Royal College - Colombo 07
Grade 12
First Term test – June 2023
Physics II

01 E II

Time : 3 hours

Important :

- *The question paper consists of **07** pages*
- *The question paper comprises **Part A** and **Part B.** The time allotted for both part is **3 hours***
- *Use of calculators is **not** allowed*

Part A - Structured Essay

(04 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

(02 pages)

*This part contains five questions. Answer only four 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	
B	3	
	4	
Total		

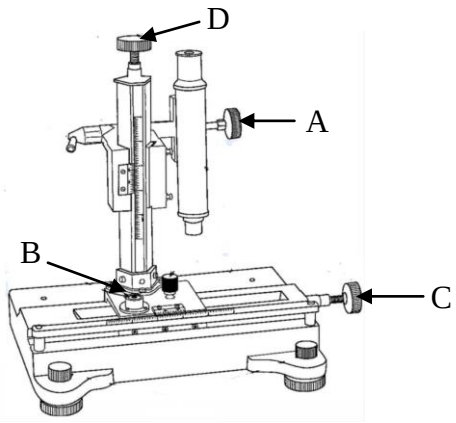
Final Marks

In numbers	
In words	

Part A – Structured Essay

Answer all questions

(1) a) Below figure shows a rough sketch of a travelling microscope which is used in the school laboratory



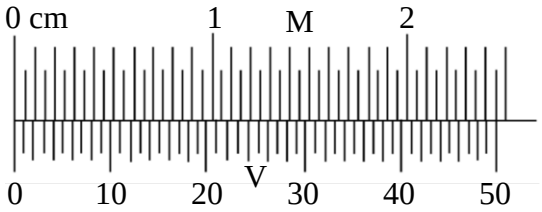
A - ……..…….

B - ……..…….

C - ……..…….

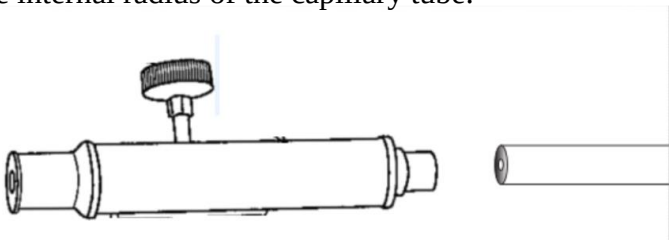
D - ……..…….

b) Below figure shows the positions of the main (M) and the verniner (V) scales of the travelling microscope. What is the least count of this apparatus according to this figure?



Least count = ……..……..……

c) As shown below, the travelling microscope is positioned in front of a capillary tube to determine the internal radius of the capillary tube.



Mark the eye, effective length (focusing length), eye piece and objective in the above figure.

d) If the effective length (focusing length) is not mentioned on the body of the microscope and you have been supplied a square ruled paper, explain briefly how to find the effective length.

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e) If the below given readings can be obtained from the travelling microscope put a (✓) and can not be obtained put a (X) in the given brackets.

i) External diameter of a boiling tube ( )

ii) Measurements of a heating object ( )

iii) Height of a virtual image ( )

f) (A) and (B) figures represent the enlarged image of the capillary hole which can be seen though the cross wires of the microscope. It is needed to move the vertical cross wire from X to Y along a vertical diameter of the capillary hole. What is the direction the fine adjustment knob should be rotated for this? Is it clockwise or Anti clockwise?

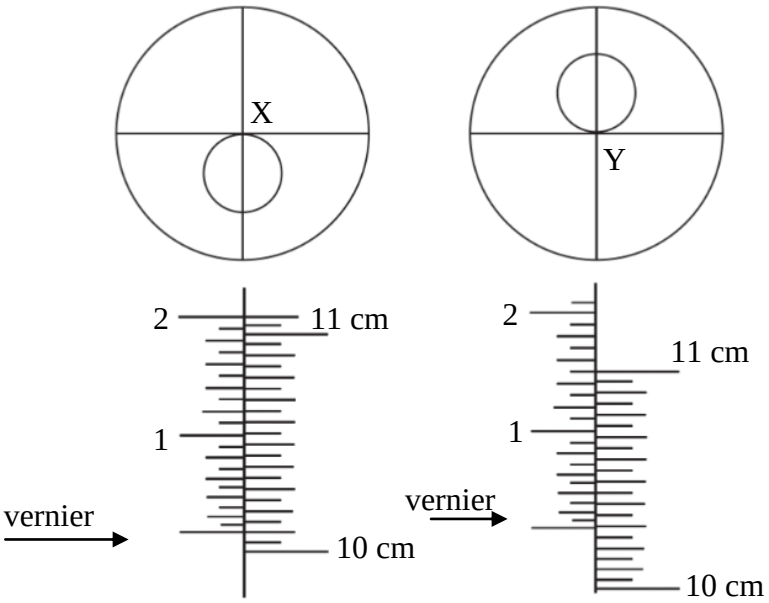

Figure A Figure B

g) What is the need that require two cross wires to be placed inside the microscope?

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…….

h) Write down the relevant readings for the above (A) and (B) figures.

A …… B ……

i) Calculate the diatmeter of the capillary tube according to the above readings.

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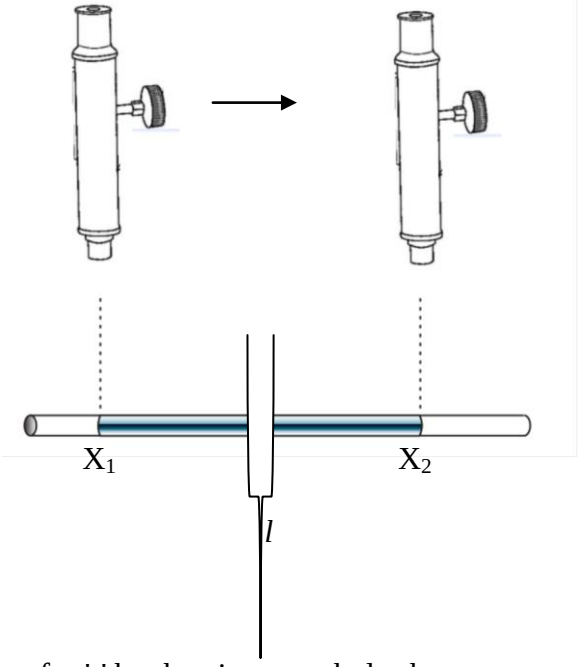
j) A mercury column is trapped inside the capillary tube to obtain the most accurate mean value for the radius of the capillary tube as shown below. The microscope was adjusted to obtain horizontal scale readings for X_1 and X_2 positions. The distance between X_1 and X_2 is m, the density of mercury is ρ and the radius of the capillary tube is r.



Obtain an expression for 'r' by the given symbols above.

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(2) You have to determine the mass of an irregular shaped stone using the principle of moment. You have been supplied the stone (mass to be determined), a meter ruler, weights with different values, strings, a pair of scissors and a knife edge.

a) i) What should you do as the initial step of the practical?

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ii) What is the reason for this?

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b) Explain briefly, how you would practically select the most suitable weight for this practical from the given weights.

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c) Draw the practical set up you have used for this practical on the below given knife edge.

d) The mass of the stone and the selected weight are m and m_0 respectively. The distances to the stone and the weight are l and l_0 respectively. Construct a relationship among m, m_0, l and l_0.

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…….....

e) There is an idea to determine the mass of the stone using a graphical method by taking the dependent variable as l_0. Rearrange the above expression by showing the independent and dependent variables separately.

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f) Draw the expected graph in the given grid and name the two axis.

g) If the gradient of the above graph is 0.9 and the mass of the weight used is 50g, calculate the mass of the stone.

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h) By using a scale, it has been found that the accurate mass of the stone is 48g. Calculate the percentage error occured due to obtaining the mass of the stone by doing the practical.

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i) Write down two reasons which cause the above error.

1. ……..…

2. ……..…

j) Write down two difficulties you face, if the above practical is done by placing the two weights on the metre rule instead of hanging the weights at the two ends..

1. ……..…

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2. ……..…

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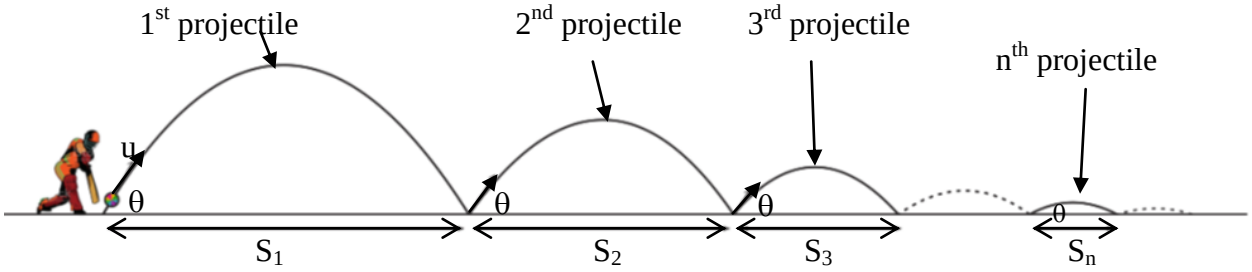
Part – B – Essay

Answer all questions

(3)



A batsman (A) who plays cricket is ready to bat the ball. He hits the ball, which coming towards the bat, at the ground level. Then the ball is projected with u velocity with θ angle to the horizontal.

a) i) Construct an expression for the horizontal flying time in the first projection.
ii) If the horizontal range for the first projection is S_1,

Show $S_1 = \frac{u^2 \sin(2\theta)}{g}$ [consider $\sin 2\theta = 2 \sin\theta \cos\theta$]

b) Due to the kinetic energy loss of the ball when it hits the ground, the ball bounces with θ angle at a velocity that is half of the velocity which it hits the ground. The ball moves out of the playground after bouncing like this for several times.

i) If the horizontal ranges for the second and third projectiles of the ball are S_2 and S_3, deduce expressions for S_2 and S_3 using the expression obtained for S_1 in (a) (ii).
ii) Show S_1, S_2 and S_3 are in a geometric progression.
iii) What is the initial term of this geometric progression?
iv) What is the common ratio of this progression?
v) Using that, write down the horizontal range (S_n) for nth projection.
[Hint : nth term of a geometric progression is given by ar^{n-1} a is the initial term and r is the common ratio]

c) Draw the displacement-time graph and the velocity-time graph separately for the vertical displacement of the above ball.

d) A batsman hits the ball with 40 ms^{-1} velocity at a 30° angle inclined to the horizontal. In this instance, B fielder who is $175\sqrt{3}$ m from the batsman, starts to run with 10 ms^{-1} velocity towards the batsman to catch the ball.

i) Calculate the horizontal range relevant to the first projectile of the ball.
ii) During the time period relevant to the first projectile of the ball, calculate the displacement of B.
iii) Using that, show that the ball can not be caught by B.

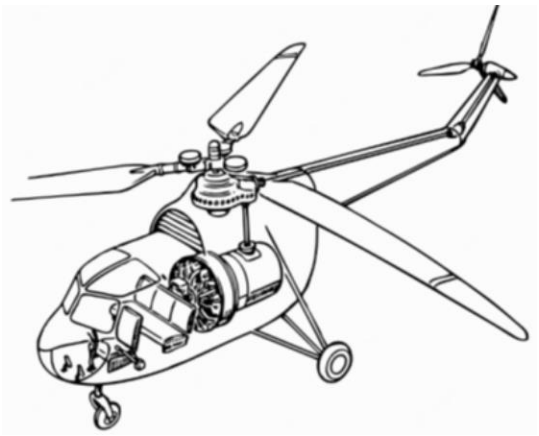
(4) a) i) Write down the Newton's second law.

ii) A motor car starting from rest and uniformly accelerating in 4s, reaches a velocity of $8ms^{-1}$. If the force acting on the car is 2000 N, what is the mass of the car?

iii) During the above time, the constant air resistance acting on the car is 800N and the constant frictional force acting on the car is 200 N. What is the force exerted by the engine?

iv) When the force exerted by the engine becomes zero (when the gear is released), the air resistance and the frictional force mentioned in the above remain constant. What is the distance travelled by the car before it comes to rest?

b) An air craft is retained in space due to an upthrust force created from stream lines. But a helicopter is retained in space due to the rotation of the rotor at a high speed and a stream of air is pushed verticaly downward. When the stream of air is pushed downwards, an upward force is created on the helicopter. Due to that upward force, helicopter travels upwards. The length of a blade of the rotor is 5m, the mass of the helicopter with passengers is 3600kg and the density of air is 1.2 kgm^{-3}. Take $\pi = 3$.



i) Calculate the minimum velocity of the stream of air which should be pushed downwards, to slightly raise the helicopter from the ground.

ii) Calculate the minimum power needed to push the stream of air downwards.

iii) What is the velocity of the air that is pushed downwards when the helicopter is moving in a vertical upward direction with 2.1 ms^{-2} acceleration?

iv) Consider an instance when the helicopter is moving upward with an acceleration but the velocity of the rotor remains constant. When the helicopter is moving upwards, does the acceleration remain constant? Explain.

c) Consider the helicopter is moving forward horizontaly with an acceleration 'a'. An object of mass m is hanging from a string of length l on the roof of the helicopter. Using a and g, write down an expression for the angle made with vertical by the string. g is the gravitational acceleration.

d) Consider an instance where the helicopter is flying horizontaly with a uniform velocity of 10 ms^{-1} at a height of 2 km from the ground. In this instance, an object which is inside the helicopter is gently released. After 10s from releasing, it exploeds into two identical parts and one part drops straight down from the place of the explosion. After the explosion, both parts reached the ground at same time.

i) What is the horizontal velocity of the object after 10s of it being released?

ii) What is the vertical velocity of the object just before the explosion?

iii) Calculate the vertical velocities of the parts after the explosion.

iv) Calculate the horizontal velocities of the parts after the explosion.

v) Calculate the distance between two parts on the ground.