Royal College - Colombo 07
Grade 13
First Term Test – November 2018
Physics I

**01 E I**

Time : 2 hours

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

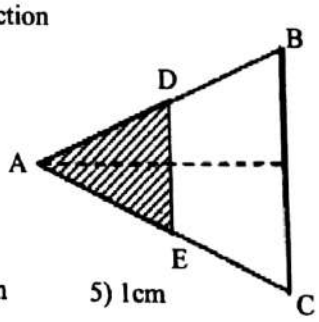
❖ **Answer all questions.**

1) The dimensions of angular speed would be
1) $LT^{-1}$ 2) $L^{-1}T^{-1}$ 3) $T$ 4) $T^{-1}$ 5) $L^{-1}$

2) The least count of an electronic balance and a four beam balance are 0.1g and 0.01g.The fractional errors of two masses measured by using above two balances are same. The ratio of two masses would be,
1) 0.01 2) 1 3) 10 4) 100 5) 1000

3) When a sound source is moving towards an observer with $u_s$ velocity, the observer hears the real frequency emitted by the source. This situation can be occurred when
1) the observer should moves towards the source with a higher velocity than $u_s$ .
2) the observer should moves towards the source under velocity $u_s$
3) the observer should moves away from the source under velocity less than $u_s$
4) the observer should moves away from the source under velocity greater than $u_s$
5) Source and the observer should move under same velocity in same direction

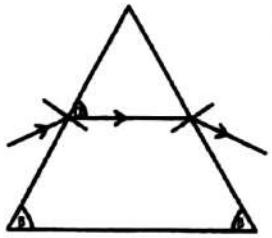
4) ABC is an equilateral triangular uniform plate having 12cm median. Another equilateral triangle ADE cut by a same material of having 6cm median is combined with ABC triangle as shown in the figure. The distance between the centre of gravity of ABC plate and the centre of gravity of the combined object would be
1) 0cm 2) 0.4cm 3) 0.6cm 4) 0.8cm 5) 1cm




5) An object is at rest is subjected to a uniformly increasing force from zero. The work done on the object during the first 10m is 100J. The work done for next 20m would be,
1) 200J 2) 300J 3) 400J 4) 600J 5) 800J

6) Small letter are observed under maximum angular magnification by a hand lens of having 5cm focal length. The least distance of distinct vision of the observer is 25cm. The distance in cm to be displaced the hand lens to make 5.5 angular magnification is
1) $\frac{20}{66}$ 2) $\frac{25}{66}$ 3) $\frac{20}{60}$ 4) $\frac{25}{60}$ 5) $\frac{25}{6}$

7) An incident ray of equilateral triangle is refracted under minimum deviation. The correct relationship of following would be
1) $2\beta - \alpha = 180^0$ 2) $\alpha > \beta$ 3) $\alpha < \beta$
3) $\alpha = \beta$ 5) $\alpha + \beta = 90^0$



8) A light beam is converged to a point of a screen. When a glass block of having $t$ thickness and $\mu$ refractive index is kept across the beam , the point of convergent is,

1) Moved away in $t\left(1-\frac{1}{\mu}\right)$
2) Moved towards in $t\left(1-\frac{1}{\mu}\right)$
3) Moved away in $t\left(1+\frac{1}{\mu}\right)$
4) Moved towards in $t\left(1-\frac{1}{\mu}\right)$
5) Moved towards in $t\left(1-\frac{1}{(\mu-1)}\right)$

9) Consider the following data relevant to three rods in the table. The most correct statement statement from following is,

| Rod | Initial length | Temperature difference | Increase in length |
|---|---|---|---|
| A | 2L | $\Delta T$ | $\Delta L$ |
| B | 3L | $2\Delta T$ | $3\Delta L$ |
| C | 4L | $\Delta T$ | $\Delta L$ |

1) Only A and B rods are made in same material
2) Only A and C rods are made in same material
3) Only B and C rods are made in same material
4) All A, B and C rods are made in same material
5) All A, B and C rods are made in different materials

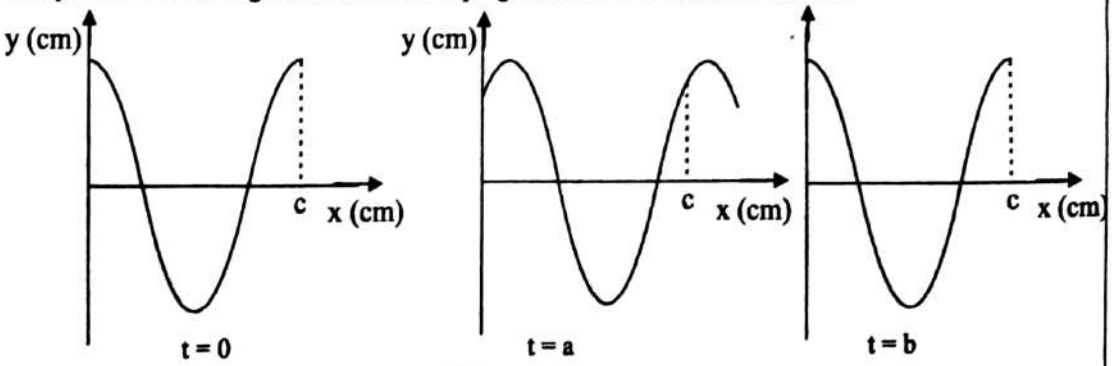
10) The most strength force in a black body even having an ability to absorb light is

1) Electrostatic Force
2) Magnetic Force
3) gravitational Force
4) Nuclear Force
5) Inter molecular attraction Force

11) Mass of the sun is $1.5\times10^{30}$kg and the distance between the sun and the earth is $1\times10^{11}$ m. The velocity of the earth around sun is $3\times10^{4}$ms$^{-1}$ The minimum velocity to be applied on earth to escape the sun's gravitational field is
($G = 6\times10^{-11}$ m$^2$Kg$^{-2}$)

1) $3\times10^{4}$ms$^{-1}$
2) $6\times10^{4}$ms$^{-1}$
3) $9\times10^{4}$ms$^{-1}$
4) $12\times10^{4}$ms$^{-1}$
5) $15\times10^{4}$ms$^{-1}$

12) The positions of three given moments in a progressive wave are shown in below.




The velocity of the progressive wave would be.

1) cb
2) c(b-a)
3) $\frac{c}{b}$
4) $\frac{c}{(b-a)}$
5) $\frac{(b-a)}{c}$)

13) Consider the following statements regarding seismic waves.

A) Raleigh waves are travelling through the interior of the earth.

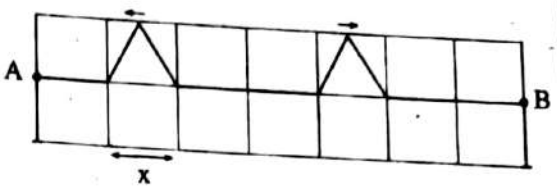
B) The secondary waves are entirely responsible for the damages and destructions

C) Primary waves can be travelled through both solid and liquid mediums.

The most suitable statement / (S) from following is / are

1) A only 2) B only 3) C only 4) A and C only 5) All A, B and C

14) Two pulses are formed in a string as shown. The string is hardly fixed at pint A and smoothly fixed at point B. These pulses can be travelled in x distance within 1s. Figure shows the initial positions of two pulses. The time taken to superimpose the two pulese is.



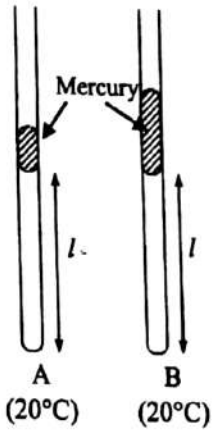

1) 3.5s 2) 4.0s 3) 4.5s 4) 5.0s 5) 5.5s

15) The readings of constant pressure apparatus when its bulb is in a melting ice and a boiling liquid are x and y respectively. The boiling point of the liquid may be.

1) $237.15 \times \frac{y}{x}$ 2) $273.15 \times \frac{x}{y}$ 3) $273.16 \times \frac{x}{y}$

4) $273.16 \times \frac{y}{x}$ 5) $\frac{273.15 \times x}{273.16 \times y}$

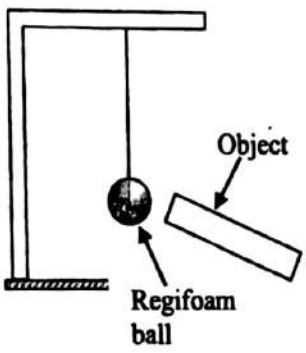
16) Two air columns having equal lengths are trapped in similar narrow tubes to verify the Charl's Law at $20^0$C. The difference between two tubes is the length of the mercury thread used to trap the air inside only.




The temperature of the both setup is increased up to $40^0$C

1) The length of the air column in tube A is greater than that of tube B
2) The length of the air column in tube B is greater than that of tube A
3) Lengths of the air columns in both tube A and B are equal
4) Since the length of the mercury column in tube B is increased, the length of the air column inside the tube may be decreased
5) Since the temperature is doubled the air columns inside the both tubes will be doubled.

17) A small ball of rigifoam is hung by a light string as shown in the figure. An object is kept closer to the rigifoam ball. Consider the following statements.




A) If the object is uncharged, the rigifoam ball stays at rest.

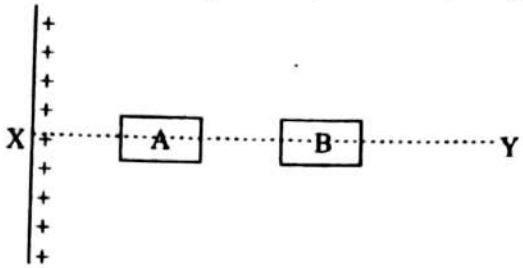
B) If the object is positively charged the rigifoam ball is attracted to the object

C) If the object is negatively charged the rigifoam ball is repelled from the object.

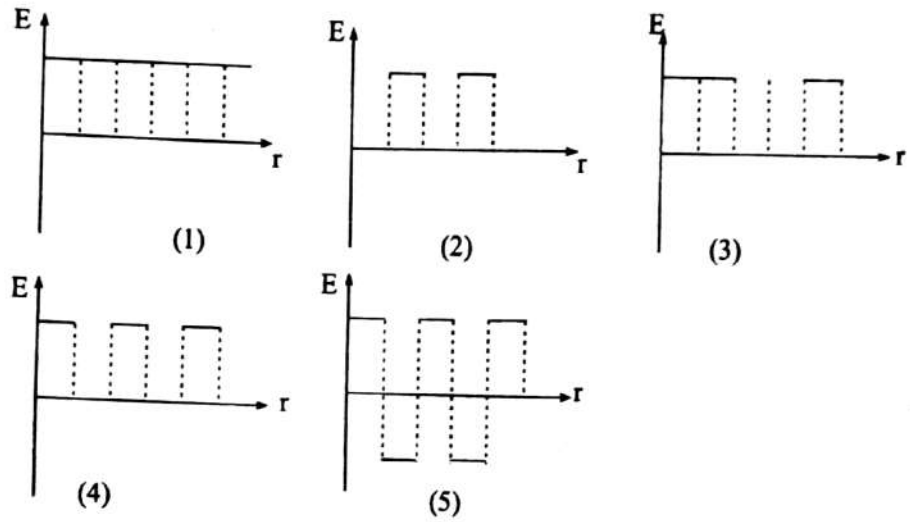
The true statement / S from flowing is/are

1) A only 2) B only 3) C only
4) A and B only 5) All A, B and C

18) Two uncharged cuboids of A and B are kept closer to a uniformly charged conducting plate having infinite surface area.



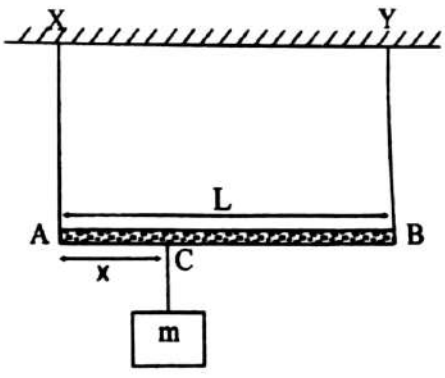

The best representation of the variation of the electrostatic field intensity with the distance r along the line XY is




19) A 1kHz musical tone is played by a gramophone recorder which is having $33\frac{1}{3} rmp$ angular speed. If the same musical tone is played in a faulty gramophone recorder having angular speed of $33 rmp$ with the above recorder simultaneously, the beat frequency would be.

1) $\frac{1}{3} Hz$ 2) 1Hz 3) 10Hz 4) 20Hz 5) 67Hz

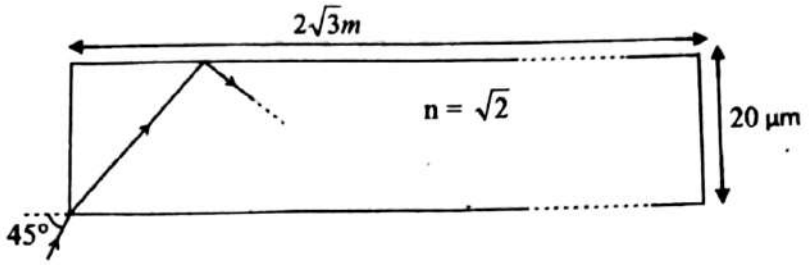
20) AB uniform straight wire of length L is hung horizontally by two light strings as shown in figure. m mass is hung at x distance from A. The AC and CB parts of the string are vibrated in fundamental and first overtone modes respectively with a given tuning fork. The length x would be




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

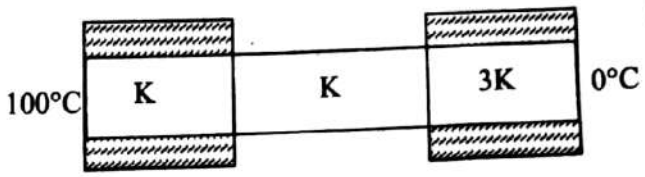
4) $\frac{2L}{3}$ 5) $\frac{3L}{5}$

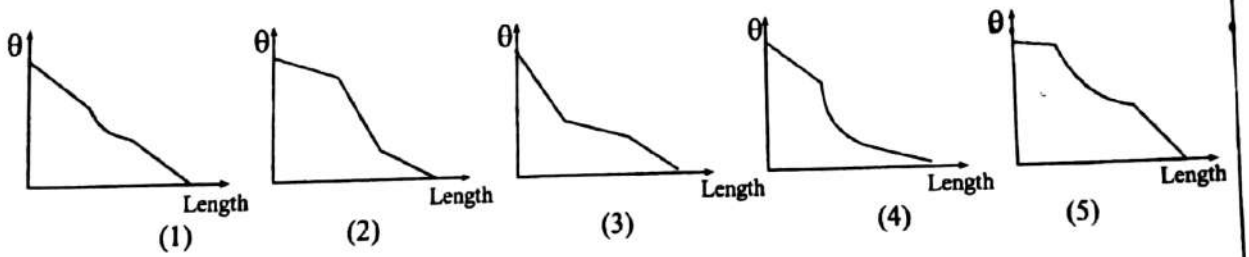
21) A light ray is entered in $45^0$ angle to the horizontal to an optical fibre of $2\sqrt{3}m$ length and 20 μm diameter. The refractive index of the optical fiber is $\sqrt{2}$. The number of reflections occurred when the ray is emerged from the optical fiber is




1) $1 \times 10^4$ 2) $5 \times 10^4$ 3) $1 \times 10^5$ 4) $5 \times 10^5$ 5) $1 \times 10^6$

22) Three uniform rods of having thermal conductivities of K, K, and 3K are connected each other as shown in the figure. The three rods are having equal lengths. One end of a combined rod is kept at $100^0$C and the other end is kept at $0\ ^0$C. The rod at the middle is not lagged. The best representation of the variation of the temperature along the rod is




23) Time taken to decrease the temperature of an object from $55^0$C to $45^0$C is 10 minutes. At the next 10 minutes its temperature is $39^0$C. The temperature of the object at the end of next 10 minutes would be

1) $30.0^0$C 2) $32.4^0$C 3) $32.8^0$C 4) $35.4^0$C 5) $35.8^0$C

24) The ratio of the radii of **A** planet and the **B** planet is **y**. The ratio of the gravitational accelerations on the surfaces of **A** and B is **x**. The ratio of escape velocities of a given object on the surface of A and on the surface of B is

1) $\frac{y}{x}$ 2) $\frac{x}{y}$ 3) $\sqrt{\frac{y}{x}}$ 4) $\sqrt{xy}$ 5) $\sqrt{\frac{x}{y}}$

25) There is an infinite distance between two isolated rest masses of $m_1$ and $m_2$. As a result of gravitational force, they are moving towards each other. When the distance between the two masses is r, the velocities of them are given by,

1) $\sqrt{\frac{2Gm_2}{r}}, \sqrt{\frac{2Gm_1}{r}}$

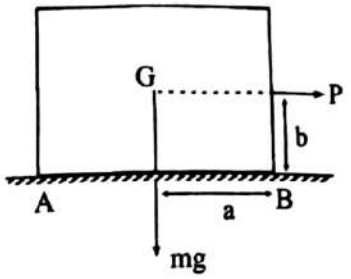
2) $\sqrt{\frac{2Gm_1}{r}}, \sqrt{\frac{2Gm_2}{r}}$

3) $\sqrt{\frac{2Gm_1m_2}{r}}, 0$

4) $0, \sqrt{\frac{2Gm_1m_2}{r}}$

5) $\sqrt{\frac{2Gm_1m_2}{r}}, \sqrt{\frac{2Gm_1m_2}{r}}$

26) A box is kept on an horizontal rough surface and subjected to a force P as shown in the figure. The line of action of force P is through the centre of gravity and the magnitude of the force is uniformly increased. The condition should be satisfied to roll the box without slipping is.




1) $P < \frac{mgb}{a}$

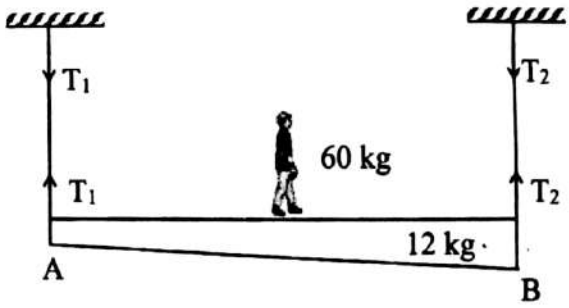
2) $P > \frac{mgb}{a}$

3) $P = \frac{mgb}{a}$

4) $P > \frac{mga}{b}$

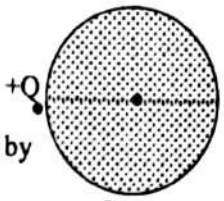
5) $P > \frac{mg(a-b)}{b}$

27) The centre of gravity of AB non uniform rod of mass 12 kg is at a point of 2:1 ratio from A edge. This rod is hung horizontally by two light strings as shown in figure. When a man of 60kg mass is at the midpoint of the rod, the tensions of the strings are $T_1$ and $T_2$. The maximum tensions borne by the strings when the man is walking between A and B are $T_1'$ and $T_2'$ respectively. The values of $T_1$, $T_2$, $T_1'$ and $T_2'$ are correctly represented by



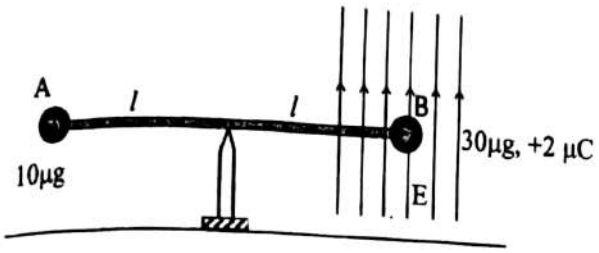

| | $T_1$(N) | $T_2$(N) | $T_1'$(N) | $T_2'$(N) |
|---|---|---|---|---|
| (1) | 640 | 680 | 340 | 380 |
| (2) | 680 | 640 | 380 | 340 |
| (3) | 340 | 380 | 640 | 680 |
| (4) | 380 | 340 | 680 | 640 |
| (5) | 640 | 680 | 380 | 340 |

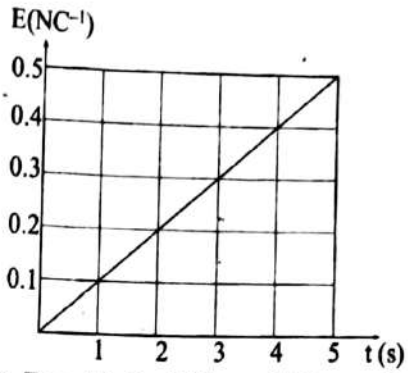
28) A $Q$ point charge is placed very close to the circumference of the thing circular conducting plate as shown
(The permeability of air is $\varepsilon_0$)
The effective electrostatic flux across the plate due to +Q charge is given by




1) $\frac{Q}{\varepsilon_0}$ 2) $\frac{2Q}{\varepsilon_0}$ 3) $\frac{1}{4\pi\varepsilon_0}\frac{Q}{r}$ 4) $\frac{1}{4\pi\varepsilon_0}\frac{2Q}{r}$ 5) zero

29)

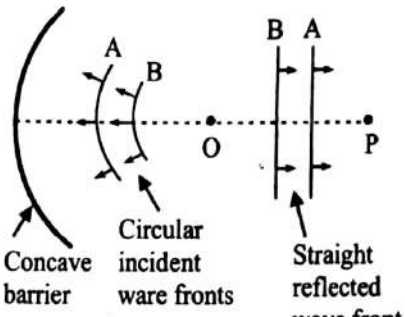



A Light rod is under equilibrium on a knife edge at its centre. Two objects of 10μg and 30μg are fixed at A and B points as shown in the figure. The object A is uncharged and B is having +2 μc charge. A uniform electrostatic field (E) is applied vertically across the mass B. The value of E is uniformly increased according to the graph given above. The time taken to become the rod horizontal,

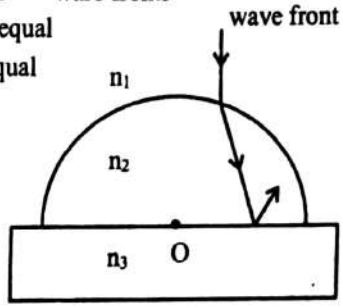
1) 1s 2) 2s 3) 3s 4) 4s 5) 5s

30) A circular wave front of having centre O is approached on to a concave barrier and it is reflected as a straight wave front as shown in the figure. The **false** statement / (s) is / are



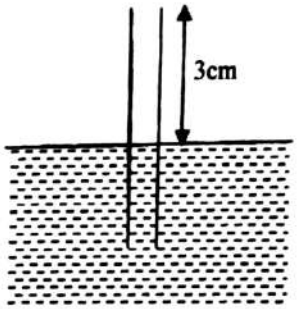

1) O is the centre of the concave barrier
2) O is the focal point of concave barrier.
3) The velocities of both circular and the straight wave fronts are equal
4) The wave lengths of both circular and the straight wave fronts are equal
5) The frequencies of both circular and the straight wave fronts are equal

31) A light ray is travelling through three mediums as shown in figure . The correct relationship between refractive indexes of three mediums is given by



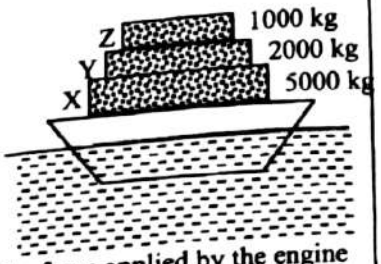

1) $n_1 = n_2 = n_3$ 1) $n_1 > n_2 = n_3$
3) $n_1 > n_2 > n_3$ 4) $n_1 < n_2 < n_3$
5) $n_1 > n_2 < n_3$

32) A both end opened tube of 1 $cm^2$ cross sectional area and 20 cm length is immersed in the water as shown in the figure. The length of the part of the outside of the water is 3 cm. An oil of having 0.8 relative density is poured in to the tube from the upper end. The maximum volume of the water flowing out from the lower end of the tube is,



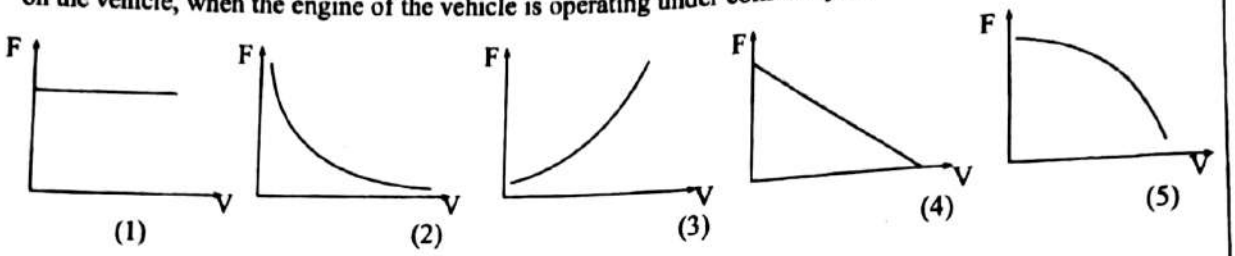

1) 20 $cm^3$ 2) 17 $cm^3$ 3) 15 $cm^3$ 4) 12 $cm^3$ 5) 3 $cm^3$

33) The given figure shows that the three containers of 5000 kg, 2000 kg and 1000 kg masses are packed in a ship. The ship is moving under constant velocity. Then the resultant force exerted on Y container is

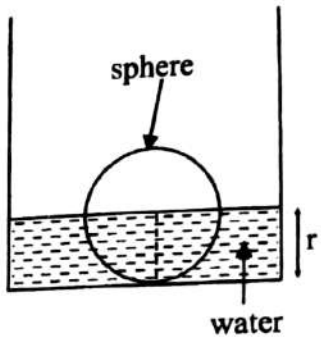



1) $3 \times 10^4$ N downward
2) $2 \times 10^4$ N upward
3) $1 \times 10^4$ N upward
4) $1 \times 10^4$ N downward
5) zero

34) The best representation of the variation of the velocity (V) of a vehicle with the force applied by the engine on the vehicle, when the engine of the vehicle is operating under constant power.

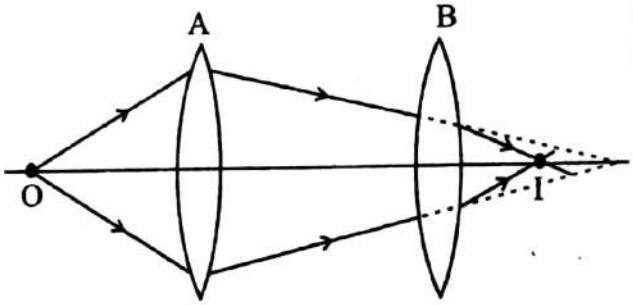



35) A sphere of mass M and radius r is in a container as shown in the figure. Water is poured into the container and when the water level is equal to the radius of the sphere, the normal reaction force on the sphere from the container is reduced by ¼ of its weight. When immiscible oil is poured in equal volume of added water to cover the sphere, the normal reaction is reduced in fraction of 3/5 of its weight. The relative density of the oil is,



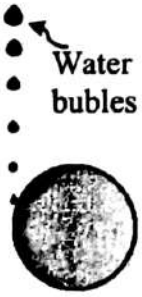

1) 0.6
2) 0.8
3) 1.2
4) 1.4
5) 2

36) Two rays coming from a point object (o) are refracted through two lenses and formed an image I as shown in figure. When the lens B is shifted away from lens A, the correct statement regarding imaged I is,



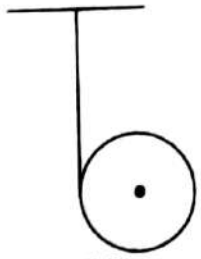

1) It remaining at the same position.
2) It moving rightward.
3) It moving leftward.
4) It shifting outward from lens B.
5) The lens B never passes the image I.

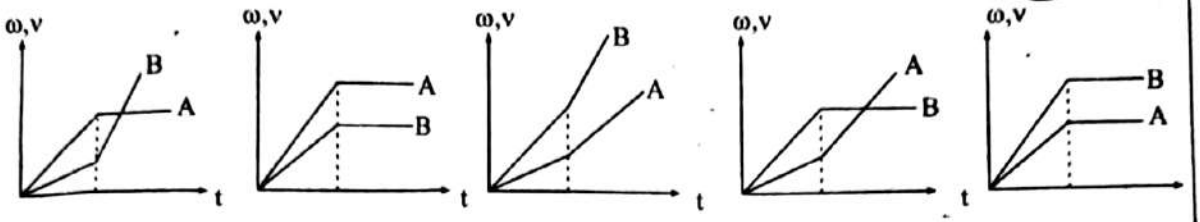
37) A disk of having 0.01 $kgm^2$ moment of inertia is free to rotate about a perpendicular axis through the point O. A disk gained 0.01$kgm^2rads^{-1}$ angular impulse as a result of colliding the water bubbles at its circumference tangentially in every 4 seconds. The angular velocity of the disk after 30 s in $rads^{-1}$




1) 12 $rads^{-1}$
2) 10 $rads^{-1}$
3) 8 $rads^{-1}$
4) 7 $rads^{-1}$
5) 6 $rads^{-1}$

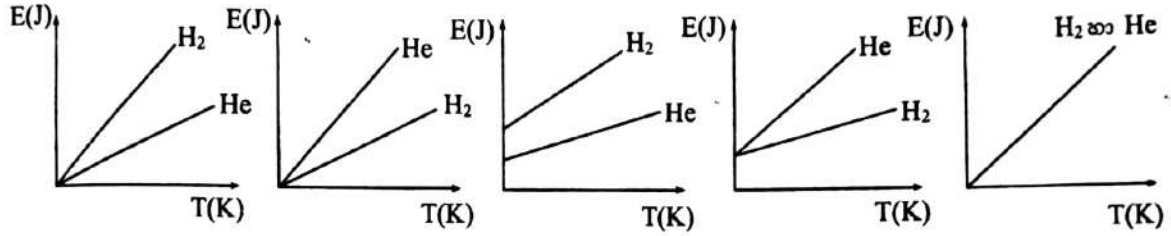
38) A string is wound around the circumference of rough pulley and the other end is connected to a rigid point as shown in figure. Consider the end of the string is not fixed on the circumference. Now the pulley is released smoothly. The variation of the angular and the translational velocities of the pulley are represented by the graphs A and B respectively. The best representation of A and B is given by,






(1) (2) (3) (4) (5)

39) The equal masses of $H_2$ and He gases are consisted in two closed separate cylinders. The best representation of the variation of the internal energy of both gasses with the absolute temperature is,




(1) (2) (3) (4) (5)

40) An amount of water in a huge metal vessel is heated by a 500 W heater. It is observed that the temperature of the water cannot be increased more than $72^0$C. Consider the following statements given by the students regarding above situation.

A. The heater is burnt at $72^0$C.
B. If the vessel is covered with thermally insulated material, the final temperature may be increased more than $72^0$C.
C. If the vessel is polished, the final temperature may be increased more than $72^0$C.
D. If two heaters of each 500 W power are used to heat the water, then the final temperature can be doubled

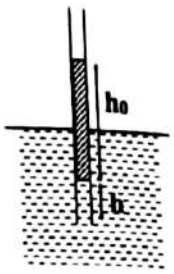
The correct statement/s is/are,

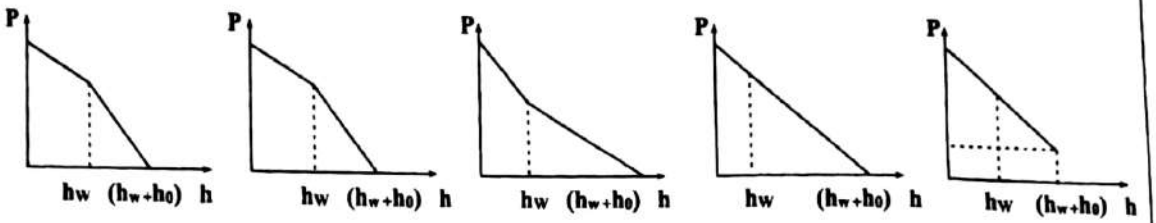
1) only B, C 2) only B, C, D 3) only C, D
4) only B, D 5) all A, B, C, D

41) A beaker of having 'd' diameter is filled with water of $\rho_w$ density up to the level of half of its height. It is moving under 'a' acceleration. The maximum pressure difference between two end points of a diameter of the beaker is given by

1) $\frac{ad\rho_w}{2g}$ 2) $\frac{ad\rho_w}{2}$ 3) $\frac{ad\rho_w}{g}$ 4) $ad\rho_w$ 5) $2ad\rho_w$

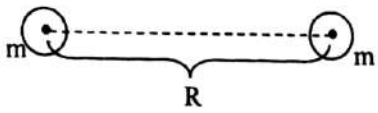
42) A both end opened glass tube is submerged vertically in the water as shown in figure. The rest of the tube is filled with an immiscible oil. The tube is raised slowly till it comes out the water layer. The variation of the pressure (P) at the below end of the tube with the height of raising the tube is correctly represented by,

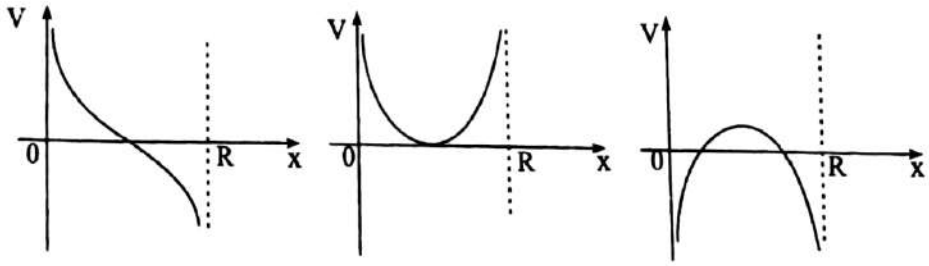


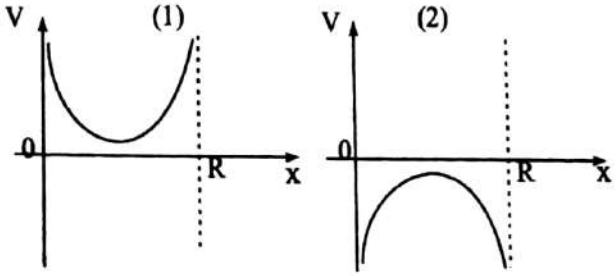

(1) (2) (3) (4) (5)

43) Two equal masses are kept at R distance each other. If the system is isolated from other external masses, the variation of the gravitational potential (V) with the distance (x) along the line of connection of two masses is correctly represented by



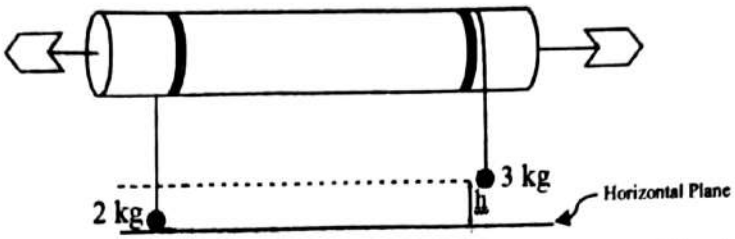




(1) (2) (3)




(4) (5)

44) Two masses of 2 kg and 3 kg are hung by two light strings which are wound around a cylindrical drum which is free to rotate its axis as shown figure. These two masses are smoothly released at the indicated position. Consider the following statements regarding their motions.




A) The change of potential energy of two masses is equal to the change of kinetic energy.
B) The velocity of 3kg mass when it reaches the floor is equal to the moving velocity of 2kg mass.
C) The rotational kinetic energy of the drum at the moment of colliding the 3kg mass on the floor and the change of potential energy of two masses are equal to the change of kinetic energy of two masses.

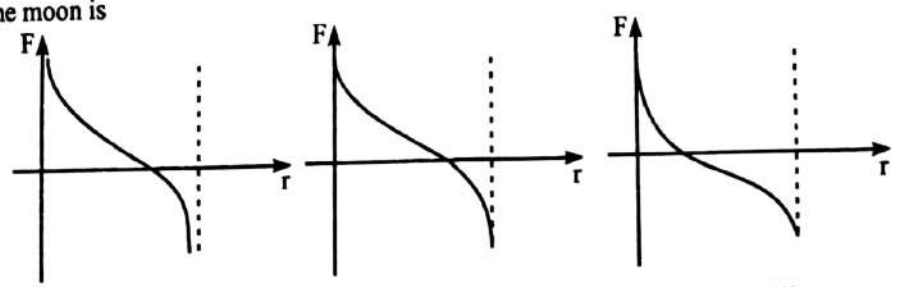
The true statement/s is/are

1) A only 2) B only 3) C only
4) A and B only 5) B and C only

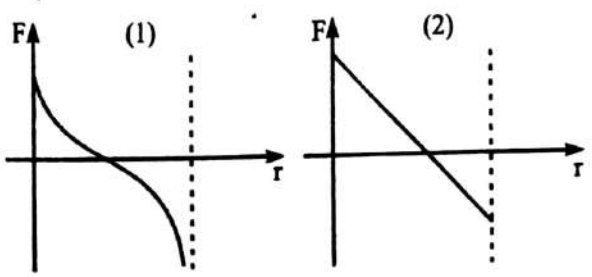
45) When the man traveled to the moon by Apollo –II space craft, it is landed at an orbit (Parking Orbit) of 190km away from the earth surface. The velocity of the Apollo –II space craft at this orbit is represented by ($G = 6.67 \times 10^{-11}\ Nm^2kg^{-2}$, Mass of the earth $= 5.98 \times 10^{24}$kg, radius of the earth = 6400 km)

1) $\sqrt{\frac{6.67\times10^{-11}\times5.98\times10^{24}}{6.40\times10^{6}}}$
2) $\sqrt{\frac{6.67\times10^{-11}\times5.98\times10^{24}}{(6.40\times10^{6})^2}}$
3) $\sqrt{\frac{6.67\times10^{-11}\times5.98\times10^{24}}{6.59\times10^{6}}}$
4) $\sqrt{\frac{6.67\times10^{-11}\times5.98\times10^{24}}{(6.59\times10^{6})^2}}$
5) $\sqrt{\frac{6.67\times10^{-11}\times5.98\times10^{24}}{0.19\times10^{6}}}$

46) When the Apollo –II space craft in above question is reached to the moon, the best representation of the variation of the resultant gravitational force (F) on this air craft with the distance (r) from the earth surface to the moon is

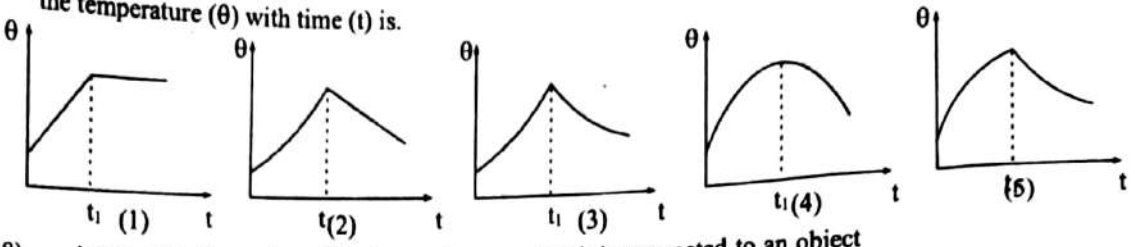



(1) (2) (3)

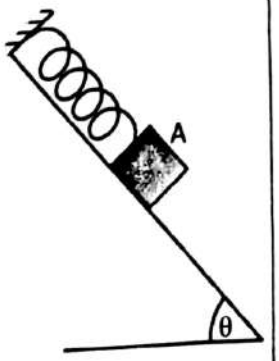



(4) (5)

47) Heat energy is supplied in constant rate to a vessel of having vax. The vessel is opened to the environment. After 't' time period the heat supply is stopped. The best representation of the variation of the temperature (θ) with time (t) is.




48) A one end of a spring of having spring constant k is connected to an object and the other end is connected to a rigid point on an inclined plane as shown in the figure. The object is kept on the inclined plane under equilibrium state and the angle of inclination of the plane is θ. At this moment the spring is subjected to an extension. Consider the following statements.




D) The object A is under limiting equilibrium.

E) When increasing the inclination of the plane, the extension of the spring will be increased.

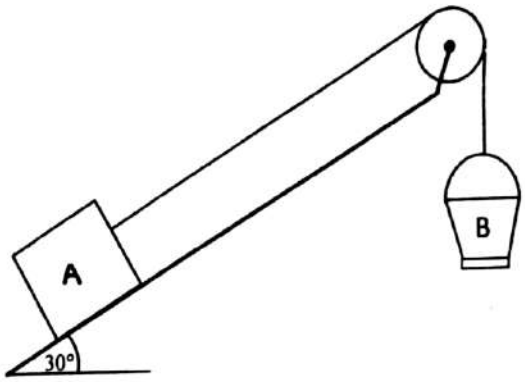
F) When the inclination is increased furthermore , the frictional force acting on the object by the plane will be increased.

The most correct statement/s is /are

1) A Only. 2) A and B only 3) B and C only.

4) A and C only. 5) All A, B and C

49) A object is on a rough inclined plane. The string connected to the object is going around a pulley and connected to an empty bucket as shown in the figure. When releasing the A and B smoothly, the A object is moving downward along the plane. While moving A and B, the empty bucket is filled with water under a constant rate. Consider the following statements regarding above situation.




A) At the initial state the dynamic frictional force is upward and then it can be changed to the downward direction along the plane.

B) When the bucket is completely filled with water and the masses of A and B are equal, to move the system under constant velocity, there should be $\frac{1}{\sqrt{3}}$ co-efficient of friction between A and the plane.

C) When the bucket is filled with water the frictional force applied on A is remain constant.

The true statement/s is/are from following

1) A only 2) B only 3) C only

4) A and B only 5) A and C only

50) The latent heat of fusion of ice at $0^0$C is $2.3\times10^5$Jkg$^{-1}$ and the specific heat capacity of water is 4200Jkg$^{-1}$K$^{-1}$. When the melting point of ice is reduced by increasing the pressure up to $-10^0$C, then the latent heat of ice at $-10^0$C is,

(The specific heat capacity of ice is 2100Jkg$^{-1}$K$^{-1}$. Neglect the change of volume when melting ice)

1) $2.1\times10^5$Jkg$^{-1}$ 2) $2.2\times10^5$Jkg$^{-1}$ 3) $2.3\times10^5$Jkg$^{-1}$

4) $4.1\times10^5$Jkg$^{-1}$ 5) $4.2\times10^5$Jkg$^{-1}$

Royal College - Colombo 07
Grade 13
First Term Test – November 2018
Physics II

01 | S | II

Time : 03 hours

Name :- ..... class : -..... Index no :- .....

**Important :**

- *The question paper consists of **12** pages*
- *The question paper comprises **Part A** and **Part B**. The time allotted for both part in **3 hours.***
- *Use of calculators is **not** allowed*

**Part A - Structured Essay**
(07 pages)
*Answer all the questions on this paper itself. Write your answers in this spaces provided is sufficient for your answers and that extensive are not expected.*

**Part B - Essay**
(05pages)
*This part contains five questions. Use the papers supplied for this purpose. At the end of the time allotted for this paper, tie the two papers so that **Part A** is on top of **Part B** before handing them over to the Supervisor.*
*You are permitted to remove **only** **Part B** of the question paper from Examination hall.*

$g = 10\ Nkg^{-1}$

**For Examiner's use only**

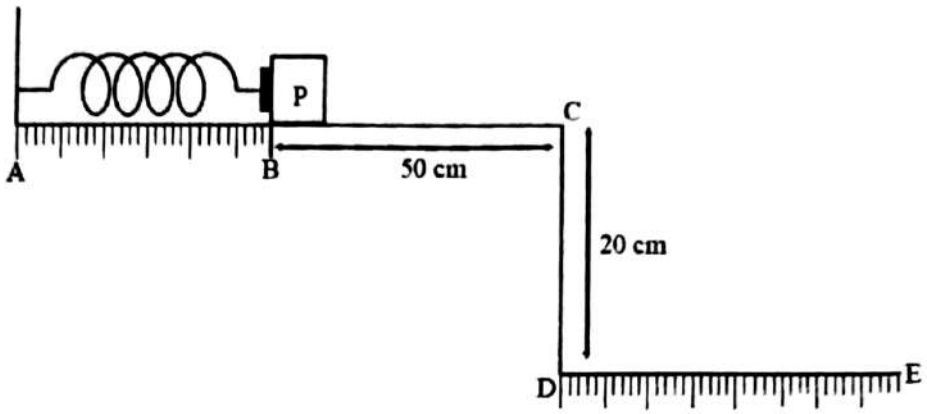
| For the second paper | | |
|---|---|---|
| Part | Question nos. | Marks |
| A | 1 | |
| | 2 | |
| | 3 | |
| | 4 | |
| | 5 | |
| | 6 | |
| | 7 | |
| | 8 | |
| | 9 | |
| Total | **Final Marks** | |

| | |
|---|---|
| **In numbers** | |
| **In words** | |

## Part A – Structured Essay

❖ Answer all questions.

1)




Above experimental set up is arranged to determine the co-efficient of dynamic friction ($\mu_k$) of a plane and the spring constant (K) of a spring. The AB part of the plane is smooth and the BC part of the plane is rough. The dynamic co-efficient of friction of BC part is $\mu_K$. A one end of the spring is fixed at a rigid point and the other end is slightly touched with the object P. The mass of the object P is 0.5kg.The object P is pushed to compress the spring in length 'e' and then it released. After releasing the object it slides along the plane and it escape the plane at point C and collided on the DE plane. There are two scales to measure the compression length of the spring and the horizontal distance to the point of dropping on the floor from point D.

i) How long it takes to drop the object P on the DE plane after releasing at point C?

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ii) Find the work done against the frictional force when the object is moving from B to C in terms of $\mu_K$.

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iii) If the distance measured from point D to the point of dropping the object P on DE plane is "S', then find the escape velocity of the object P at point C.

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iv) Write an expression for the stored elastic potential energy of the spring when the spring is compressed in 'e' extension.

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v) Construct a relationship between the results obtained in part (ii), (iii) and (iv) using the energy conservation law.

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vi) A linear graph has to be plotted to determine the spring constant (K) and the co-efficient of dynamic friction($\mu_K$) of the plane BC. Modify the relationship obtained in part (v) to draw the graph.

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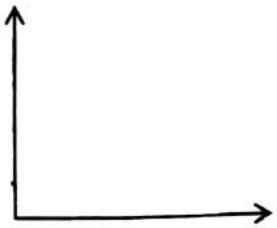
vii) Sketch the expected shape of the graph in following given axes and name the axes.



viii) If the graph makes an angle in 80° towards anti clockwise direction from the positive direction of the x axis and the intercept of the graph is 0.4 $m^2$find the co-efficient of dynamic friction($\mu_K$) and the spring constant (K).

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2) a) i) Write an expression for the velocity of transverse waves through a stretched string, using usual symbols.

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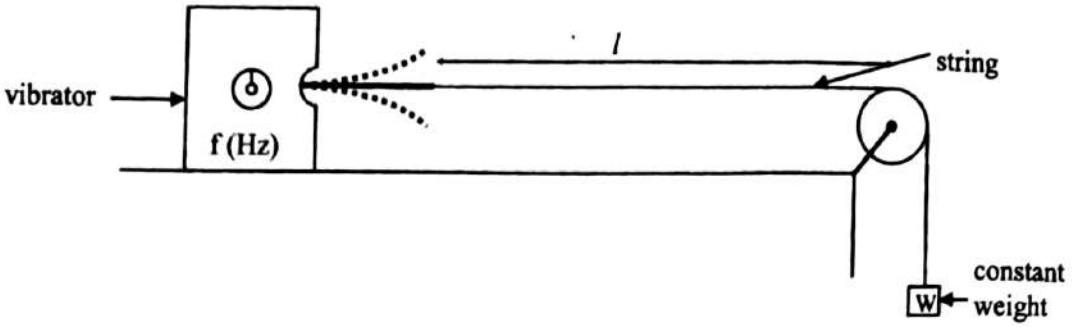
ii) Draw the wave patterns for fundamental and first overtone for the stretched string in the following given figure.

Fundamental First overtone

iii) Write an expression for the frequency of fundamental mode. (length of the string - $l$, tension of the string – T, mass of the unit length of the string – m)

.....

b) Following setup can be used to observe the number of loops of a string along with the frequency easily. The string is vibrated by a vibrator and the frequency of the vibrator can be changed as required.




i) Just after the vibrator operates, two loops were observed in the string. Write the experimental steps to obtain the fundamental mode after this situation.

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ii) Obtain an expression for the frequency (f) of the stationary waves when the number of loops in the string is 'n'.

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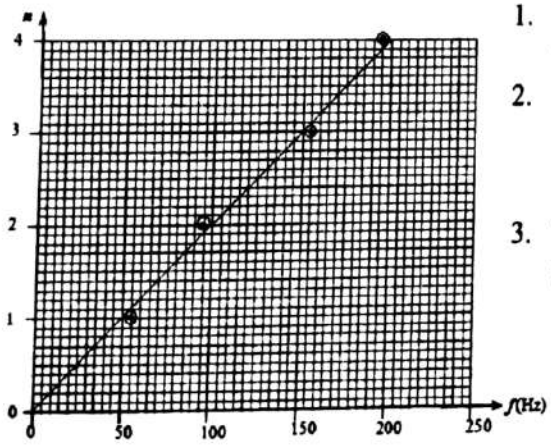
iii) Following graph shows the variation of the number of loops with frequency.




1. Mark two suitable points on the graph to obtain the gradient.
2. Hence find the gradient.

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3. The length of the string is 1m and the tension is 50N. Determine the mass per unit length.

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iv) Now the W weight is completely immersed in the water. Does the frequency of the vibrator make increase or decrease to take the fundamental mode again?

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Explain your answer

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3) A student plans to determine the focal length of a convex lens using a graphical method. He expects to take image distances for real images as well as virtual images for a given real object. An optical pin which is fixed on a wooden box is used as the object and the position of the image is identified by no parallax method.

i) Write the sign convention for lenses.

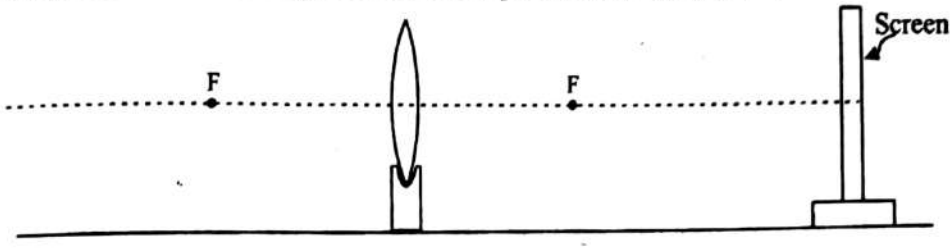
1. .....

2. .....

ii) Write the lens formula using usual symbols.

.....

iii) He expects to take the real image distances at first and arranged the following setup along a line drawn on the table. The approximate focal points are marked as 'F'.




a) Draw the optical pin in above figure clearly and mark it as $O_1$.

b) Draw the image of $O_1$ as $I_1$ at the correct range in the above figure.

c) Another objective pin $O_2$ is used to identify the position of the image.

I. How can you identify that the $O_2$ and $I_1$ pins are coincided together.

.....

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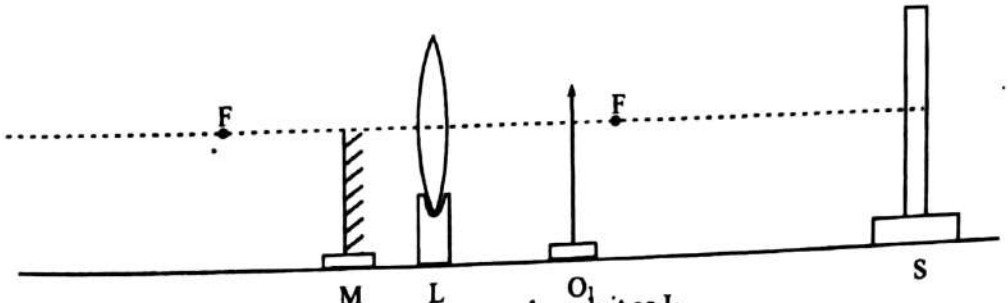
II. Draw the $O_2$ in above figure at the position of coincidence.

iv) Now he expects to take the virtual image distances and arranged the setup as following.

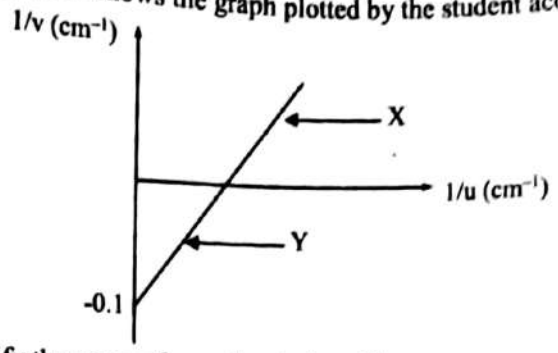
M - plane mirror
S - Screen
L - convex lens
$O_1$ – object pin




a) Locate the image of $O_1$ in above figure and mark it as $I_1$.

b) Draw another object pin which is used to locate the correct position of image $I_1$ and mark it as $O_2$ and if the image of $O_2$ is $I_2$ then mark it in dotted lines when it is positioned to take readings.

v) Following figure shows the graph plotted by the student according to his readings.




a) Identify the ranges for real and virtual images.

X - .....

Y - .....

b) Find the focal length of convex lens by using the graph.

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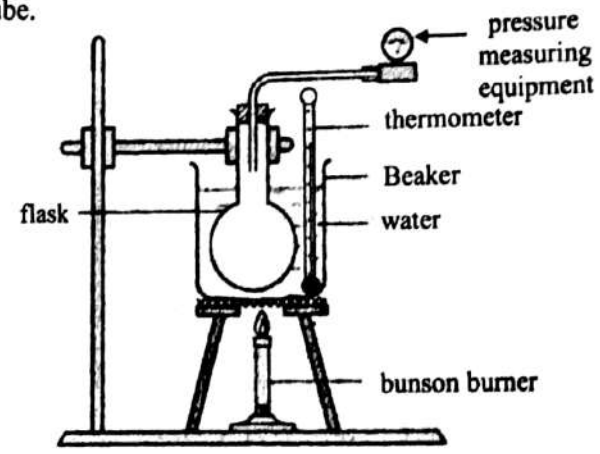
4) A gas law can be verified by using following experimental set up. The flask is having dry air and the pressure of the air inside the bulb with the temperature has to be measured by equipment connected at the end of the narrow tube.




i) State the gas law which can be verified by the above setup.

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ii) What is the essential part that is not indicated in the diagram?

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iii) Why the inside of the bulb should be dry? Explain briefly.

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iv) The thermometer is placed incorrectly in the above diagram. How it should be placed correctly.

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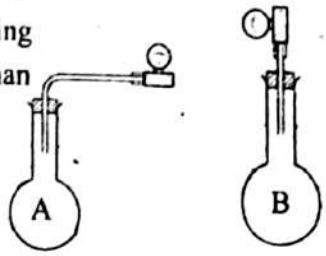
v) The A and B diagrams shows that the two methods to connect the There are two methods to fix the pressure equipment as following diagrams. A student said that the 'B' setup is most suitable than 'A' setup. Explain the reason.

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vi) Why do not consider the expansion of the flask in this experiment.

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vii) State the reasons for following selections by a student.

a) Selecting a flask of having a large volume.

.....

b) Selecting a flask of having thin walls.

.....

viii) What are the readings should be taken to verify the above gas law.

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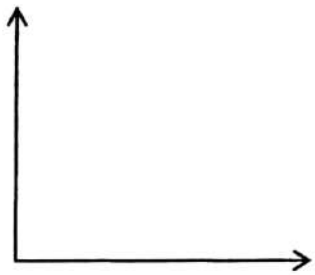
ix) Draw a rough sketch of the variation of above readings in following given axes. Name the both axes.



x) The readings of the pressure equipment at 0°C and 100°C are 69 Hgcm and 93.2 Hgcm. Calculate the difference of the values of the co- efficient of pressure increasing obtained by the practical and its theoretical value.

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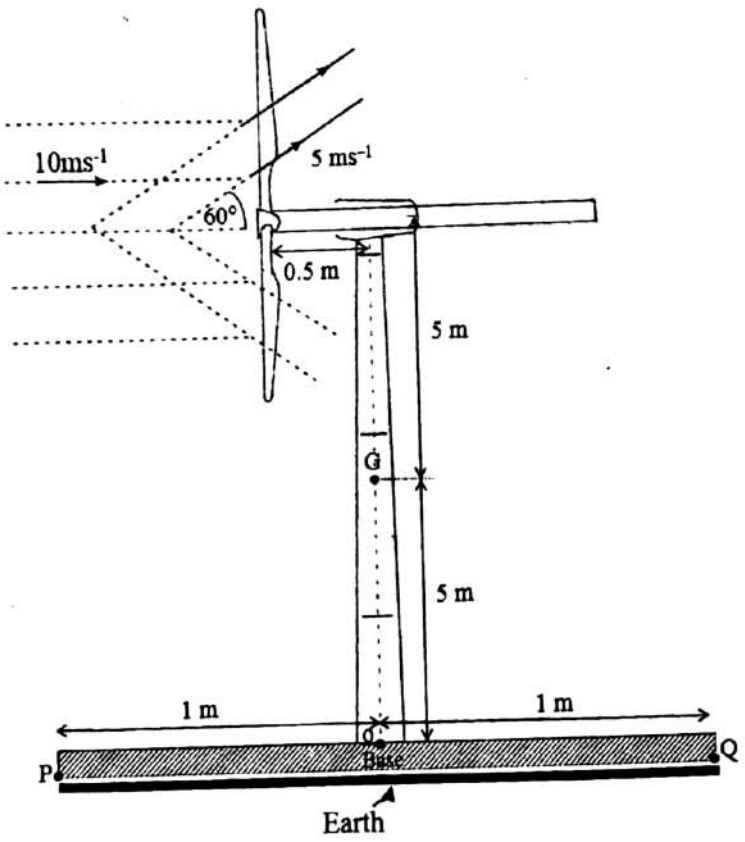
Part B - Essay

❖ Answer **four** questions only.

5) a) i) Write expressions for the linear momentum and the kinetic energy for an air flow under V velocity through A cross sectional area.
(the density of air is ρ.)

ii) The length of a rotter blade of a rotter in a wind power station is 2m.. Wind is blowing horizontally in $10ms^{-1}$ velocity. The rotating plane of the rotter is in vertical. Once the horizontal air flow is collided with the rotter blades, it leaves the blades under $5ms^{-1}$ velocity to the direction of 60° angle to the horizontal as shown in figure.




The mass of the rotter with the rotter tower is 2000 kg and the centre of gravity of the system is at 5m height from the base. The centre of the base 'O' and the centre of gravity of the system are in a same vertical line. The lengths are marked on the figure.

b) i) Find the kinetic energy loss due to the collision of air particles on the rotter blades. (the density of the air 1.2kgm$^{-3}$ and take $\pi = 3$)

ii) Determine the force exerted on the rotter, due to collision of air particles.

iii) The edge across point P is slightly lifted due to the air is collided with rotter. Find the reaction force acting on the edge across point Q at this moment.

iv) A 90% of the loss of kinetic energy of the wind is transformed as the rotating kinetic energy of the rotter. Determine the angular velocity of the rotter, When the moment of inertia of the rotter about its rotating axis is 4kgm$^2$.

v) A 75% of the rotating kinetic energy of the rotter can be converted to the mechanical energy. A water pump has to be operated by the energy generated by the wind power station. The water in a well has to be completely taken out by using this pump.
The cross sectional area of the well is 2 m$^2$ and the depth of the well is 8m.
Water is filed up to 4m height in the well. The water is drawn up to the ground level and has to be projected in 2ms$^{-1}$.

i) Find the work has to be done by the pump for above requirement.
ii) If the efficiency of the pump is 80%, find the input energy to the pump.
iii) How long it takes to complete the above function to the wind power station.
iv) Write two difficulties of using wind power stations.

6) a) Velocity of sound wave in a gas can be given in the following equation. Every symbols are followed their usual meaning.

$$v = \sqrt{\frac{\gamma P}{\rho}}$$

i) Identify the physical quantities in the above equation.

ii) Obtain an equation for the velocity of sound waves in terms of absolute temperature (T) and the molar mass of the gas (M) by using the ideal gas equation.

iii) Consider the following information regarding a gas related to two different temperatures.

| **Temperature** ($^0$C) | **Pressure** (Pa) | **Sound velocity** (ms$^{-1}$) |
|---|---|---|
| 27 | 1.5 x 10$^5$ | 340 |
| 77 | 2.5 x 10$^5$ | - |

Find the velocity of sound in that gas at the temperature of 77°C.

b) An energy of $2.5 \times 10^8$ J is released within 4s by lightning strike in a rainy day at 23°C temperature.

(The velocity of sound in air at 27°c is $340 ms^{-1}$)

i) Find the power of the lightning strike.

ii) Consider the energy of the lightning strike is spread spherically in every direction. A 40% of total energy of the lightning strike is converted in to the sound energy. Determine the sound intensity and the sound intensity level at a point of 5 km away from the point of lightning.

iii) Is there a possibility to make a pain of the ear of a man at the point of 5 km away from the point of lightning? Explain your answer.

iv) Find the energy incident in one second on the ear drum of the man. The effective area of the ear drum is 5 $mm^2$.

v) Draw a graph to show the variation of the sound intensity (I) due to the lightning strike with the distance (r).

vi) Consider the hole of the ear is a cylindrical one end closed tube of having length of 2.5 cm. Find the frequency of the sound, when he hears a maximum intensity. (The temperature of the air inside the ear is 27°C)

vii) The mean frequency of the sound of lightning is 3400Hz. Find the frequency heard by a man who is in a vehicle which is moving in $60 ms^{-1}$ velocity towards the point of lightning. (The velocity of sound in air is $340 ms^{-1}$)

7) Nitrogen air is commonly used in car tires. There are more advantages of using Nitrogen air in car tires than normal air. When using Nitrogen air, the pressure change in the tire with the temperature and corrosion of metal can be minimized due to the absence of water vapour. Also less heating effect is another advantage using this.

i) Explain how can maintain the constant pressure in tires by using Nitrogen air.

ii) Nitrogen can be stored easily as liquid Nitrogen under low temperatures. But it can be used as a gas as well as liquid in those low temperatures. But the gas laws cannot be applied at the lowest temperatures. (<195°C) Explain this.

iii) A Nitrogen tank of having $1.2 \times 10^2$ $m^3$ volume is used to fill the tires of a motor vehicle. The temperature and the pressure in the tank are 300 K and 450 kPa respectively.
The pressure in the tank is reduced up to 260 kPa in the same temperature after filling the tires. Find the mass of the filled Nitrogen.
(Molar mass of the Nitrogen is $28 \times 10^{-3}$ kg)

iv) The temperature of the tires of a motor car was increased from 27°C to 67°C after participating in a car race. The initial pressure inside the tire is 300kPa. The increment of volume as a percentage is 8%. What is the new pressure in the tire?

v) If the volume increment of the tire is due to the expansion of the rubber only, find the volume expansivity of rubber.

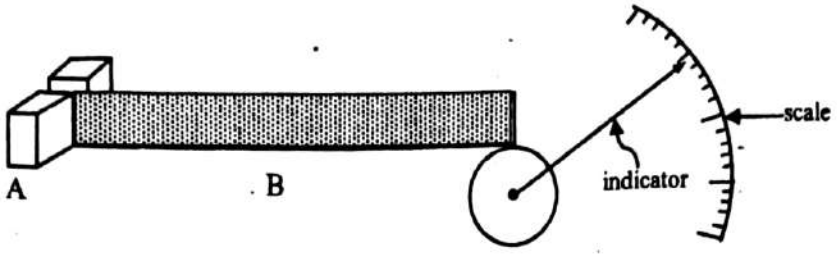
vi) Find the root mean square speed of the Nitrogen molecules at 27°C.
($R = 8.31$ $Jmol^{-1}K^{-1}$)

vii) a) Draw the variation of the pressure of Nitrogen gas with its density at 27°C.

b) Mark the value of the density of Nitrogen gas at the pressure at 300kPa in the graph drawn in part( a).

c) Draw the variation of the pressure of Nitrogen gas with its density at 67°C in the same axes in part (a). Explain the reasons for the shapes of the graphs.

viii) Following figure shows a specially designed thermometer to measure the temperature of a tire after travelling.




A part can be fixed to the tire directly and the rod B can be expanded freely. The rod and the roller are in contact each other and the roller is rotating without slipping when the rod is expanding. The radius of the roller is 1mm and the length of the indicator is 100mm. The linear expansivity of the rod is $2 \times 10^{-5} C^{-1}$. The minimum reading that can be taken by the scale is 0.5mm. What would be the initial length of the rod to read the 1°C temperature difference accurately by using the above thermometer?

8) The universe is formed as a result of big – bang about twelve billions years ago. The biological and physical revolution after the big – bang is very complex. There are four fundamental forces which are related to the physical revolution.

i) Nuclear Force
ii) Weak force (inter molecular force)
iii) Electromagnetic force
iv) Gravitational force.

a) Briefly explain what is meant by gravitational field ?

b) Define the gravitational field intensity.

c) Write an expression for the gravitational field intensity on the surface of a planet of mass M and radius R.

d) Draw a graph to show the variation of gravitational field intensity (E) with the distance (r) measured from the centre of the planet.

e) The mass of the earth is $6 \times 10^{24}$ kg and 6400 km. The earth is rotating about it's axis with 24 hours periodic time ($\pi = 3$)

i) Find the angular velocity of the earth.

ii) The effective gravitational field intensity along the earth surface from the north and south poles towards the equator is varied due to the rotation of the earth.

1. Find the effective gravitational field intensity at a point which is very closer to the north and south poles.
   ($G = 6.67 \times 10^{-11} Nm^2 kg^{-2}$)
2. Find the effective gravitational field intensity at a point of equator.
3. When exporting tea leaves of 100 metric tons by a ship from Sri Lanka to a country which is closer to earth poles, determine the change of weight of the tea leaves.
   (1 Metric ton = 1000 kg)

f) Satellite launching technology is being developed very fast in these days.

1. Write another two advantages except using satellites in weather forecasting purposes.
2. Obtain an expression for the velocity ($V_0$) of a satellite which is at an orbit of r distance from the centre of the earth. (Mass of the earth is M and the gravitational constant is G)
3. Obtain an expression for the minimum velocity of an object to escape the earth gravitational field from this satellite.

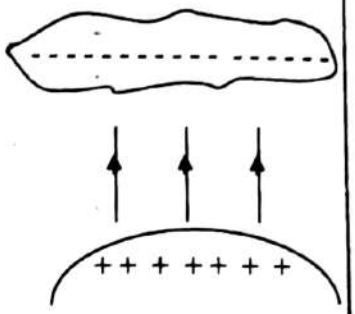
g) An astronomer in a space station feels a weight less situation. It is as a result of a zero normal reaction force on the astronomer. Under this situation astronomer will not be able to walk in the space station. Suggest a method to mitigate this situation using physics theories.

9) a) i) Define the electrostatic field intensity at a given point in an electrostatic field.

ii) Write an expression for the electrostatic field intensity (E) of a point at r distance from +Q point charge.

iii) Write an expression for the force(F) acting on +q charge which is kept at the point of having intensity E.

b) A uniform electrostatic field is created between the earth and a thunder cloud as shown in the figure.



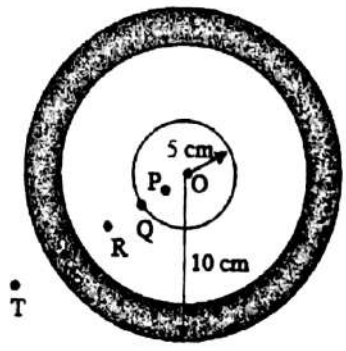

i) The value of the electrostatic field intensity (E) is $2 \times 10^3\ C^{-1}N$. Find the force acting on a small ball kept in that field having mass 5 g and charge $5 \times 10^{-6}$ C.

ii) Find the force acting on the above ball due to gravity.

iii) Now the ball enters in to the electrostatic field under 5 $ms^{-1}$ horizontal velocity. Draw the path of the ball in electromagnetic field.

iv) When the ball is dropped on the earth, it has been moved 25m horizontal distance from the starting point. Find the vertical height to the ball from the earth at the moment of entering to the electrostatic field.

c) Following figure shows a concentric conducting shell and a conducting sphere. The external radius and the thickness of the conducting shell are 10cm and 0.5cm respectively. The radius of the conducting sphere is 5 cm. $\left\{\frac{1}{4\pi\varepsilon_0} = 9\times10^9\ NC^{-2}m^{-2}\right\}$




i) Copy the above diagram on your answer sheet and mark the induced charges on the surfaces of the sphere system when +5μC charge is given to the inner sphere.

ii) Find the electrostatic field intensities at points P, Q, R, S and T when OP = 2cm, OQ = 5cm, OR = 8cm, OS = 9.8cm, OT = 15cm ($\pi = 3$)

iii) Draw the variation of the electrostatic field intensity with the distance from the centre.

iv) When -8μC charge is given to the surface of outer shell find the charge density of the outer surface. ($\pi = 3$)

v) Now find the force acting on -16 μC point charge which is kept at a distance of 12 cm from the centre of the sphere system.