GCE (A/L) Examination, March - 2019

Conducted by Field Work Centre, Thondaimanaru
In Collaboration with
Provincial Department of Education Northern Province

FWC

Grade : 12 (2020)	*Physics - 1*	*One hours*

Instructions:

- *Answer **all** the questions.*
- *Write your **Index number** in the space provided in the answer sheet.*
- *Choose **correct or most approprite answer** and **mark your response on the answer sheet with a cross** (x)*

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

Part I

01) The expression of the Photon energy (E) is given by E = hf, where f - frequency of the photon and h is a constant. The dimensions of the h is

1) ML^2T^{-1} 2) ML^2T^{-3} 3) MLT^{-1} 4) MLT^{-3} 5) ML^2T

02) If x = a - b and Δa and Δb are the least count in the measurement of a and b, respectively, then the maximum percentage error in the value of x will be

1) $\left(\frac{\Delta a}{a}+\frac{\Delta b}{b}\right)$ x 100% 2) $\left(\frac{\Delta a}{a}-\frac{\Delta b}{b}\right)$ x 100% 3) $\frac{\Delta a}{(a-b)}$ x $\frac{\Delta b}{(a-b)}$ 100%

4) $\left(\frac{\Delta a}{a-b}+\frac{\Delta b}{a-b}\right)$ x 100% 5) $\left(\frac{\Delta a}{a-b}-\frac{\Delta b}{a-b}\right)$ x 100%

03) Consider the following statements about the motion of an object

(A) An object moving with constant speed that can accelerate.

(B) The velocity of an object be constant, that speed can change.

(C) The speed of an object be constant, that velocity can change.

of the above statements,

1) only (B) is true 2) only (C) is true 3) only (A) and (B) are true

4) only (B) and (C) true 5) only (A) and (C) is true

04) The resultant of two forces of magnitude F and 2F can be

1) less than F 2) more than 3F 3) Zero

4) perpendicular to F 5) perpendicular to 2F

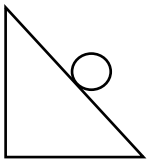
05) The frequency of the first harmonic of a standing wave on a wire is f. The length of the wire and tension in the wire are both doubled the frequency of the first harmonic is

1) $f/\sqrt{2}$ 2) f 3) $\sqrt{2}$ f 4) 2f 5) f/2

06) An airplane drops a payload while travelling due north, parallel to the ground, at a constant speed of $100ms^{-1}$. If air resistance is neglected, what is velocity of the payload relative to the plane 4.0 sec. after it is released?

1) $100ms^{-1}$ North and $40ms^{-1}$ down
2) $100ms^{-1}$ South and $40ms^{-1}$ down
3) $40ms^{-1}$ down
4) $80ms^{-1}$ down
5) 0

07) A ball rolls without slipping down an inclined plane as shown in the figure. Which of the following vectors best represents the direction of the total force that the ball exerts on the plane?



1) ← 2) ↖ 3) ↙ 4) ↖ 5) ↓

08) An object of uniform density floats partially submerged so that 20% of the object is above the water. A 3N force presses down on the top of the object so that the object becomes fully imerged. volume of the object is (consider the density of water is 1000 kg m^{-3})

1) 300 cm^3
2) 670 cm^3
3) 1200 cm^3
4) 1500 cm^3
5) 3000 cm^3

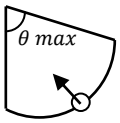
09) A block takes twice as much time to slide down a rough 45° inclined plane as it takes to slide down an identical smooth 45° inclined plane. the coefficient of kinetic friction between the block and the rough inclined plane is

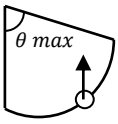
1) 0.25
2) 0.4
3) 0.50
4) 075
5) 1.0

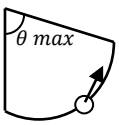
10) A wind turbine has blades that sweep an area of 2000 m^2, it converts the power available in the wind to electrical power with an efficiency of 50%. What is the electrical power generated if the wind speed is $10ms^{-1}$? (the density of air is 1.3 kgm^{-3})

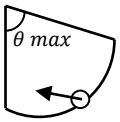
1) 130 kW
2) 650 kW
3) 1300 kW
4) 2600 kW
5) 65 kW

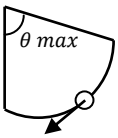
11) A pendulum consists of a small bob of mass m attached to a fixed point by a string of length L. the pendulum bob swings down from rest from an initial angle $\theta_{max} < 90^0$. consider the pendulum bob when it is at an angle $\theta = \frac{1}{2}\ \theta_{max}$ on the way up (moving toward θmax), the direction of the acceleration vector is

1) 

2) 

3) 

4) 

5) 

12) Which of the following statements is false of standing wave patterns?

1) A standing wave pattern is formed as a result of the interference of incident and reflected waves.
2) When standing wave pattern is established, there are portions of the medium which are not disturbed .
3) There is always formed greater number of 'nodes' than 'antinodes"
4) The energy of the standing wave is all in the form of potential energy.
5) Nodes on a standing wave pattern is a point which is stationary, it does not undergo any displacement from its position.

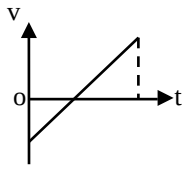
13) The mass of fuel in a racing car decreases during a race. As a result the lap time decreases. Which of the following could explain this decreases?

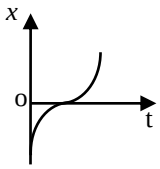
1) There is less friction on the car
2) The maximum speed of the car has increased
3) The maximum force on the car has increased.
4) The maximum acceleration and deceleration are greater.
5) The engine is more efficient.

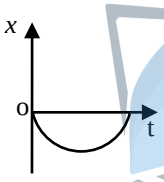
14) A molecule consists of two atoms each of mass m separated by a distance **a**. If ***K*** is the average rotational kinetic energy of the molecule at room temperature, its frequency of rotation

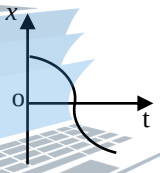
1) $\frac{1}{\pi a}\sqrt{\frac{K}{m}}$ 2) $\frac{1}{2\pi a}\sqrt{\frac{K}{m}}$ 3) $\frac{1}{\pi a}\sqrt{\frac{2K}{m}}$ 4) $\frac{1}{2\pi a}\sqrt{\frac{2K}{m}}$ 5) $\frac{1}{\pi a}\sqrt{\frac{K}{2m}}$

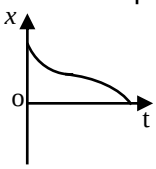
15) The figure shows velocity (v) - time (t) graph of an object, the displacement (x) - time (t) graph of the object is best represented by

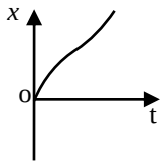


1) 

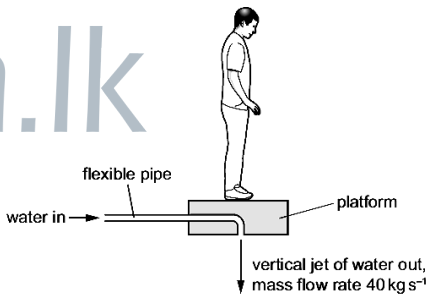
2) 

3) 

4) 

5) 

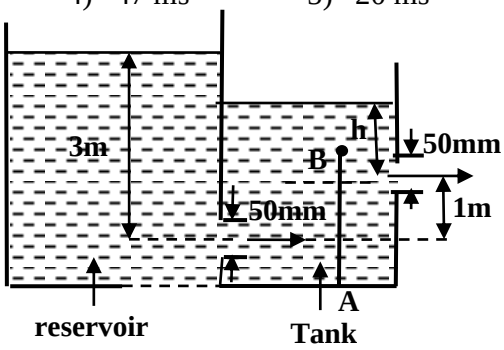
16) The diagram shows a man standing on a platform that is attached to a flexible pipe. Water is pumped through the pipe so that the man and platform floats in air remain at a constant height. The masses of the man and platform are 80 kg and 16 kg respectively the mass of water that is discharged vertically downwards from the platform each second is 40 kg.



The speed of the water leaving the platform is

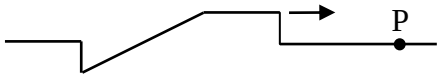
1) 2.4 ms^{-1} 2) 6.9 ms^{-1} 3) 24 ms^{-1} 4) 47 ms^{-1} 5) 20 ms^{-1}

17) The figure shows water flow system link to a water reservoir, AB is a barrier. All dimensions are shown in the figure. The flow water in the system in a steady state and the change in level of water in the reservoir can be neglected. The value of **h** shown in the figure is

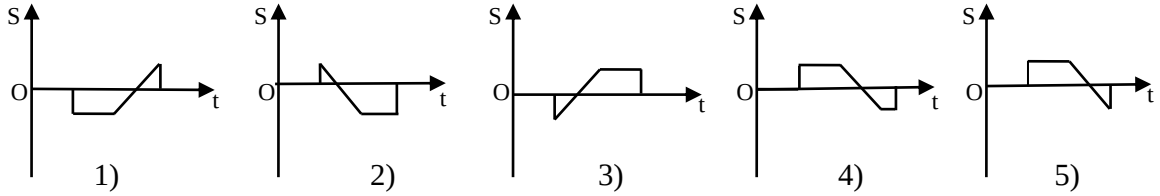


1) 0.4 m 2) 1.0 m 3) 1.2 m 4) 1.5 m 5) 1.6 m

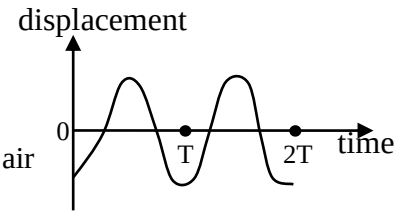
18) A wave pulse moves along a stretched rope in the direction shown below.



Which diagram shows the variation with time t of the displacement S of the particle P in the rope?

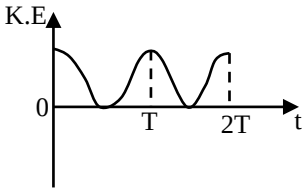


19) When sound travels through air, the air particles vibrate. A graph of displacement against time for a single air particle is shown.



The best graph shows how the kinetic energy (K.E) of the air particle varies with time (t)

1)



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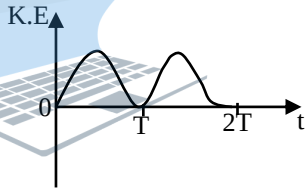

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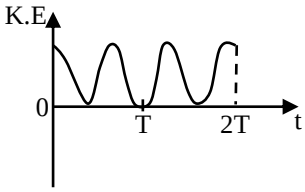

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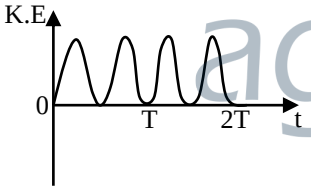

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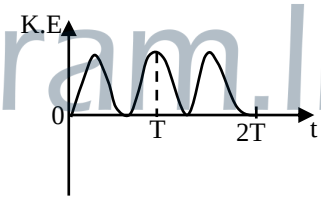
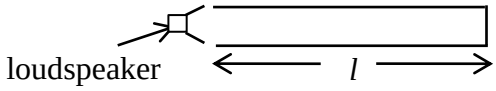
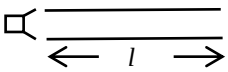


20) A loud speaker emitting sound of frequency f is placed at the open end of a pipe of length *l* which is closed at the other end. A fundamental resonance of standing wave is set up in the pipe.

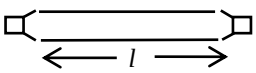


A series of pipes are then set up with either one or two loudspeakers of frequency f. The pair of loudspeakers vibrates in phase with each. Which pipe contains a resonance of standing wave?

1)



2)



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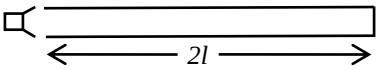

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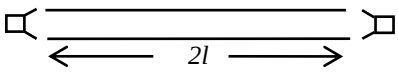

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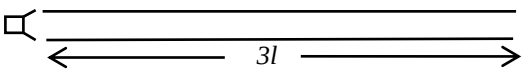
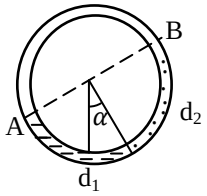
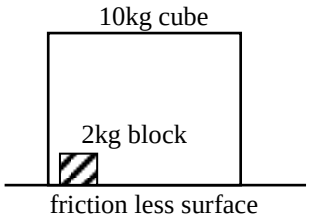


21) There is a circular tube in a vertical plane. Two liquids which do not mix and of densities d_1 and d_2 are filled in the tube. Each liquids subtends 90° angle at centre. Radius joining their interface makes an angle α with vertical as shown in the figure. Ratio d_1/d_2 is



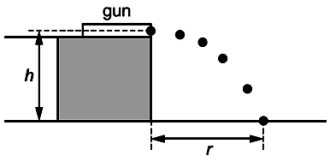
1) $\frac{1+\sin\alpha}{1-Cos\alpha}$ 2) $\frac{1+\sin\alpha}{1-sin\alpha}$ 3) $\frac{1+Cos\,\alpha}{1-Cos\alpha}$ 4) $\frac{1+\tan\alpha}{1-tan\,\alpha}$ 5) $\frac{Cos\,\alpha-\sin\alpha}{Cos\alpha+\sin\alpha}$

22) A cubical box of mass 10 kg with edge length 5m is free to move on friction less horizontal surface. Inside is a small block of mass 2 kg. Which moves without friction inside the box at time t=0. the block is moving with velocity $5ms^{-1}$directly towards one of the faces of the box, while the box initially at rest. If any collision between the block and box is perfectly elastic, after one minute displacement of the block from the original position is

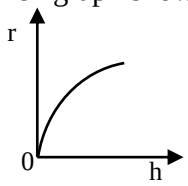


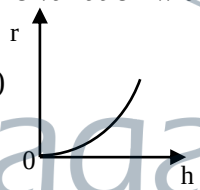
1) 0 m 2) 50 m 3) 100 m 4) 200 m 5) 300 m

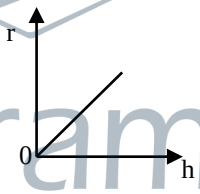
23) A student uses a spring gun to launch a steel ball with a constant horizontal velocity. He varies the height h of the gun and measures the horizontal displacement r of the ball when it hits the ground.

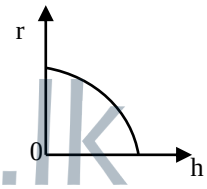


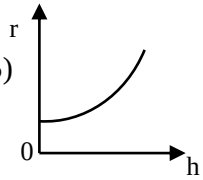
Which graph shows the variation with height h of the horizontal displacement r

1) 

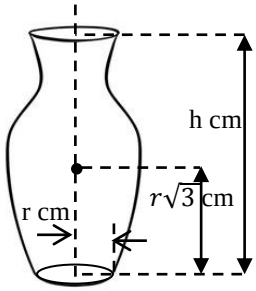
2) 

3) 

4) 

5) 

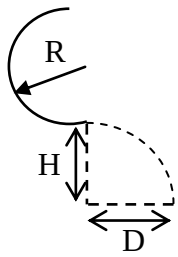
24) A vase h cm tall has its center of gravity $r\sqrt{3}$ cm from the bottom, which is circle of radius r cm. How far can the top of the vase be pushed to the side without toppling it?

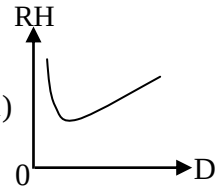


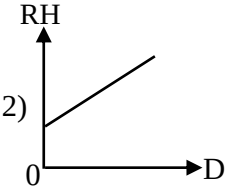
1) $\frac{\pi h}{6}$ cm 2) $\frac{\pi\sqrt{h^2+r^2}}{3}$ cm 3) $\frac{\pi h}{3}$ cm

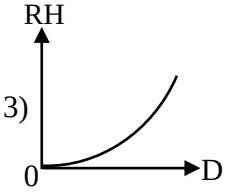
4) $\frac{\pi\sqrt{h^2+r^2}}{6}$ cm 5) $\frac{\pi r\sqrt{3}}{6}$ cm

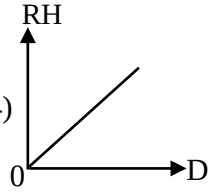
25) A semicircular wire of radius R is oriented vertically. A small bead is released from rest at the top of the wire, it slides without friction under the influence of gravity to the bottom, where is then leaves the wire horizontally and falls a distance H to the ground. The bead lands horizontal distance D away from where it was launched. Which of the following is a correct graph of RH against D

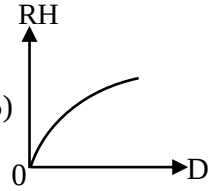


1) 

2) 

3) 

4) 

5) 

GCE (A/L) Examination, March - 2019

Conducted by Field Work Centre, Thondaimanaru
In Collaboration with
Provincial Department of Education Northern Province

FWC

Grade : 12 (2020)	*Physics - II*	*Two hours*

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

Part II (A) Structured Essay

Answer all four questions on this paper itself

01)

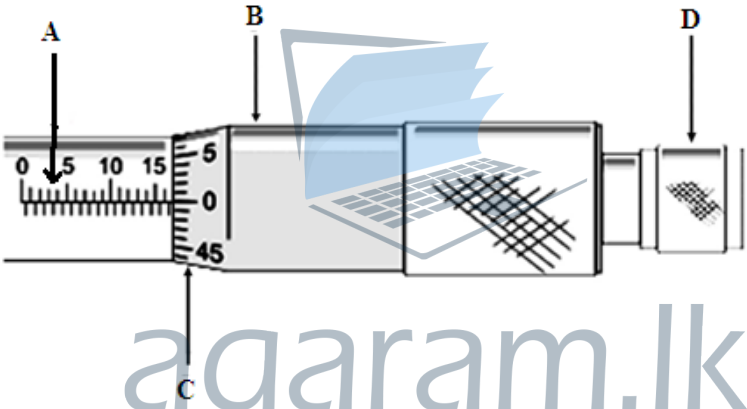


Figure shows a section of a micro meter screw gauge it has 50 equal divisions in the thimble scale and When the thimble is rotated one complete turn it moves through one division (0.5 mm) on the sleeve scale.

a) Name the parts of the micrometer screw gauge labeled as A,B,C and D in the figure.

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b) (i) What is the pitch length of the micrometer screw gauge?

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(ii) Find the least count of the micrometer screw gauge.

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c) (i) When taking a measurement, the component marked (D) serves an important function, what is it?

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(ii) How do you make sure that the component (D) has been utilized correctly in performing the function mentioned in c (i) ?

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d) How do you check zero error in the instrument?

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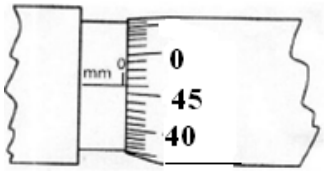
e) When checking the zero error, the reading obtained is shown in the diagram below, what is zero error?



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f) The screw gauge is used to measure the diameter of a steel ball and the reading obtained is shown in the diagram given at the beginning of the question.

(i) What is the reading of the instrument?

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(ii) What is the diameter of the metal ball?

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g) Using a micrometer screw gauge, how do you obtain better value for the diameter of the steel ball?

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02) (a) i. State laws of flotation.

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ii. A graduated boiling tube is to be used to determine the density of a liquid. At the bottom of the tube small lead shots were placed and sealed with wax in order to make it to float upright with stability explain this

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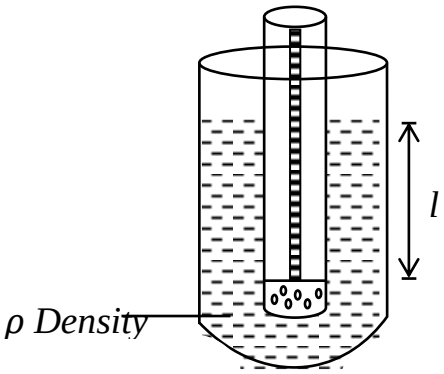
(b) Take the volume of the curved portion of the tube as V. A scale is drawn on a strip of paper and fixed inside the tube with the zero mark at the upper and of the curved surface. The tube is made to float in liquids and the length of the tube above the curved portion immersed in liquids is *l*. The mass of the tube with lead shots is M and the additional mass added inside the tube is m.



i. When the prepared tube is placed in a liquid of density $800kgm^{-3}$, up thrust be U_1 and in a liquid of density $1000kgm^{-3}$ be U_2. Does U_1 is greater, equal or less than U_2. Explain your answer.

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ii. Write down a relationship between the quantities stated above using the principle of law of flotation,

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iii. Rearrange the equation which you have written in section b (ii) to draw a graph of added mass m as independent variable and *l* as dependent variable.

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iv. After finding the gradient of the graph, what additional measurement is required to determine the density of the liquid. what instrument and which part is need to measure the quantity?

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v. To improve the accuracy of measuring *l*, what kind of boiling tube to be used.

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(c) i. The gradient of the above graph is found to be 312.5 cm kg^{-1} and the area of cross section of the uniform part of the tube is $4cm^2$, what is the density of the liquid used?

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ii. What experimental steps you would follow to obtain uniform distribution of points to draw a graph of *l* versus *m*?

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03) a) A pendulum consists of a bob suspended by a light inextensible string from a rigid support. The pendulum bob is moved to one side and then released. The sketch graph shows how the displacement of the pendulum bob undergoing simple harmonic motion varies with time over o one time period.

On the sketch graph above,

i) Label with the letter **A** a point/points at which the acceleration of the pendulum bob is a maximum.

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ii) Label with the letter **V** a point/points at which the speed of the pendulum bob is a maximum.

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(b) Explain why the magnitude of the tension in the string at the midpoint of the oscillation is grater than the weight of the pendulum bob.

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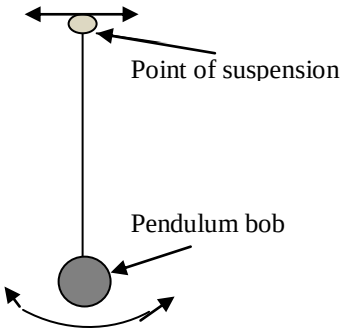
(c) The figure shows the point of suspension of the pendulum bob is moved from side to side with a small amplitude by electric vibrator in variable frequency which frequency is displayed in digital mode. For a certain frequency, the pendulum bob oscillates maximum constant amplitude.



(i) For a certain frequency, the pendulum bob oscillates maximum amplitude, explain the reason for this.

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(ii) If the percentage error of the certain frequency measurement in the vibrator is 5% and the least count of the vibrator is 1Hz, find the frequency of the vibrator.

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(d) A student decides to determine the acceleration due to gravity for this method, and he measures the frequencies (**f**) for maximum amplitude of variable lengths(***l***) of pendulum.

(i) Write down an expression for the frequency **f** of the simple pendulum in terms of the length ***l*** of the pendulum and the acceleration due to gravity ***g***.

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(ii) Rearrange the above expression for f^2 versus $1/l$ graph.

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(iii) The student plotting the f^2 versus $1/l$ graph he found that the gradient was $0.25\ m\ s^{-2}$. Determine ***g*** (Take $\pi = 3.14$)

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(e) Which is the best choice for the pendulum bob, whether same radius of metal sphere or wooden sphere for the maximum amplitude of the oscillation? Give the reasons for your choice.

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04) A student plans to carry out an experiment using a sonometer to determine the frequency (f) of tuning fork.

a) (i) Where should he place the sounded tuning fork in order to obtain resonance?

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(ii) In generally, fundamental resonance state is obtained for this experiment , explain why is it?

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(iii) What types of wave forms in the string, travelling or stationary and transverse or longitudinal?

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b) What procedure must be follow in order to obtain the **fundamental** resonance length?

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c) The student measured the fundamental resonance length (l_o) , tension of the sonometer wire (T) and mass per unit length of the wire (m). Write down an expression for the fundamental resonance frequency (f) in terms of l_o, T and m.

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d) Now the student arranged the practical, with same length of composite steel wire AB and BC, A & C are the points touch of the bridges, and diameter of AB is twice of BC. The resonance obtained in both wire for the same tuning fork while node forms at B.

i) If the number of loops form in wire AB and BC are n_1 ,n_2 respectively, write down the related equations and find the ratio of $\frac{n1}{n2}$

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ii) Find the minimum number of loops in both wires.

AB : ..... BC : .....

iii) If AC = 1m find the maximum wave length of wave in wire BC.

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iv) If mass per unit length of wire BC is 1×10^{-3} kgm^{-1} and tension of the wire 40N, find the frequency of the tuning fork.

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GCE (A/L) Examination, March - 2019

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FWC

Grade : 12 (2020)	*Physics - II*	

Part II (B) Structured Essay

Answer any two questions only

05) The subject Mechanics help us to understand why the majority of the structures of the body parts are in the present day state. This section describes the structure of the lower jaws of reptiles and mammals and the forces acting on their jaws when they bite. The force of bites of animals being hard is due to the structures of their jaws, the magnitude of the forces exerted by the muscle fibers close to the jaws, the direction and the point of its application. To prevent the breaking and dislocation of jaws, the bones of the upper and lower jaws are being strong. Based on research results, it has been found the jaws of mammals are similar to that of the reptiles. When a reptile bites, the forces acting at the lower jaw, which are in equilibrium, is shown in figure I.

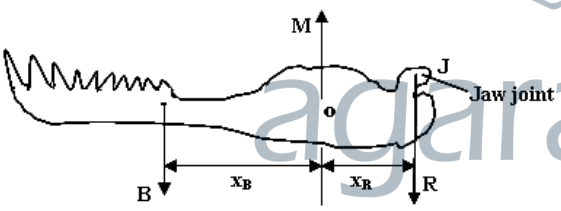


Figure I

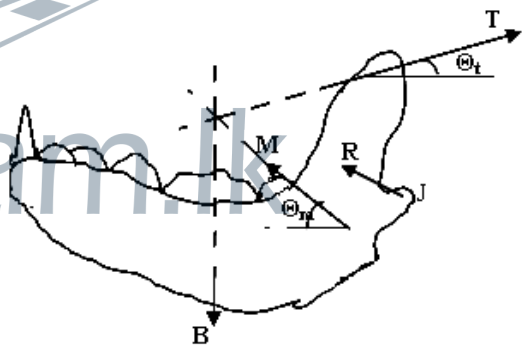


figure II

Where, B – The force exerted at the lower jaw by the food when biting it.

M – The force exerted by the muscle fibre at point O.

R – The force acting at the jaw joint (J).

The shortest distance of forces B and R from point O are x_B and x_R respectively.

The figure II shows the forces acting at the lower jaw of a mammal and they are in equilibrium during a mammal bites.

Where, M, T – Force exerted by the muscle fibre.

B – Force acting at the lower jaw when biting food.

R – Force acting at the jaw joint (J).

a) (i) What are the factors which determine the hardness of the bite?

(ii) State the important conditions to be satisfied for the forces M, T, B and R acting on the jaw of a mammal, shown in figure II, to be in equilibrium.

b) The force acting at the jaw joint (R) could not exceed 3 N , Consider the figure I and answer the following questions.

(i) Derive an expression for R and M in terms of B, x_B and x_R.

(ii) When $x_B = 2x_R$, what is the maximum value of biting force (B)?

(iii) When $x_B = 2x_R$ and the maximum value of M is 6 N, with the help of calculations, explain whether the jaw joint will be damaged or not?

(iv) When the bite force (B) of a snake is 2 N and $x_R = 0.03$ m ,find the greatest distance of The bite force (B) from the jaw joint such that the joint will not be damaged.

c) By considering the figure II, answer the following question.

When a mammal is herbivorous (feeding on plants) and R = 0, $\theta_t = \theta_m = \theta$ then should be greater than what angle for the biting force B to be greater than the forces T and M given by the muscle fibre?

d) The figure III shows the lower jaw of a particular carnivorous animal (feeding on flesh) at equilibrium during a bite.

If M = 30 N, T is 1.3 times of M and $\theta = 60^o$,

(i) What is the value of θ_t?

(Take $\sin 22^o\ 37^1 = 0.3846$, $\sin 52^o\ 37^1 = 0.7946$)

(ii) What is the ratio of B/M?

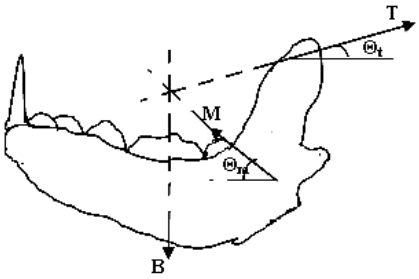


figure III

06) The process of lifting up of helicopter and airplane are based on similar scientific principles. In case of airplane, the lifting force is created by the pressure difference caused by the laminar flow of air above and below the wings, and by the force created when the air molecules strike the wings at an oblique direction are reflected downwards at an inclined direction as a results of wings design. For an airplane to obtain a sufficient force for it to move upwards it must have wings of larger area and must fly with high velocity. For this purpose, the runway of the airplane must be constructed very long. The small lifting force due to pressure difference caused by the laminar flow of air above and below the rotor of the helicopter, roughly at its highest rotation of 500 rpm, and the force obtained by pushing the air downwards by the rotor makes it possible for the helicopter to stay at a certain height or move upwards. When the rotor of the helicopter rotates the helicopter slowly rotates about the axis of the rotor in a direction opposite to that of the rotation of the rotor; the torque caused by this will cause instability in the helicopter. To control this problem a rotor is fixed, on one side, at the tail to provide torque opposite to the direction of rotation of the helicopter.

(a) (i) Which of the Physics laws explain the lift of the airplane and the helicopter?

(ii) How to overcome the problem facing the lift of the airplane?

(iii) In generally, aircraft carrier warship, the length of the run way is insufficient to achieve the required speed for the aircraft take off. Suggest an action that can make the same aircraft to take off from the same carrier.

(iv) Briefly explain, why the entire body of the helicopter tends to rotate somewhat slowly in the opposite direction to the direction of the spin of the rotor?

(b) The helicopter of mass 2160 kg supports itself in a stationary position by imparting a down ward velocity $\boldsymbol{v}$ to all the air in a circle of area 80 m^2 and density of air is 1.2 kg m^{-3}.

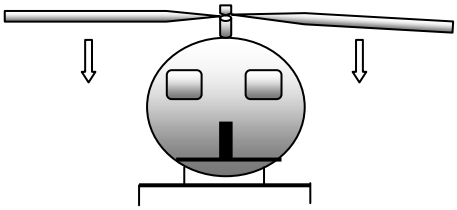


Figure I

(i) Find the rate of change of momentum of the air molecules in terms of $\boldsymbol{v}$.

(ii) Calculate the value of $\boldsymbol{v}$.

(iii) Find the power needed for the rotor of the helicopter push the air molecules down ward.

(iv) The rotor wings rotates 420 rpm , moment of inertia of the rotor and helicopter about rotating axis are 100 kg m^2 and 8800 kg m^2 respectively. Find the angular speed of the helicopter when stationary position in air and tail rotor at rest.

(c) The helicopter rotor tilts 12^0 42^1 with horizontal and turn left side , moves in a horizontal Circular path of radius 100 m with constant speed *V*. In this stage rotor in the tail rotates, to protect rotation of the helicopter.

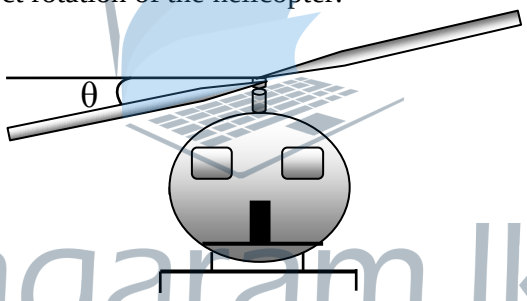


Figure II

(i) Copy the diagram in your answer sheet as shown in the figure II denote the lift force and weight act on it.

(ii) Now the rotational speed of rotor whether increase or decrease compare with rotational speed in question b(iii)

(iii) Find the orbital speed *V*.

(Sin (12^0 $42^{1)}$ = 0.2198, Cos (12^0 42^1) = 0.9755, tan (12^0 42^1) = 0.2253)

(d) Finally the helicopter rises with vertical acceleration 1 m s^{-2} due to the upward thrust **U** generated by its rotor, while rotor rotates horizontally.

(i) Find the value of **U** .

(ii) Calculate the down ward velocity to all air push by rotor.

07) a) The air column in a pipe will one end closed undergoes longitudinal vibration when an electric vibrator of variable period is held close to the open end of the pipe. When the period of vibration is gradually decreased from T_1 to T_2, a loud sound was heard corresponding to period T_O, where $T_1 > T_O > T_2$.

i . What do you understand by the term longitudinal wave?

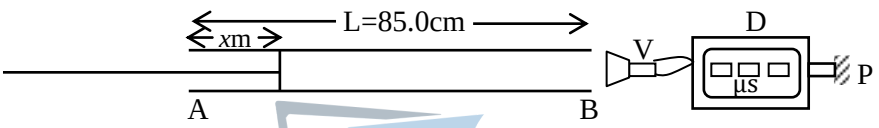
ii. What property of air is responsible for its vibration?

iii. What kind of wave is set up in the pipe, is it standing or travelling wave? Give reason for your answer.

iv. Does the air column in the pipe undergo forced or natural vibration at resonance?

v. Sketch a graph showing the variation of the amplitude of the vibration of air molecules at the open end of the pipe with the period of the vibrator as it is decreased from T_1 to T_2. Indicate the values T_1, T_2 and T_O in your graph.

b)



The figure shows a uniform cylindrical metal pipe AB of radius r=2.0 cm and length L=85.0 cm, fitted with plunger of negligible thickness as shown in the above figure. The plunger can be moved freely to any position inside the pipe. At the beginning the distance of the plunger from the end A of the pipe is kept at the value of *x* metres. An electric vibrator V is kept, just outside the open end B of the pipe, and its period of vibration T can be chosen from ranging from 500μs to 15,000μs, by turning the knob P attached to the digital display D. The chosen value of T would be displayed on the digital meter D.

i . Does this electric vibrator produce audiable sound or ultrasonic sound? Explain your answer.

ii. When x=0, has would you change the period of the vibrator to have the first harmonic as the first resonance.

iii. How would you confirm that the first resonance obtained is not corresponding to overtones?

iv. Draw the pipe and sketch the wave pattern formed in the pipe corresponding to b(ii), without neglecting the true position of the antinode.

v. When $x \neq 0$, derive an expression for x in terms of L, T, r, V and K for fundamental resonance corresponding to period T of the vibrator , Where V is the speed of sound in air and Kr is the end correction for the pipe.

vi. Sketch a graph of x Vs T for fundamental vibration.

vii. If the slope of your graph is - 85.6ms^{-1}, find the speed of sound in air.

viii. The intercept on x-axis is 0.862m. Determine the value of K.