G.C.E (A/L) Examination - July - 2015

Conducted by Field Work Centre, Thondaimanaru
In Collaboration with
Zonal Department of Education Jaffna.

Physics | **Grade: 12 (2016)** | **Three Hours**

Instructions

- ✶ Answer all questions
- ✶ Write your index number in your answer sheet.
- ✶ Select the most suitable answer and tick (X) in your answer sheet provided.

Part- I

1. Dimension of angular momentum is

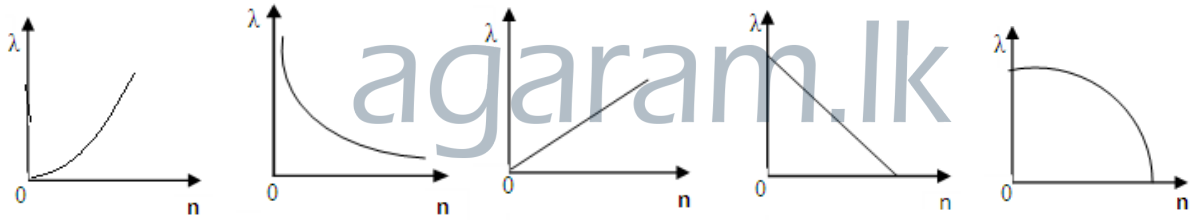
   1) MLT^{-1} 2) ML^2T^{-2} 3) ML^2T^{-1} 4) $ML^{-1}T^{-1}$ 5) $ML^{-2}T^{-1}$

2. A stone is thrown vertically upward, which of the following quantities reverse in direction at the highest position?

   A) Velocity B) Displacement C) Acceleration

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

3. The appropriate graph showing the variation of wave length(λ) of light with the refractive index (n) of medium is



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

4. A convex and a concave lenses separated by a small distance are then put in contact. The focal length of the combination

   1) Decreases 2) increases 3) becomes zero 4) becomes infinity 5) remains the same

5. One end closed organ pipe and an open organ pipe of same length produced 2 beats per second while vibrating in their fundamental modes. The length of the open organ pipe is halved and that of closed pipe is doubled. Then, the number of beats produced per second while vibrating in the fundamental mode is

   1) 2 2) 5 3) 6 4) 7 5) 8

6. A motor boat covers a given distance in 6 hours moving downstream on a river. It covers the same distance in 10 hours moving upstream. The time it takes to cover the same distance in still water is

   1) 6.5 hours 2) 8 hours 3) 9 hours 4) 7.5 hours 5) 8.5 hours

7. When an aeroplane turns on horizontal path at steady speed V , the resultant force on it due to

   (A) the lift force (B) its weight (C) the drag force

Of the above forces

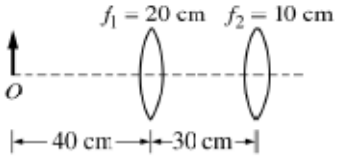
1) Only (A) is correct 2) only (B) is correct 3) only (A) and (B) are correct

4) only (A) and (C) are correct 5) all (A) ,(B) and (C) are correct.

8. A balloon is descending with a constant acceleration $\boldsymbol{a}$. The mass of the balloon and its contents is M. What mass m of its contents should be released so that the balloon starts ascending with the same acceleration $\boldsymbol{a}$? (Assume that the volume of the balloon remains constant.)

1) $\frac{2a}{g+a}$ M 2) $\frac{2a}{g-a}$ M 3) $\frac{a}{g+a}$ M 4) $\frac{g}{g+a}$ M 5) $\frac{2g}{g+a}$ M

9. An object is located 40cm from the first of two thin converging lenses of focal lengths 20cm and 10cm respectively as shown in the figure. The lenses are separated by 30cm, the final image formed by the two lenses system is located



1) 5cm to the right of the second lens.
2) 13.3cm to the right of the second lens.
3) Infinitely far to the right of the second lens.
4) 13.3cm to the left of the second lens.
5) 100cm to the left of the second lens.

10. A progressive wave has wave length 30cm. the minimum distance between two points which differ in phase by 60° is

1) 5cm 2) 10cm 3) 15cm 4) 20cm 5) 7.5cm

11. The image forms by spectacles which use in defect eye is

1) real and inverted 2) real and erect 3) virtual and inverted

4) virtual and erect 5) depends on defect

12. A one liter flask contains some mercury It is found that at the different temperatures the volume of air inside the flask remains the same. The volume of mercury in the flask is

(coefficient of linear expansion of glass =9 x 10^{-6}/°C ,volume expansion of mercury = 1.8 x 10^{-4}/°C)

1) 120 cm^3 2) 150 cm^3 3) 225 cm^3 4) 300 cm^3 5) 450 cm^3

13. Sound waves can't be polarized because they

1) are mechanical waves. 2) require a material medium for propagation.

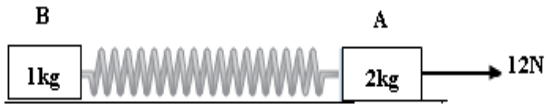
3) are longitudinal waves. 4) are transverse waves. 5) have low velocity.

14. In an elastic collision of two particles the following is conserved:

1) momentum of each particle 2) speed of each particle 3) kinetic energy of each particle

4) total energy of both the particles 5) total kinetic energy of both the particles

15.

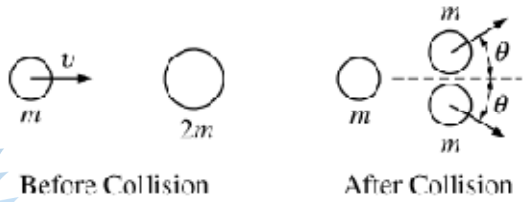


Two blocks A and B of masses 2kg and 1kg respectively, which are connected by mass less spring of force constant $100Nm^{-1}$, are moving with the same speed on a smooth horizontal surface under a horizontal force of 12N, energy stored in the spring is

1) $48x10^{-2}$ J 2) $16x10^{-2}$ J 3) $8x10^{-2}$ J 4) $4x10^{-2}$ J 5) 0

16. A particle of mass *m* is moving along the x-axis with speed *v* when it collides with a particle of mass 2*m* initially at rest. After the collision, the first particle has come to rest and the second particle has split into two equal-mass pieces that move at equal angles $\theta > 0$ with the x-axis, as shown in the figure. Which of the following statements correctly describes the speeds of the two pieces

1) Each piece moves with speed *v*
2) One of the pieces moves with speed *v*, the other moves with speed less than *v*.
3) Each piece moves with speed *v/2*
4) One of the pieces moves with speed *v/2* the other moves with speed greater than *v/2*.
5) Each piece moves with speed greater than *v/2*.



17. Consider the following statements about adjustment of spectrometer.

A) Telescope adjusts for obtaining the paralell rays.

B) Collimater adjusts for providing the paralell rays.

C) Levelling the prism table for the refracting edges of the prisim should be parell to the axis of rotation of telescope.

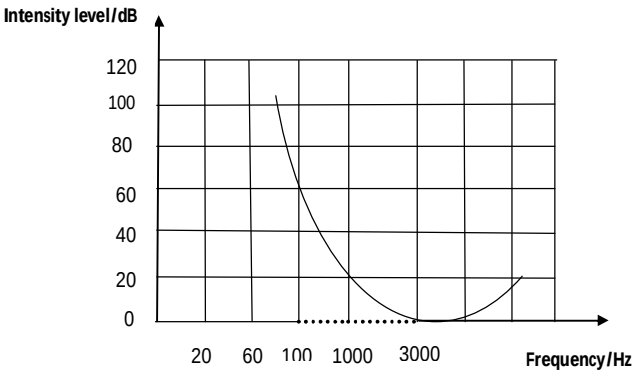
Of the above statements

1) Only (A) is correct 2) only (B) is correct 3) only (A) and (B) are correct

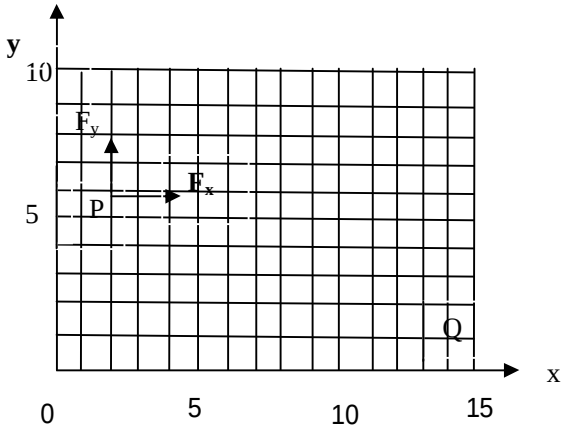
4) only (A) and (C) are correct 5) all (A) ,(B) and (C) are correct.

18. The ear drum of the person being tested has a cross- sectional area of 12 mm^2 .The person hearing loudness varies with frequency curve shown below.The power incident on the eardrum at frequency of 100 Hz is

1) $12 x10^{-2}$ W
2) $12 x10^{-12}$ W
3) $6 x10^{-12}$ W
4) $12 x10^{-6}$ W
5) $6 x10^{-2}$ W

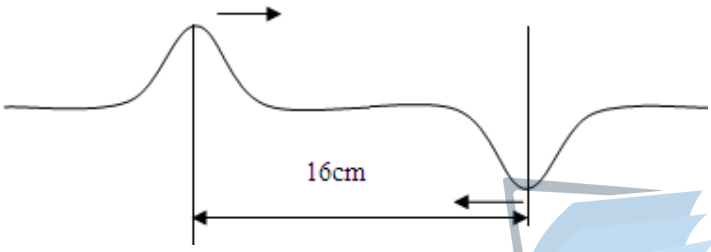


19. The constant force F with components F_x = 3N and F_y = 4N shown in the figure, acts on a body while that body moves from the point P (x = 2m ,y = 6m) to the point Q (x = 14m, y = 1m). How much work does the force on the body during this process?



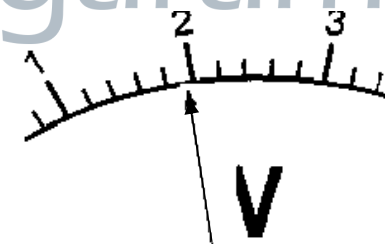
1) 16J 2) 30J 3) 46J
4) 56J 5) 65J

20. The initial distance between the centers of two identical pulses travelling along a stretched string is 16cm.These two pulses travel in opposite directions with a speed of 4cms^{-1}as shown in the figure. The total energy of the pulses after 2s is



1) Zero.
2) totally kinetic energy.
3) totally elastic potential energy.
4) partially kinetic energy and partially elastic potential energy.
5) exactly half kinetic energy and exactly half potential energy.

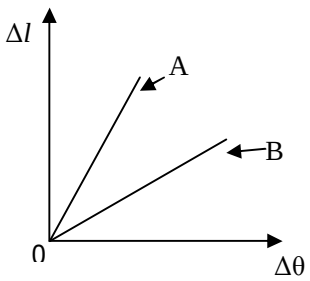
21.



Deflection of the indicator of the voltmeter corresponding to one such voltmeter reading is shown above. The value of this reading and the maximum estimated error in the measurement are respectively

1) 2.0V and 0.2V 2) 1.9V and 0.2V 3) 2.0V and 0.1V 4) 1.9V and 0.1V 5) 1.8V and 0.1V

22) When two metal rods A and B at room temperature are heated together and their expansion Δl are plotted with the increase in temperature $\Delta\theta$, the two curves are shown in the figure. Consider the following statements about the rods A and B.



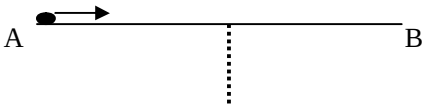
(A) linear expansivity of A is greater than that of B.
(B) length of A is greater than that of B.
(C) If the product " linear expansivity x original length" is same for both rods the two curves will coincide with each other.

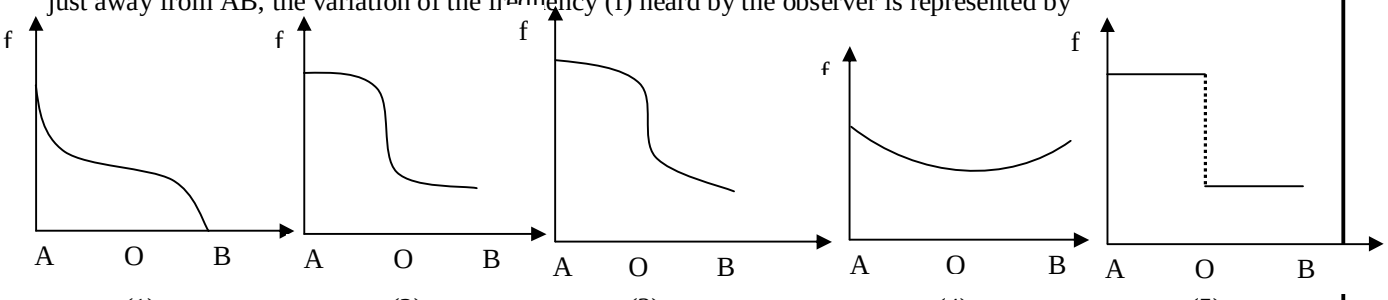
Of the above statements

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

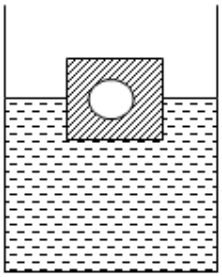
4) only (A) and (C) are correct 5) all (A) ,(B) and (C) are correct.

23) A sound source emitting signals at a constant frequency(f_o), moves along straight line path AB with constant speed 0.1 V as shown in the figure, where velocity of sound is V. A stationary observer is located at a point O, which is in just away from AB, the variation of the frequency (f) heard by the observer is represented by





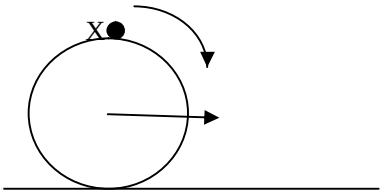
24) A solid plastic of mass ***m*** having an internal cavity floats in water with half the volume submerged as shown in the figure. The density of water and plastic are ***d*** and ***ρ*** respectively, the volume of the cavity will be

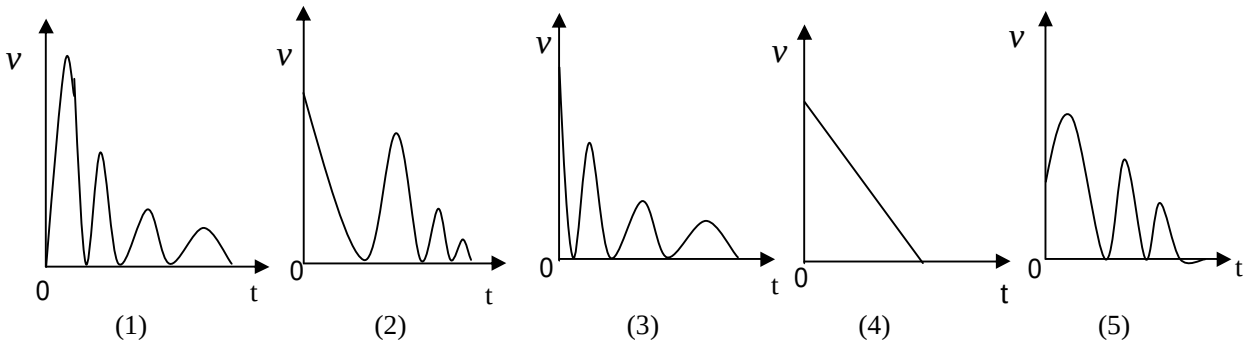


1) $m\left(\frac{1}{d}-\frac{2}{\rho}\right)$ 2) $m\left(\frac{1}{\rho}-\frac{2}{d}\right)$ 3) $m\left(\frac{2}{d}-\frac{1}{\rho}\right)$

4) $m\left(\frac{1}{2d}-\frac{1}{\rho}\right)$ 5) $2m\left(\frac{1}{d}-\frac{1}{\rho}\right)$

25) A wheel starting with horizontal velocity ***v,*** is allowed to roll without slipping along the rough horizontal plane as shown in the figure, after a short time wheel rolls certain revolutions and come to rest. Which of the following graphs best represents the variation of the magnitude (v) of a point X located on the perimeter of the wheel , relative to the earth with time (t) ? (The point X in **top of the wheel** at **t = 0**).





Part – II (A) Structured Essay

Answer all four questions on this paper itself

$g = 10 Nkg^{-1}$

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1. In order to determine the density of glass using the principle of moments, you are provided with Only the following
   - A glass cube of side 4cm and mass of about 60g (M)
   - 20g, 50g, and 100g weights(m)
   - meter ruler, micrometer screw gauge, vernier caliper
   - knife edge, pieces of strings
   - a beaker of water, a beaker of liquid

   (a) (i) In order to determine the length of a side (a) of the cube with an accuracy better than 1%, Which given instrument would you use?

   (ii) Give the reason for other two measuring instrument didn't you select.

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   (b) (i) Draw an experimental set up that you would use to find mass M by balancing the ruler on the knife edge. Label the masses M and m and their corresponding distance $\boldsymbol{l}$ and $\boldsymbol{l_1}$ from the knife edge.

   (ii) How would you find out centre of gravity of the meter ruler ?

   (iii) What is the advantage of balancing the meter ruler at its centre of gravity?

   (c) (i) Of the weights given above, which one is the most suitable for this experiment? Give the reason for your choice.

   weight : ---

   reason: ---

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[See page seven

(ii) Write down an expression for M in terms of m, l and l_1.

(d) (i) What are the next experimental steps that you would perform in order to determine the density of glass (d_g),without changing the position of the glass cube?

(ii) What is the measurement that you would take? (Say l_2)

(e) Obtain an expression for the density of glass (d_g),in terms of density of water(d_w) , l_2 and l (or l_1)

(f) A student obtained the values for l = 41cm , l_1 = 49cm , l_2 = 35cm, find the density of glass.

(Density of water is 1000 kgm^{-3})

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2. 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?

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

(iii) Sketch the graph for amplitude of vibrating string verse length of the string between the bridges.

(consider fundamental and first overtone, fundamental resonance length is l_o)

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[See page eight

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

(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.

(d) Now the student arranged the practical, with composite steel wire AB and BC , A & C are the points touch of the bridges , AB:BC = 3:2 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 $\frac{n1}{n2}$

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

AB: ---------- BC: ----------

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

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

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[See page nine

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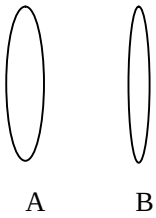
3. (a) The figure shows two lenses A and B.

(i) An astronomical telescope has to be arranged using the lenses A and B, which lens will you select as objective and eye piece ?



A B

Objective ----------

Eyepiece ----------

(ii) Explain your selection in part (a) (i) on basis of the focal length of the lenses.

(b) The focal length of lenses A and B are f_A and f_B respectively. A distant object observes by arranged astronomical telescope in normal adjustment using the lenses A and B.

(i) Draw the position of the lenses and label it , the distant object in left side of objective, denote the separation between two lenses in drawn figure.

(ii) Where does the final image form, from the eye piece?

(iii) Write down an expression of angular magnification for the above adjustment.

(c) Now, the image of lighted objective is formed by eyepiece in the screen. If the diameter of the image and objective are d and D respectively .

(i) Write down the angular magnification for the above adjustment in terms of d and D.

(ii) What is the spatiality of the image?

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[See page ten

(d) If the distance (x) between the lenses is changed and corresponding value of d measure, write down the relationship between x and d.

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(e) Draw the appropriate 1/d Vs x graph.

(iv) Which quantity is equivalent to the mod value of intercept in x axis.

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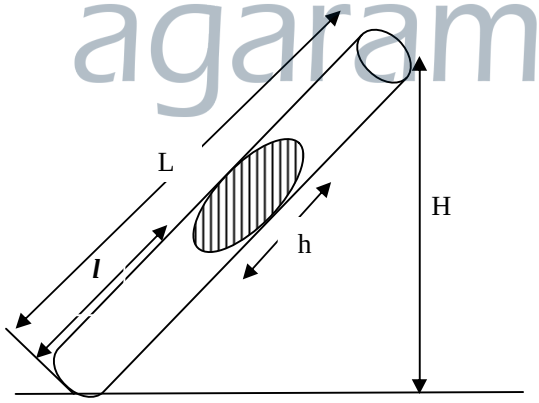

The figure shows an arrangement to determine the atmospheric pressure, using quill's tube with one end closed, and having a column of air bounded between the closed end and a thread of mercury, the tube is inclined with horizontal.

(a) How would you insert the thread of mercury inside the tube?

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[See page eleven

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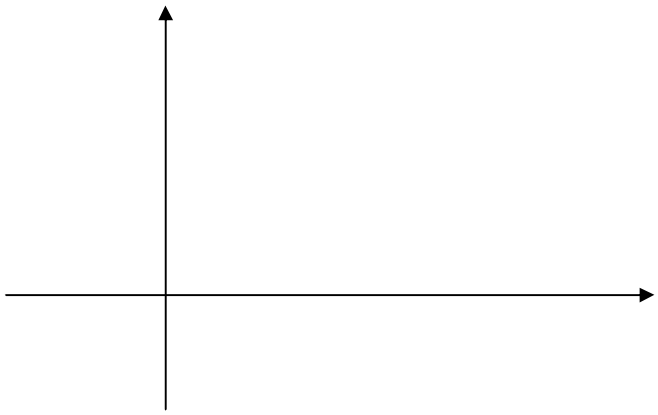
(b) Write down an expression for the volume **V** and pressure **P** of the bounded air at the inclined position shown in the figure. Consider atmospheric pressure is π cm Hg and cross sectional area of the tube is **a**.

(c) What are the measurements that you would take to carry out the experiment?

(d) Write down the relation between P and V, using the obtaining result in part (b), identify additional terms use in an expression.

(e)Rearrange the above expression for plotting the straight line graph.(**independent variable** denotes in **x- axis**)

(f) Draw a rough sketch of expected graph and labeling the axes clearly.



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[See page twelve

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(g) In order to obtain a value for π, a student plotted the above graph he found that the gradient was 1.64×10^{-4} $cm^{-1}(cm\ Hg)^{-1}$ and the intercept was 0.05 cm^{-1}.

(i) If h= 10cm, L= 40cm and $\frac{1}{0.61} \approx 1.64$ find the value of π .

(ii) If the tube is placed in horizontal, find the length of bounded air inside the tube.

(iii) Is it successfully performing the experiment using mercury thread of very small length? Explain your answer.

(iv) Draw a rough sketch of **H** verses ***l*** graph. ($-L \leq H \leq +L$)

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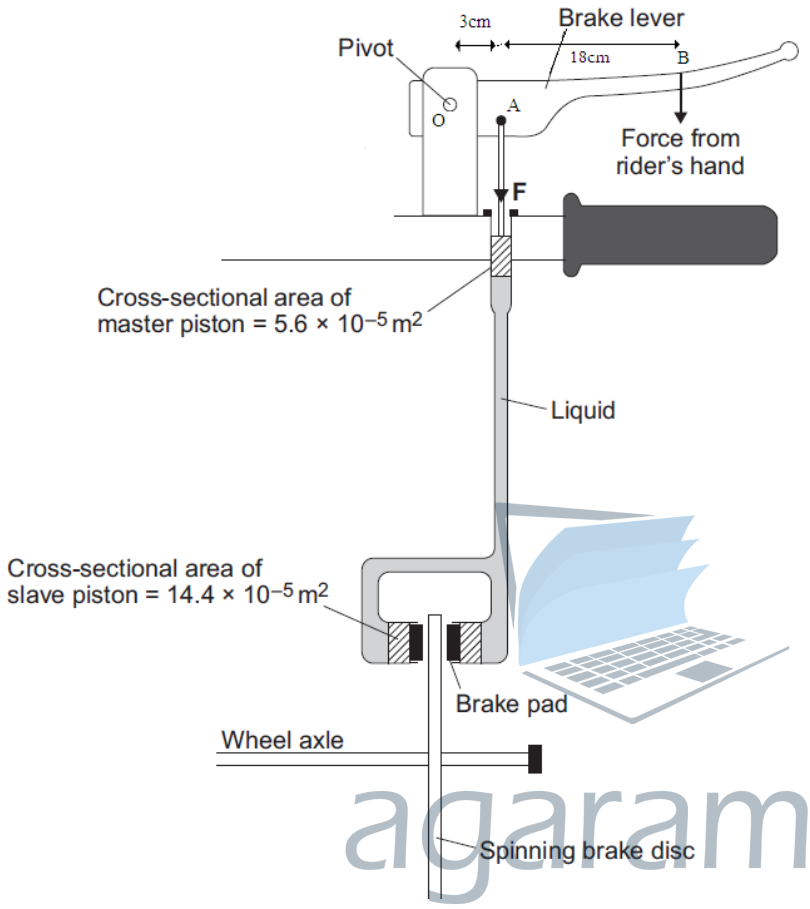
Part-II(B)

Answer any two questions only.

1.



The figure shows mountain bikes hydraulic breaking system which could be used to stop spinning brake disc. A force $\mathbf{F_b}$ is applied perpendicular to the brake lever at B. Brake lever moves freely about a fixed axis through O and perpendicular to the plane of the paper. A force **F** to be applied perpendicularly to the master piston the resulting pressure is transmitted by the brake liquid to the two identical slave pistons. Then the brake pads attached to the pistons move a little distance and press against both sides of the spinning brake disc. Cross sectional area of the master piston and the slave piston are 5.6×10^{-5} m^2 and 14.4×10^{-5} m^2 respectively.

(a) Pascal's principle applicable for gases, a gas cannot be used as the working fluid in a hydraulic jack, explain the reason for this.

(b) What property of liquid enables a hydraulic brake system to work ?

(c) When the rider's hand pulls on the break lever, the master piston applies a pressure of 1.5×10^6 Pa to the liquid, calculate the force **F** exerted on the liquid by the master piston.

(d) (i) Clearly denotes direction of force $\mathbf{F_a}$ acts on the point **A** in the brake lever, and write down the relation

between **F** and $\mathbf{F_a}$.

(ii) Calculate the force $\mathbf{F_b}$ .Using the information in the diagram,(shortest distance between **F** and $\mathbf{F_b}$ is 18cm.)

(e) (i) What is the pressure exerted on the liquid by the slave piston.

(ii) Calculate the force on a slave piston.

(f) If the coefficient of dynamic friction between the brake pads and spinning brake disc is 0.5 , calculate the frictional force acting on the spinning disc due to each pad when they are pressed against the spinning disc.

(g) Wheel and combined spinning brake disc of axis of rotation are same, the distance between brake pads and axis of spinning disc is 6cm. Moment of inertia wheel and spinning disc about is 0.12 kgm^2 ,when brakes are applied wheel comes to rest in 1sec.

(i) Find the frictional torque act on the spinning disc. Assume that the frictional force remains constant throughout the motion .

(ii) Calculate the angular velocity of the wheel, before applying the brakes.

(iii) How many revolutions does the wheel make before coming to rest ? (Take $\pi = 3$)

(iv) How do you modify the wheel, to reduce the revolution before coming to rest?

2. Read the following passage and answer the questions below.

Sound waves having frequency higher than 20 kHz cannot be detected by human ear and it is called ultrasound. In modern industries ultrasound is widely used to inspect material for flaws (crack ,gap, opening). Main component of an ultrasound scanning machine is a probe contains a circular piece of piezoelectric material. Which is forced to vibrate by applying an alternating current voltage across it . Generally the frequency of the a. c. source is adjusted until the disc vibrate with maximum amplitude and give out energetic ultrasound. A material gives an opposition for the propagation of sound is called acoustic impedance. $\boldsymbol{Z} = \boldsymbol{\rho c}$ $\boldsymbol{Z}$ - acoustic impedance of material. $\boldsymbol{\rho}$ – density of material

c - speed of ultrasound

Ultrasonic waves undergo partial reflection at boundaries of different media. At air / material interface the reflection of wave is very high as the acoustic impedance of air is very law. When inspecting materials with ultrasound a coupling gel is applied to the surface of material before placing the ultrasound producing device (transducer probe). This will ensure the flow of ultrasound energy into testing material.

The reflection coefficient of a boundary is given by

$$R = \left[\frac{[Z2 - Z1]}{[Z1 + Z2]}\right]^2$$ Where R - reflection coefficient of boundary

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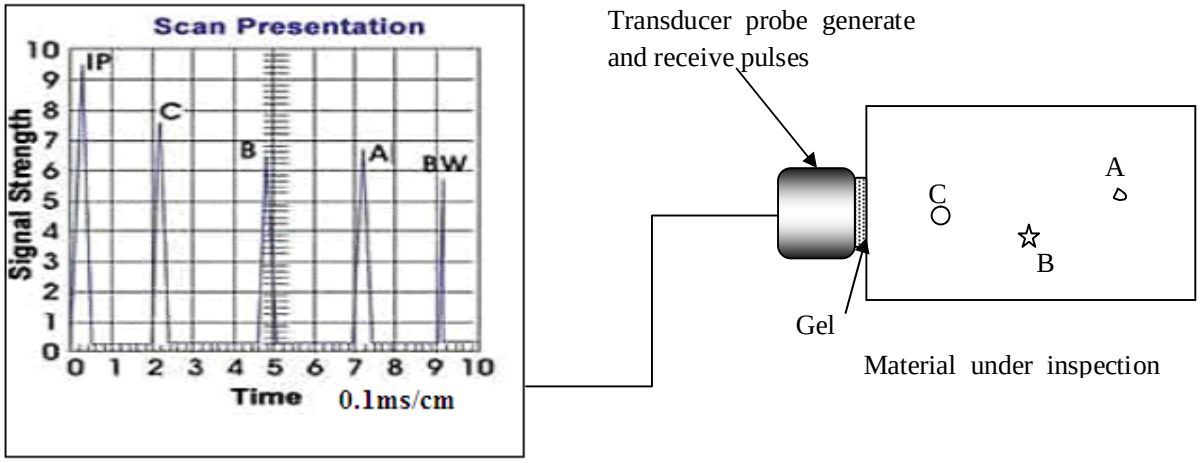
[See page fifteen

Z_1 - acoustic impedance of medium one , Z_2 - acoustic impedance of medium two.



The diagram above shows the scan trace on a cathode ray tube (CRT). The pulse sent into the material returns as it meet boundaries as shown in the diagram. The transducer probe send and received the pulse to CRT monitor to analyze. Use of ultrasound in inspecting materials are non distructive , unhamful , time saving and efficient method compared with other available methods.

(a) (i) What is the frequency of ultrasound ?

(ii) State the condition under which piezoelectric disc can make vibration with maximum amplitude.

(iii) What is the function of the transducer probe ?

(b) (i) What are the factors which determine the acoustic impedance of a material.

(ii) Why air has low acoustic impedance ?

(iii) State the SI unit of acoustic impedance in basic units.

(iv) The density of aluminium is 2700 kg m^{-3} , speed of ultrasound in aluminium is 6300 ms^{-1} calculate acoustic impedance for aluminium.

(c) (i) Why is it necessary to apply gel on the surface of the material where the probe to be placed ?

(ii) A composite bar is made by joining silver rod and gold at their ends without any air film. The density of silver and gold are 10,000 kg m^{-3} and 20,000 kg m^{-3} respectively. The speed ultrasound in silver and gold are 4,000ms^{-1} and 3000ms^{-1} respectively. An ultrasound pulse enter the silver rod and get reflected at silver – gold boundary. Calculate the reflection coefficient (R) of silver – gold boundary.

(d) Explain why there are several pulses on the display after generated pulse.

(e) In display diagram shows each centimeter in display corresponds to 0.1 milliseconds, each centimeter divided in to four equal parts , IP is initial pulse and pulse BW is formed by ultra sound reflected from back wall of the material. The speed of ultrasound in the material is 3000ms^{-1}.

(i) Explain how to form the initial pulse(IP) on the display.

(ii) Calculate the total time taken the ultrasound to travel from front wall to back wall of the materials.

(iii) What is the length of the material under inspection?

(iv) Find the horizontal distance between defect A and defect B.

(f) (i) State two advantages of using ultrasound for inspecting materials.

(ii) Explain why electromagnetic waves can't use for this purpose.

3. The eye has the ability to form clear images on the retina of objects at differing distances from the eye, actually the combination of the cornea and the eye lens forms the image. The cornea is a transparent window and has a high refractive index, it can be considered as a convex lens with a fixed focal length while the focal length of the eye lens can be adjust by ciliary muscles movements, this effect is called accommodation. In practice two separate images on the retina would need to be separated by a distance of 50 μm to be distinguished.

(a) (i) Which part of the eye, the light rays undergoes more deviation? Give reason.

(ii)What is meant by accommodation?

(b) The corena and eye lens of a normal, unaccommodated eye has a power of + 50 dioptres.

(i) Find the distance between eye lens and retina.

(ii) Calculate the power of the lens system required to clearly focus on objects at a point 25cm from the eye.

(iii) If the power of cornea 44 diopters, calculate the focal length of the eye lens for the case mentioned above part (b) (ii).

(iv) Draw the shape of eye lens for the following cases

- Eye is in relax position.
- Eye is in full accommodation.

(c) A person with short sight has a far point of 250 cm and near point of 15 cm.

(i) Draw a ray diagrams for the far point of normal eye and defect eye.

(ii) Calculate the power of the spectacle lens required to enable distant objects to be seen.

(v) Calculated the near point for the person when using this spectacle lens.

(vi) State the range of distinct vision when wearing the spectacles.

(vii) When the person wearing the spectacles, what is the minimum separation of two dots to be seen clearly? (consider length of the eyeball is 2cm)