

Part $II - B -$ Essay Questions

Answer any two questions

05)



Fig(1)

Figure (1) shows the part of a robot , is in stable equilibrium. The upper arm is connected with an axis at A. The fore arm is connected with upper arm at B. The gripper C carries a payload. The joints are smooth and free to rotate. Electric motors provide necessary torques and reactional forces.

(a) i. Write down an expression for the torque of couple τ and identify the quantities. How would you find the direction of torque?

ii. Write down the conditions that is required to satisfy the equilibrium of rigid body under the action of coplanar forces.

(b)

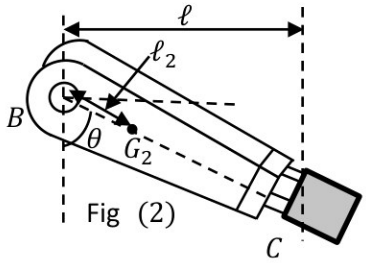


Fig (2)

$G_2 -$ *Centre of gravity of the forearm*

i. If the weight of the forearm is W_2, weight of the payload is W_p and the reaction on the joint B is R_B then draw free body force diagram of the forearm.

ii. The distance between the centre of gravity $\mathbf{G_2}$ of the forearm and the axis of the joint B is l_2 . Write an expression for the torque τ_B produced by electric motor at the joint B in terms of $\ell_2, \ell, \theta, W_2$ *and* W_p.

iii. What is the direction of the torque produced by the motor at the joint B.

(c) The upper arm AB is in horizontal position as shown in the figure(3) and the fore arm BC is in equilibrium as shown in the figure(2). The weight of the upper arm is W_1

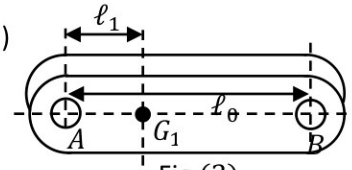


Fig (3)

i. Write down an expression for the reaction R_A on the joint A in terms of W_1 and R_B. What is the direction of R_A?

ii. Write down an expression for the torque τ_A produced by the motor on the joint A in terms of W_1, ℓ_1, τ_B, R_B and ℓ_0

iii. What is the direction of the torque τ_A ?

(d) If $\ell_1 = \ell_2 = 20cm, \ell = 30\ cm, \ell_0 = 50\ cm, W_1 = W_2 = 20\ N$, $W_p = 20\ N$, $\sin\theta = 0.6$ and $\cos\theta = 0.8$, and the arms are in the positions as the mentioned in the parts (b) and (c) then find

i. Calculate the reactional force R_A and R_B at the joints A and B respectively.

ii. Calculate τ_A and τ_B .

06)(a) i. Define the terms coefficient of static friction and kinetic friction.

ii. A gradually increasing applied force is provided on an object. Sketch the graphs which show the variation of frictional force with the applied force and the other one shows the variation of resultant force with applied force on the same axis.

(b) A man of mass 60 kg walks on a floor without sliding in a non air resistance region. The coefficient of static and kinetic frictions are 0.6 and 0.5 respectively.

i. What type of friction acts on the man ?

ii. What is the maximum acceleration the man can experiences?

iii. The man pushes a block of 60 kg on the same floor. The coefficient of friction also same value in between the block and the floor. What is the maximum acceleration by which the man pushes the block horizontally ?

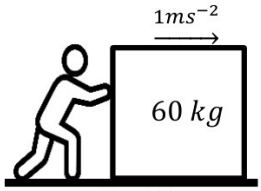


fig (1)

iv. The coefficient of static and kinetic frictions in between the man and the floor are increased to 0.8 and 0.7 by wearing slipper. What is the maximum acceleration by which the man can pushes the same block ?

v. Explain the advantages of pushing the block by wearing the slippers.

vi. The man standing on the same horizontal floor by wearing the slippers and pushes the block along an incline of inclination 37^0 which is closer him. He pushes the block with constant High force F in a small time interval and release it while he is rest. The coefficient of static and kinetic frictions in between the block and the incline are 0.6 and 0.5. $(Cos\ 37° = 0.8, Sin\ 37° = 0.6)$

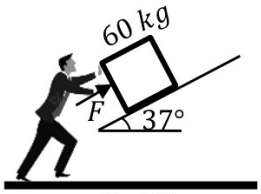


fig (2)

i. What is the maximum pushing force (F) given by the man on the block along the incline ?

ii. What is the initial acceleration of the block when the man pushing it?

(c) i. A man pushes and moves a car its engine does not work as shown in the figure. Draw and denote the all the frictions which acts on the system.


fig (3)

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(d)



Fig (4)

When a vehicle applies brake (Car, bus and lorry ..etc) while it is moving with high speed, its total weight is displaced towards the front wheel. That means its center of gravity displaces towards the front wheel. The front section of the car becomes lowered. The displaced weight depends on the height (h) of the centre of gravity of the vehicle from the ground , the total weight of the vehicle (w) , the separation between the wheels (L), deceleration of the vehicle (a) and the gravitational acceleration (g). The magnitude of the displaced weight ΔW is given by $\Delta w = \frac{hwa}{Lg}$. A vehicle moving with $10ms^{-1}$ applies a brake and come to rest in 2 seconds. The mass of the vehicle is $1500\ kg$ and the separation between the front wheel is $2.5\ m$. The height of the centre of gravity from the ground is $0.5\ m$.

i. What is the displaced weight when the brake is being applied?

ii. What is the force required to stop the car ?

iii. Which wheel has high friction when the brake is being applied?

07) The diameter of the bullet of the $9mm\ Pistol$ is 9mm. The figure (1) shows the diagram of $9mm\ Pistol$. Magazine is the part of the pistol in which the bullets can be held. The figure(2) shows the diagram of magazine. The length of the magazine is 100 mm. Ten bullets can be held in the magazine at a time as shown in the figure(2). The magazine contains a spring of spring constant $(k) 1000\ Nm^{-1}$.The natural length of the spring is $110\ mm$.The effective length of the spring when the magazine is fully loaded by the bullets is, 10 mm and the effective length of the spring when the magazine is empty , is 100 mm and also the compression of the spring is not made by the weight of the bullets.



fig*(1)*

(a) The table is given to find the force exerted on the bullet and the compression in the spring Complete the table. No need to copy the table on to your answer paper.

i. What is the length of the spring when 9 bullets are in the magazine?

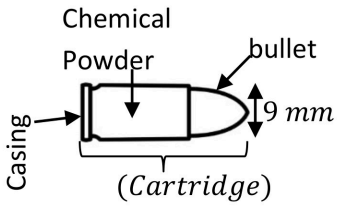
Number of bullets in the magazine(N)	Length of the spring (mm)	Compression in the spring (mm)
10	10	100
9	.....	.....
8	.....	.....
7	37	.....
6	46	64
5	.....	.....
4	.....	46
3	73	37
2	82	28
1	91	.....
0	.....	.....

ii. What is the compression of the spring when 8 bullets are in the magazine?

iii. What is the force exerted on the spring when 5 bullets are in the magazine?

iv. What is the potential energy stored in the spring when one bullet is in the magazine?

(b) Cartridge of the pistol contains bullet , chemical powder charge and casing. The total mass of the cartridge is 12 g and mass of the bullet is 8 g. The mass of empty (unloaded) pistol is 1492 g. When the pistol is triggered the hammer strikes the firing pin and firing pin strikes the rear part of the casing. This would cause to explosion the chemical powder charge. Then bullet is released from the cartridge and accelerates through the barrel from rest. The bullet emerges from the muzzle and the casing emerges upper portion of the pistol



fig(3)

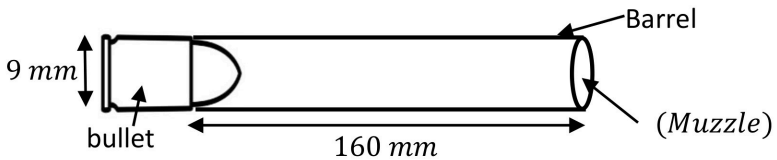


figure (4)

When explosion takes place an average pressure of $70\ MPa$ is produced and acts continuously on the area of cross section of the bullet up to it emerges from the muzzle. The area of cross section of the bullet is 60 mm².

i. Calculate the thrust on the bullet .

ii. If friction between the barrel and the bullet acts as 200 N, find the acceleration of the bullet.

iii. Find the speed by which the bullet emerges from the muzzle.

iv. How long the bullet takes to emerge from the barrel after the explosion?

v. Find the recoiling speed of the pistol when the first bullet is fired from the completely filled magazine .

vi. Calculate the kinetic energy of the bullet when it emerges through the muzzle.

vii. What percentage of the energy is lost against the friction between the barrel and the bullet compared to the energy supplied by the pressure due to the explosion.

(c) The bullet is fired horizontally towards the target which is 80 m from the pistol. The vertical displacement of the bullet is 40 m when it has passed 40 m distance.

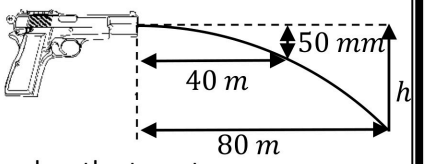


fig (5)

i. Find the vertical displacement (h) of the bullet when it reaches the target.

ii. find the vertical component of the velocity when it strikes the target.

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