கல்விப் பொதுத் தராதரப் பத்திர(உயர் தர) பயிற்சிப் பரீட்சை - 2024

General Certificate of Education (Adv.Level) Practice Examination - 2024

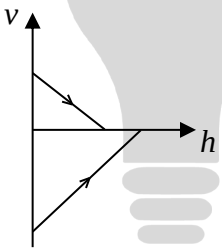
| பௌதீகவியல் I<br>Physics I | 01 E I | ஒரு மணித்தியாலம்<br>One hour |
|---|---|---|

**( The acceleration due to gravity, $g$ = 10 m s$^{-2}$)**

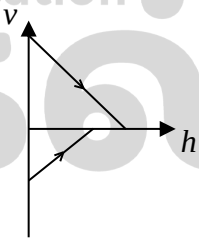
**1.** A vehicle of mass 1000 kg is travelling on a horizontal road with constant power 10 kW. Air resistive force is 250 N when the vehicle is moving with 10 m s$^{-1}$ at an instant. If the air resistive force is directly proportional to the velocity, what is the maximum velocity that can be attained by the vehicle?

(1) $10\sqrt{2}$ m s$^{-1}$ (2) $10\sqrt{3}$ m s$^{-1}$ (3) 20 m s$^{-1}$ (4) 40 m s$^{-1}$ (5) 30 m s$^{-1}$

**2.** A ball is released from height $h$ and it bounced upto $\frac{2h}{3}$ height after hitting the ground. Which of the following graphs best represents the change in velocity of the ball with its height from the ground ? (Neglect the air resistance)




(1)

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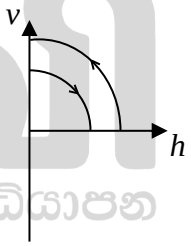


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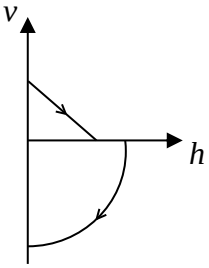


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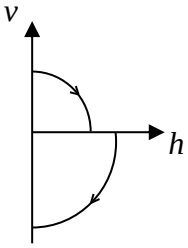
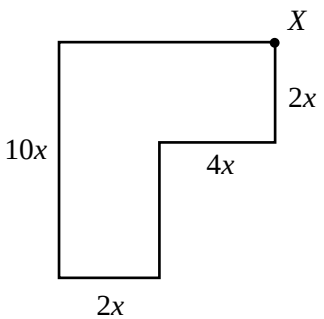



(5)

**3.** The mass of the given uniform lamina is 7$m$. What is the magnitude of the maximum mass that can be connected to point $X$ to maintain equilibrium?

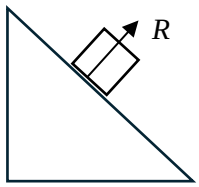
(1) $\frac{m}{4}$ (2) $\frac{m}{2}$ (3) $m$

(4) 2$m$ (5) 4$m$

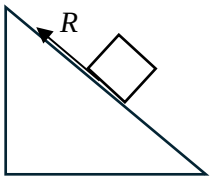



[ see page 2

**4.** An object moves along a rough inclined plane with an acceleration. Which of the following correctly denotes the reaction given by the inclined plane to the object?



(1)



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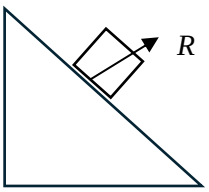

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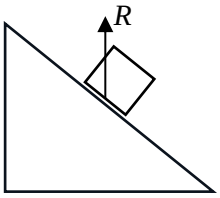

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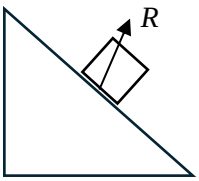


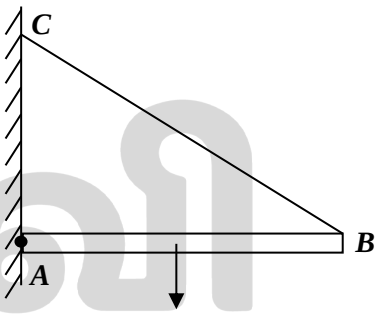
(5)

**5.** Rod *AB*, connected to a light, inextensible string, is kept as shown in the figure. A monkey is moving from *B* to *A* along the rod. Consider the following statements.

(A) Reaction given by wall to rod decreases and then increases.

(B) There is high possibility for string to break, when monkey is at *A*.

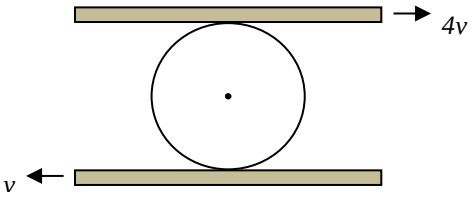
(C) Reaction given by wall to rod *AB* never acts along *AB*.




Of the above statements,

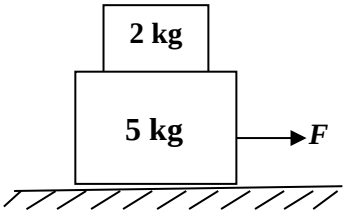
(1) Only (A) is true.
(2) Only (C) is true.
(3) Only (A) and (B) are true.
(4) Only (A) and (C) are true.
(5) Only (B) and (C) are true.

**6.** A solid cylinder of radius *r* is placed between two horizontal rods. If the cylinder is rotating without slipping when the rods are moved as shown above, what is the angular velocity of the cylinder?




(1) $\frac{3v}{2r}$ (2) $\frac{2v}{r}$ (3) $\frac{5v}{2r}$ (4) $\frac{v}{3r}$ (5) $\frac{4v}{3r}$

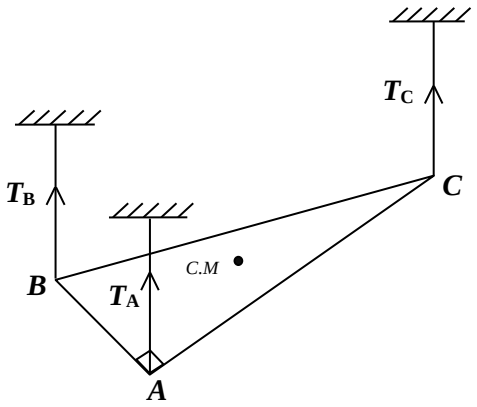
**7.** Blocks of masses 5 kg and 2 kg are placed on a smooth plane as shown in the figure. Force *F* is applied to the block of mass 5 kg. What is the maximum value of *F* such that the blocks do not slip between them?
(Frictional coefficient between blocks = 0.5)




(1) 10 N (2) 14 N (3) 25 N (4) 30 N (5) 35 N

[ *see page 3*

**8.** A uniform right angled triangular lamina made by a wood is kept horizontally by tying all three vertices to three inextensible strings. Which of the following gives the relationship between $T_A$, $T_B$ and $T_C$ when a point mass of $M$ is placed at the center of mass of the lamina?




(1) $T_C < T_A < T_B$

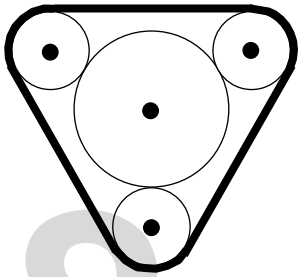
(2) $T_C < T_B < T_A$

(3) $T_A = T_B > T_C$

(4) $T_A = T_B = T_C$

(5) $T_A = T_B < T_C$

**9.** The figure shows four wheels which can rotate along stationary axes without slipping. Here, only the big wheel is connected to the motor and the other three small wheels are connected with a rough belt as shown in the figure. Consider the following statements.



(A) The angular velocities of all wheels are equal.

(B) The linear speeds are not equal at points where wheels made contact with each other.

(C) The rotational frequencies of all four wheels are always equal.

Of the above statements,

(1) (A) is only true.

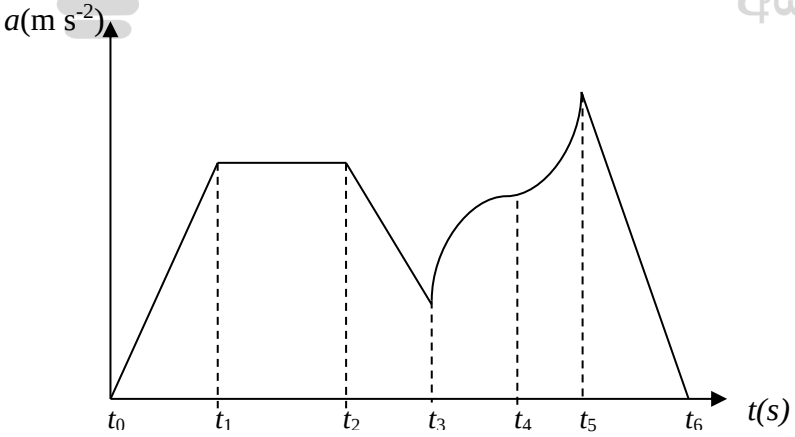
(2) (A) and (B) are only true.

(3) (A) and (C) are only true.

(4) (A), (B) and (C) are true.

(5) All are false.

**10.**




Which of the following statements is incorrect regarding the acceleration-time graph of a vehicle travelling from rest?

(1) Velocity of vehicle increases between the time intervals $t_0 - t_1$ and $t_3 - t_5$.

(2) Velocity of vehicle doesn't increase uniformly between the time interval $t_2 - t_3$.

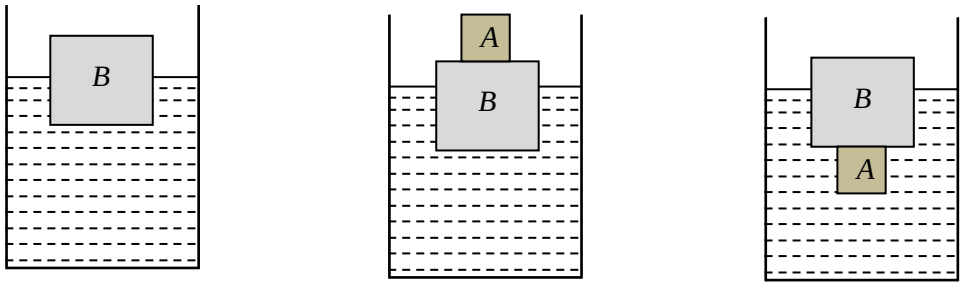
(3) Velocity of vehicle doesn't change at the time interval $t_1 - t_2$.

(4) Vehicle would have maximum velocity at $t = t_6$.

(5) Velocity of vehicle increases non-uniformly in time interval $t_3 - t_5$.

[ *see page 4*

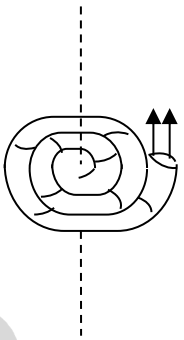
**11.**




A cuboid *B* is floating in water. When a small cuboid A with density less than water is placed on the top of cuboid *B*, the additional volume of cuboid *B* submerged in water is $V_1$. Then Cuboid *A* is taken and placed below cuboid *B* inside the water. The additional volume of cuboid *B* emerging from water is $V_2$. What is the volume of the small cuboid *A*?

(1) $V_1 - V_2$ (2) $V_1 + V_2$ (3) $2(V_1 - V_2)$ (4) $V_1 V_2$ (5) $\frac{V_1+V_2}{2}$

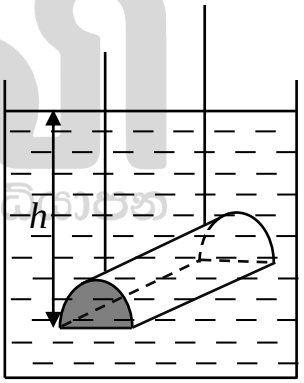
**12.** A rotating firecracker, as shown in the figure, is releasing mass *m* of explosives at a unit time with velocity *v*. What is the initial angular acceleration of the rotating firecracker? (Radius of firecracker - *r*, Mass of firecracker - *M*, Consider the firecracker as a circular disk)



(1) $\frac{4mv}{Mr}$ (2) $\frac{8mv}{Mr}$ (3) $\frac{2mv}{Mr}$

(4) $\frac{6mv}{Mr}$ (5) $\frac{10mv}{Mr}$

**13.** Half part of a solid cylinder is suspended by two inextensible strings, with its bottom surface is horizontal in a vessel containing water, as shown in the figure. The length, radius and height of the cylinder are 30 cm, 10 cm and 15 cm respectively. What is the force given by the water to the curved surface of cylinder? (density of water = 1000 kg $m^{-3}$)




(1) 22.5N ↑ (2) 22.5N ↓

(3) 45N ↓ (4) 67.5N ↓

(5) 67.5N ↑

**14.**

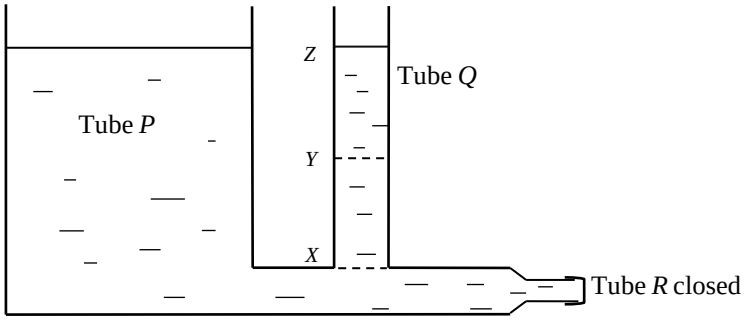



Figure 1

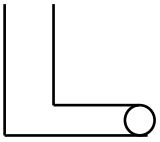


Figure 2

[ *see page 5*

An ideal fluid is in equilibrium as shown in figure 1 . Consider the following statements.

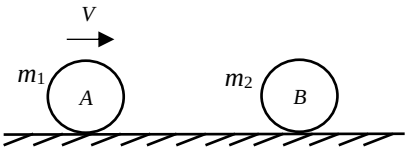
(A) Liquid level in tube *Q* is up to *Z*.
(B) If R is opened, liquid level in tube *Q* gets down quickly and reaches *X*.
(C) If tube *Q* is in curved shape as in Figure 2 , liquid level in tube *Q* gets down same as in tube *P* when *R* is opened.

Of the above statements,

(1) Only (A) is true.
(2) Only (B) is true.
(3) Only (C) is true.
(4) Only (A) and (B) are true.
(5) Only (B) and (C) are true.

**15.** Two particles *A* and *B* of masses $m_1$ and $m_2$ are placed on a smooth horizontal table. Particle A is given a velocity *v* towards particle *B*, which is at rest. Consider the following statements.

(A) If $m_1 > m_2$, both particles will move in same direction after collision.
(B) If $m_1 < m_2$, both particles will move in opposite directions.
(C) If $m_1 < m_2$, impulse on collision in *A* < *B*.




If e = 0, (e - coefficient of restitution between *A* and *B*)

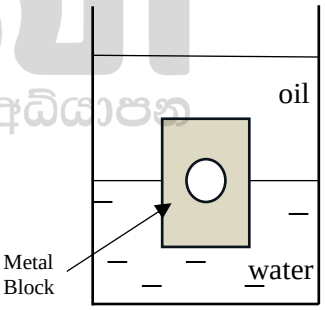
(1) Only (A) is true.
(2) Only (C) is true.
(3) Only (A) and (B) are true.
(4) Only (A) and (C) are true.
(5) All (A), (B) and (C) are true.

**16.** The density of the metal block is 2400 kg $m^{-3}$. The block is submerged so that equal volumes of it are in each liquid. If an air bubble is present inside the block, what is the fraction of volume of air bubble with volume of block?

( $\rho_{Oil} = 800$ kg $m^{-3}$, $\rho_{Water} = 1000$ kg $m^{-3}$ )

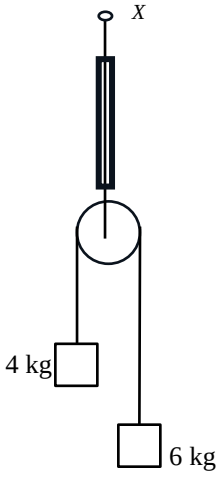
(1) $\frac{3}{8}$ (2) $\frac{5}{12}$ (3) $\frac{5}{8}$

(4) $\frac{7}{12}$ (5) $\frac{8}{12}$



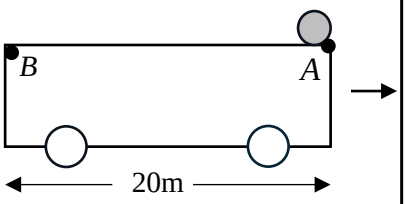

**17.** Masses of 4 kg and 6 kg are connected at the ends of a light inextensible string which is passing over a smooth massless pulley. Which direction *X* should be moved in order to keep 6 kg mass at rest and find the reading of spring balance at that moment?

(1) Towards ↑ , 120 N
(2) Towards ↓ , 120 N
(3) Towards ↓ , 140 N
(4) Towards ↓ , 145 N
(5) Towards ↑ , 145 N




[ *see page 6*

**18.** A vehicle of length 20 m is travelling with uniform acceleration. A ball is given a velocity of 5 m $s^{-1}$ vertically upwards at point *A*. If the ball reaches point *B* , what is the acceleration of the vehicle?




(1) 20 m $s^{-2}$ (2) 25 m $s^{-2}$ (3) 35 m $s^{-2}$ (4) 40 m $s^{-2}$ (5) 45 m $s^{-2}$

**19.** The apparatus is arranged on a uniform rod of mass $M_1$ as shown in the figure. The total mass of the vessel and water at the right end is $M_2$. Which of the following is the reading of the spring balance when $R = 0$ ?

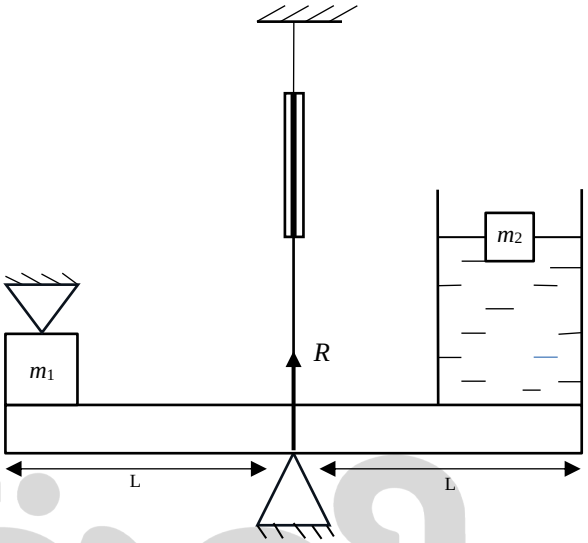
(1) $(M_2 + m_2 + M_1)$ g

(2) $(2M_2 + m_2 + M_1 + m_1)$ g

(3) $(2m_2 + 2M_2 + 2M_2)$ g

(4) $(2m_2 + 2M_2 + M_1)$ g

(5) $(2m_1 + 2m_2 + 2M_2 + M_1)$ g

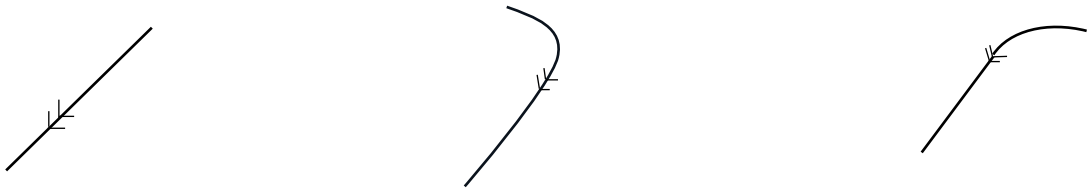



**20.** A particle of mass *m* is projected with velocity *u* and $\theta$ inclination with horizontal in a vertical plane. What is the kinetic energy of the particle when it is travelling perpendicular to the direction of projection?

(1) $\frac{mu^2}{\sin\theta}$ (2) $\frac{mu^2}{2\sec^2\theta}$ (3) $\frac{mu^2}{2\tan^2\theta}$

(4) $\frac{3mu^2\cos^2\theta}{2}$ (5) $\frac{5mu^2}{3\tan^2\theta}$

**21.**



(A) (B) (C)

A bullet, fixed at the bottom of a helicopter flying with acceleration, is fired in the opposite direction of the path of the helicopter. Which of the following indicate the path of motion of the bullet relative to the helicopter?

(1) Only (A) is true.

(2) Only (C) is true.

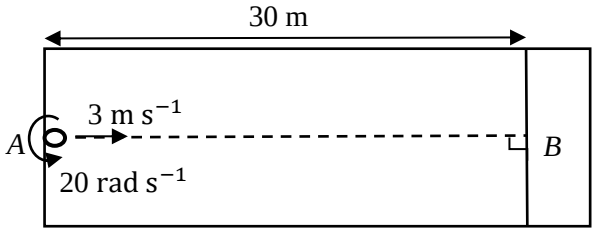
(3) Only (A) and (B) are true.

(4) Only (A) and (C) are true.

(5) All (A), (B) and (C) are true.

[ *see page 7*

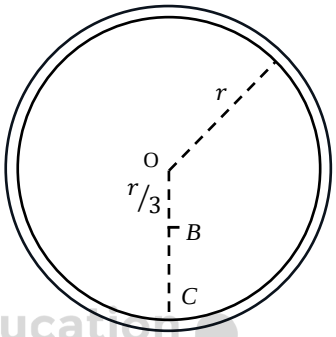
**22.**




A ball, with a mass of 300 g and a radius of 5 cm, is thrown towards point *B*, which is in a barrier, from a point *A* in a horizontal plane with still air. It is thrown with a linear velocity of 3 m s$^{-1}$ and an angular velocity of 20 rad s$^{-1}$. What is the horizontal distance that the ball moves from *B* when it reaches the barrier?
(Density of air = 1.2 kg m$^{-3}$, $\pi = 3$, Neglect the air resistance)

(1) 3.5 m (2) 4 m (3) 4.5 m (4) 5 m (5) 9 m

**23.**

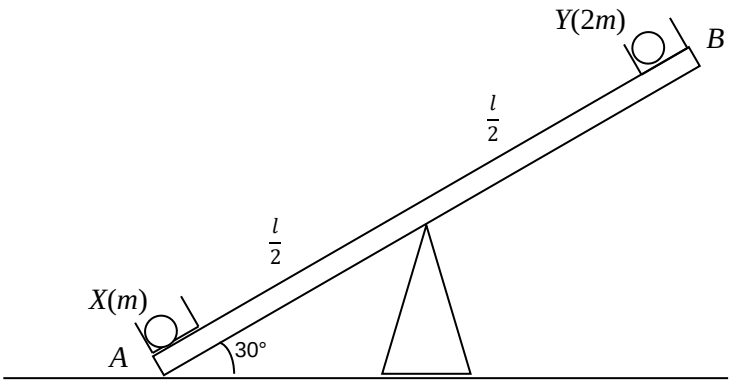



A smooth, uniform and thin ring with mass *m*, is placed horizontally on a smooth horizontal plane. A small disc of mass *m* is kept at point *B* and given a velocity *v* perpendicular to *OC*. At time *t*, the disc collides at point *C* after several collisions with ring. What is the displacement of the center of mass of the ring at time *t* ?
(*O* - Center of ring, *C* - Point on the circumference of ring, $OB = \frac{r}{3}$ )

(1) $\frac{vt}{2}$ (2) $vt$ (3) $\sqrt{\frac{vt^2}{4}+\frac{r^2}{6}}$

(4) $\sqrt{\frac{v^2t^2}{4}+\frac{r^2}{9}}$ (5) $2vt$

**24.** A uniform wooden plank *AB* of mass *m* and length *l* is smoothly hinged at the center. Particle *X* of mass *m* is held in a basket attached at *A*. The plank is inclined at 30º to the horizontal, as shown in the figure. Another particle *Y* of mass 2*m* is now kept gently in the basket at B. What is the initial velocity of particle *X* when it leaves the basket at *A*?




(Moment of inertia of plank with baskets about the axis goes through center = $\frac{1}{12}ml^2$ )

(1) $\sqrt{2gl}$ (2) $\sqrt{gl}$ (3) $\sqrt{\frac{2gl}{5}}$ (4) $\sqrt{\frac{3gl}{10}}$ (5) $2\sqrt{\frac{gl}{5}}$

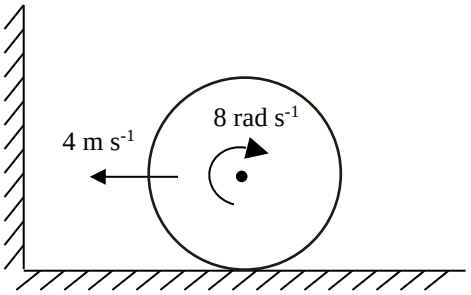
[ *see page 8*

**25.** A cylinder of mass 2 kg and radius 1m is given a linear velocity of 4 m $s^{-1}$ and an angular velocity of 8 rad $s^{-1}$, as shown in the figure. The cylinder involves to collision with the wall and rotates without slipping after the collision with 4 $ms^{-1}$ linear velocity. What is the coefficient of friction between the cylinder and the vertical wall?

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

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

(5) $\frac{2}{3}$

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# நடாத்தும் க.பொ.த உயர்தர மாணவர்களுக்கான பயிற்சிப் பரீட்சை - 01

## கல்விப் பொதுத் தராதரப் பத்திர(உயர் தர) பயிற்சிப் பரீட்சை - 2024
## General Certificate of Education (Adv.Level) Practice Examination - 2024

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| பௌதீகவியல் II<br>Physics II | 01 E II | ஒரு மணித்தியாலம்<br>One hour |

**Part A – Structured Essay**

Answer **all** the questions on the question paper itself.

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

**1.** You are provided with the following apparatus for an experiment to find the density of coconut oil.

I. An U-tube mounted to a board with suitable scales.
II. Water and Coconut oil.
III. Funnel

(a) (i) Draw a labelled diagram indicating the free surfaces of both water and coconut oil, their common surface and the reading to be taken from labelled diagram such as $\mathbf{h_1}$ and $\mathbf{h_2}$.

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(ii) Name a tool helpful for taking readings.

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(iii) State the correct reason for the U-tube to be mounted on a board.

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(iv) How should you clean the U-tube before adding the liquid to respective arms?

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(b) (i) If the densities of coconut oil and water are $\mathbf{d_1}$ and $\mathbf{d_2}$ respectively, obtain an expression for $\mathbf{d_1}$. ( Atmospheric pressure = $P_0$ )

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(ii) In order to determine $d_1$, can more water be added in respective arm? State the reason.

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(iii) If the gradient of curve used to find $d_1$ turns out to be 0.91. Then find $d_1$.

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(c) (i) What nature, the two liquids must have to be used for U-tube experiment?

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(ii) For those liquids which do not satisfy above nature, how can the experiment be conducted without changing the apparatus?

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(d) (i) Which liquid is to be poured first in U-tube? State the reason.

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(ii) Give two experimental reasons for not using mercury instead of water in this experiment.

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(iii) Draw a rough sketch of the curve that you expect in this experiment.

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(iv) What can you say about the densities of two liquids using in this experiment?

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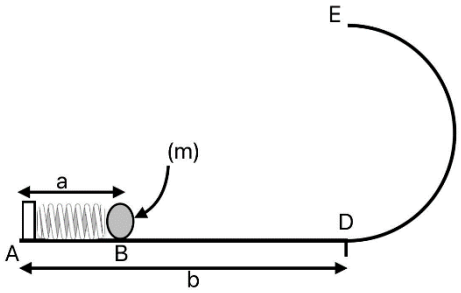
**2.** Consider the following motion of the ball.




- Only segment BD is rough, having a coefficient of friction "$\mu$", while others are smooth.
- Segment DE is a semi-circular segment of radius "R".
- AB = a
- AD = b
- Mass of the ball is m.
- Neglect the rotational motion of ball.
- The spring constant is "k".
- The extension of the spring is "e".

(a) (i) What is the equation for Hooke's law?

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(ii) Write the equation for energy stored in the spring.

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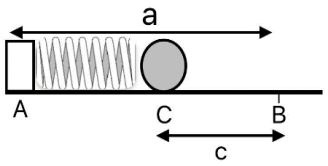
(b) If the spring is compressed by length **c** and released, using the conservation of mechanical energy, find the velocity of the ball at B (**$V_B$**).

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(c) What is the magnitude of friction acting on the ball at segment **BD** when moving from **B** to **D**?

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(d) During the motion of the ball from **B** to **D**,

(i) What is its acceleration?

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(ii) What is the expression for the velocity of ball $\mathbf{V_D}$ at **D**?

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(e) In the vertical motion of ball in between **D** and **E**,

(i) For the ball to just reach **E**, what should be its minimum velocity at **D**?

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(ii) Write an equation that satisfies e(i) in terms of **k**, **c**, **m**, $\boldsymbol{\mu}$, **g**, **b**, **a** and **R**.

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(f) What velocity that the ball should have at **E** for it to reach **A** again after performing a vertical circular motion ? Give the expression in terms of **b** and **R**.

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## Part B - Essay

**3.** (a) (i) When Bernoulli's equation is applied to a suitable fluid it turns out to be,

$\mathbf{P + \frac{1}{2}dv^2 + hdg = constant}$. Show that the dimension of *hdg* is that of pressure's dimension.

(ii) State two qualities that a fluid should consist for obeying Bernoulli's principle.

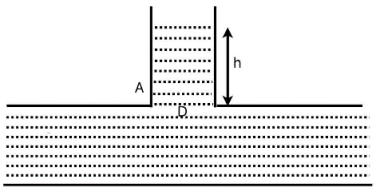
(b) (i) A liquid has raised to a height of '**h**' in a tube A when it is continuously flowing as shown.

Atmospheric pressure = $\mathbf{P_o}$

Density of liquid = $\boldsymbol{\rho}$

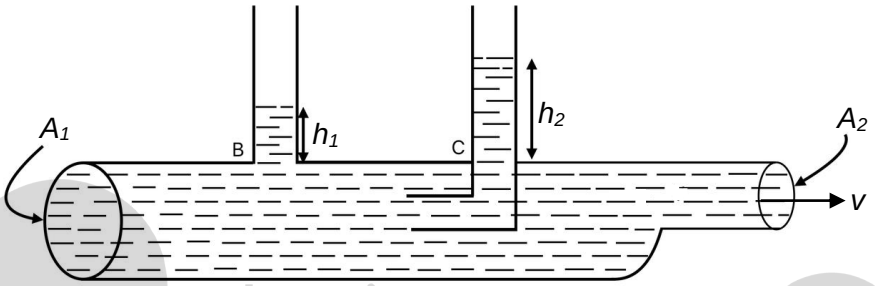
Acceleration due to gravity = **g**

Find the static pressure at point *D* in terms of $\boldsymbol{\rho}$ , **h** , $\mathbf{P_o}$ , **g**.




(ii) In b (i) what happens, if $\mathbf{p_o > p}$.

(iii)




$\mathbf{A_1}$ and $\mathbf{A_2}$ are cross sections of the bigger and smaller faces respectively. Liquid has raised to height $\mathbf{h_1}$ in tube B and $\mathbf{h_2}$ in the pitot tube C respectively. **Find the velocity(*V*)** of liquid in the tube with cross section $\mathbf{A_2}$, in terms of given quantities.

(c) (i) Air is also a fluid which obeys to Bernoulli's equation. Hence, how can the equation be written? (Temperature of air is constant)

(ii) A man is standing so close to a railway track, a train passes him swiftly. What will happen to the man and give reasons for your answer?

(iii) In question c (ii) the pressure between man and the train is $5 \times 10^4$ N $m^{-2}$ and the pressure behind him is $1 \times 10^5$ N $m^{-2}$, his mass being 50 kg and his effective cross-sectional area is 1 $m^2$. Then find the initial acceleration, at which the man will be moved.

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