THE OPEN UNIVERSITY OF SRI LANKA

CREDIT CERTIFICATES FOR FOUNDATION COURSES IN SCIENCE

TAF1502 – PHYSICS -2

FINAL EXAMINATION

DURATION – THREE HOURS

Date: 29th December 2019 Time: 0930-1230 Hours

Part -A

- **The Question paper consists of 25 multiple choice questions**
- **Answer all the questions**
- **Answers for the Multiple Choice Questions, should be provided by placing X in the relevant cage indicating the most appropriate answer in the MCQ answer sheet provided**
- **At the end of the examination you should submit the question paper with answer sheet.**
- **Maximum marks for this part is 40%.**

1). SI unit of the Frequency is

(1) $\mathrm{m\,s^{-1}}$ (2) $\mathrm{s^{-1}}$ (3) W (4) s (5) $\mathrm{s^2}$

2). An object undergo S.H.M according to the equation $a = -4x$ with an amplitude (A) 2 m. Maximum velocity of the object will be

(1) $4\ \mathrm{m\,s^{-1}}$ (2) $2\ \mathrm{m\,s^{-1}}$ (3) $8\ \mathrm{m\,s^{-1}}$ (4) $16\ \mathrm{m\,s^{-1}}$ (5) $8\ \mathrm{m\,s^{-1}}$

3). Distance between two points differing in phase by 90^0 on a wave with velocity $330\ \mathrm{m\,s^{-1}}$ and frequency 110 Hz is.

(1) 1 m (2) 3 m (3) 1.5 m (4) 2 m (5) 2.5 m

4). SI unit of refractive index

(1) $\mathrm{m\,s^{-1}}$ (2) m (3) rad (4) A (5) No units

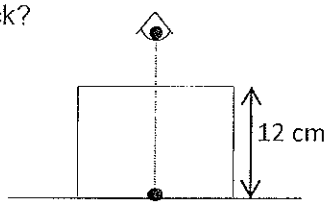
5). A light ray travelling with $3 \times 10^8\ \mathrm{m\,s^{-1}}$ in air enters to a transparent medium. Velocity of the ray in this medium is $2 \times 10^8\ \mathrm{m\,s^{-1}}$. Refractive index of the transparent medium relative to air will be.

(1) 1.5 (2) 0.66 (3) 1 (4) 2 (5) 3

6). Which is the property not show by longitudinal waves

(1) Reflection (2) Diffraction (3) Interference (4) Refraction (5) Polarization

7). A glass block with thickness 12 cm and refractive index 3/2 is placed on an ink drop as shown in the figure. What will be the apparent depth of the ink drop as seen by an observer above the block?



(1) 8 cm
(2) 4 cm
(3) 12 cm
(4) 10 cm
(5) 5 cm

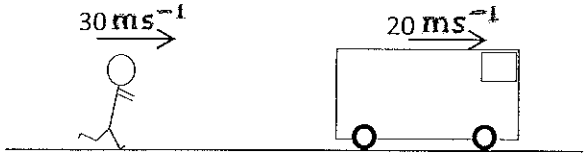
8) The velocity of sound in air at 27^0 C is V. The temperature at which the velocity of sound in air becomes 2V is,

(1) 54^0 C (2) 108^0 C (3) 600^0 C (4) 924^0 C (5) 1200^0 C

9). What is the optical element that can be used to separate white light into different colors.

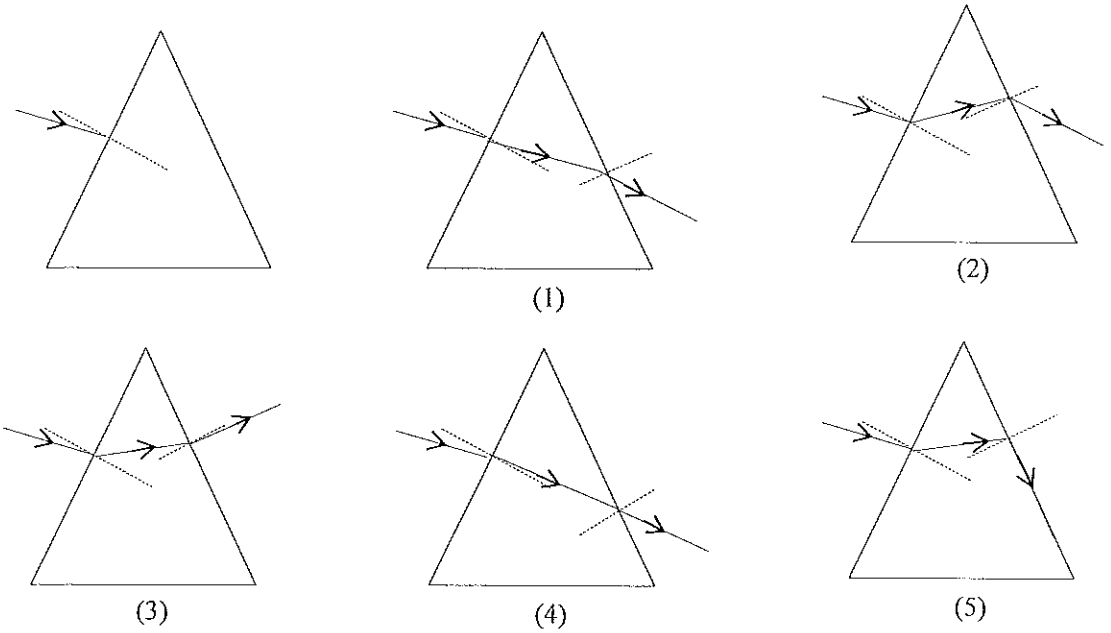
(1) Convex Lens (2) Mirror (3) Prism (4) Telescope (5) Microscope

10). A man is running with constant velocity of 30 $\mathrm{m\,s^{-1}}$ towards a bus moving with a constant velocity of 20 $\mathrm{m\,s^{-1}}$ away from the man while sounding a horn with frequency 700 Hz. What would be the apparent frequency as heard by the man? (speed of sound in air is 330 $\mathrm{m\,s^{-1}}$)



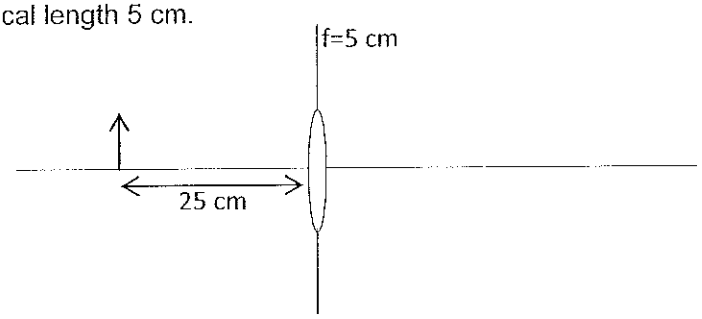
(1) 700 Hz (2) 720 Hz (3) 690 Hz (4) 710 Hz (5) 695 Hz

11). Select most suitable path for the monochromatic light ray travelling through an air cavity made in a shape of a prism in ice (Refractive index of air=1, Refractive index of ice = 1.33)



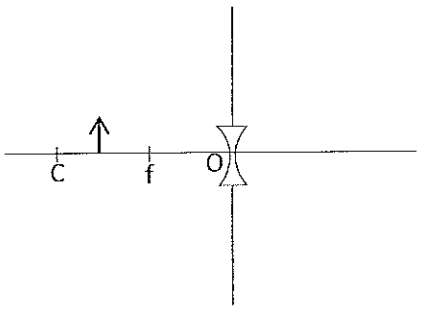
(1) (2) (3) (4) (5)

12). Find the Image distance for the object placed at 25 cm from the optical center of a convex lens with focal length 5 cm.



(1) 6.25 cm (2) 8.45 cm (3) 0.16 cm (4) 5.05 cm (5) 5.05 cm

13). Location of the image produced by the following concave lens for an object kept in between focus (F) and the point C (OC=2r) is.



(1) At the infinity

(2) In between C and infinity

(3) In between C and F

(4) In between O and F

(5) At F

14). When the moon is observed by an astronomical telescope, we can see a large image of the moon. Most suitable explanation for this will be,

(1) Telescope can reduce the distance between moon and the eye.

(2) Angle Subtended by the image of the moon on the eye through the telescope is less than the angle subtended by the moon on the eye.

(3) Angle Subtended by the image of the moon on the eye through the telescope is greater than the angle subtended by the moon on the eye.

(4) Diameter of the moon is increased by the telescope.

(5) Large amount of light rays are entering into the telescope.

15). Thin convex lens with focal length $f_1 = 10\ cm$ and concave lens with $f_2 = 20\ cm$ are in contact with each other. Find the effective focal length of the system.

(1) 5 D (2) 15 D (3) 10 D (4) 20 D (5) 40 D

16). A person can observe object at 25 cm clearly but cannot see far than 200 cm. What is his eye defect and the focal length of the lens required to correct it?

(1) Convex with f=200 cm

(2) Concave with f=200 cm

(3) Convex with f=25 cm

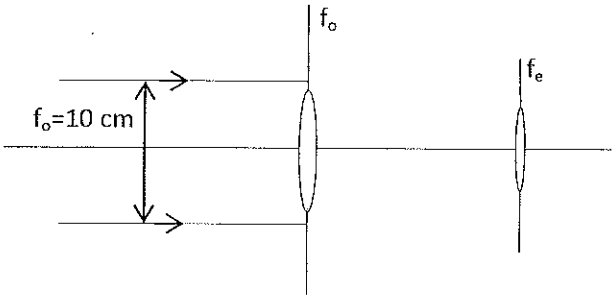
(4) Concave with f=25 cm

(5) Convex with f=100 cm

17). A student is observing a specimen through a convex lens with focal length 200 mm. The image of the specimen is formed at 25 cm from the lens. By taking the least distance of the distinct vision as 25 cm, find the angular magnification of the simple microscope.

(1) 1.12 (2) 2.25 (3) 1.25 (4) 2 (5) 3.25

18). Parallel light beam with diameter 10 cm incident parallel to the main axis on the objective lens of an astronomical telescope having angular magnification M=4 at the normal adjustment. What will be the diameter of the outgoing beam through the eye piece?



(1) 4 cm

(2) 1.5 cm

(3) 2 cm

(4) 3.5 cm

(5) 2.5 cm

19). Light signals passing through a fiber optic undergoes,

(1). Diffraction along the optical medium

(2) Total internal reflection along the optical medium

(3) Polarization along the optical medium

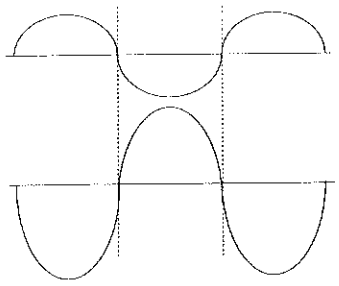
(4) Interference along the optical medium

(5). Scattering along the optical medium

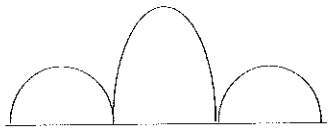
20). A 10 m long wire weights 1 x 10^{-3} kg. It's tension is 1 N. What will be the speed of transverse waves along the wire?

(1) 50 $m\,s^{-1}$ (2) 150 $m\,s^{-1}$ (3) 100 $m\,s^{-1}$ (4) 200 $m\,s^{-1}$ (5) 10 $m\,s^{-1}$

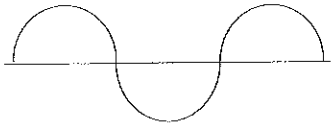
21).Select the most suitable pattern for the following two waves after superimposed with each other.



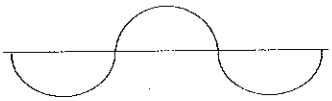
(1)



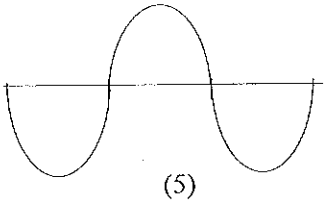
(2)



(3)



(4)

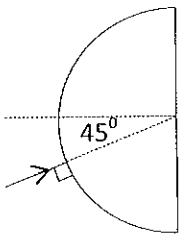


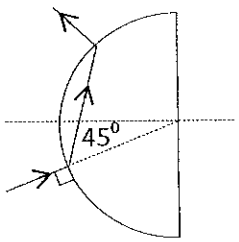
(5)

22). A tube with one end open is resonating the fundamental with a tuning fork of frequency f. If the length of the tube is 25 cm and the speed of sound in air is 330 $\mathrm{m\,s^{-1}}$. What will be the value of f?

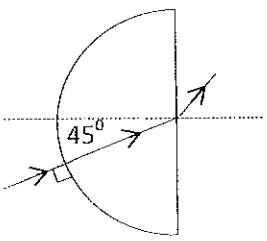
(1) 440 Hz (2) 110 Hz (3) 200 Hz (4) 400 Hz (5) 330 Hz

23). A laser beam is incident on a glass block as shown in the figure. (Critical angle for the glass-air interface = 42^0) select the most suitable ray diagram for the above instance.

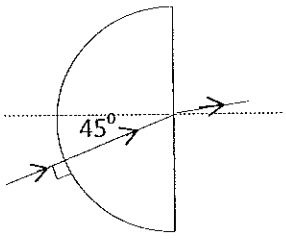




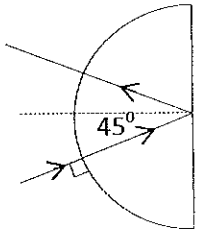
(1)



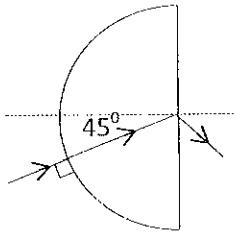
(2)



(3)

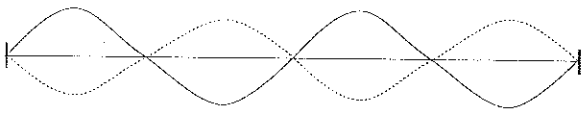


(4)



(5)

24). Find the number of nodes and anti-nodes in the following standing wave.



(1) Nodes = 2, Anti-Nodes=2 (2) Nodes = 3, Anti-Nodes=4 (3) Nodes = 4, Anti-Nodes=4
(4) Nodes = 0, Anti-Nodes=4 (5) Nodes = 5, Anti-Nodes=4

25). Tuning fork **A** (with frequency F_A) produce 10 beats per second with tuning fork **B** and Tuning fork **C** (with frequency F_C) produce 5 beats per second with the tuning fork **B**. If the frequency of the tuning fork B is 256 Hz and $F_A < F_C$. What will be the frequencies of tuning fork **A** and **C** ?

(1) F_A =246 Hz, F_C =261 Hz (2) F_A =261 Hz, F_C =246 Hz (3) F_A =250 Hz, F_C =260 Hz

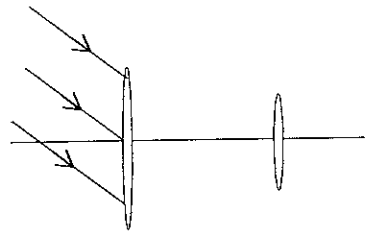
(4) F_A =240 Hz, F_C =250 Hz (5) F_A =230 Hz, F_C =260 Hz

Part - B

- **Answer any four (04) questions only.**
- **If more than (04) question are answered only the first four will be marked.**
- **Each question earn fifteen (15) marks, amounting to total of 60% marks.**
- **You have to show the steps involved in solving problems. No marks are awarded for the mere final answer without proper steps.**

1). (a). Define magnifying power of an Astronomical telescope **(2 Marks)**

(b). Show how the final image is formed in an astronomical telescope at the normal adjustment by completing the ray diagram in the following figure. You may copy the diagram to your answer script and complete the path of the rays (you should mark the relevant focal lengths and path of the rays clearly). **(5 marks)**



Objective lens Focal length = f_o

Eyepiece Focal length = f_e

(c) By using your ray diagram derive an expression for the angular magnification of the telescope **(4 Marks)**

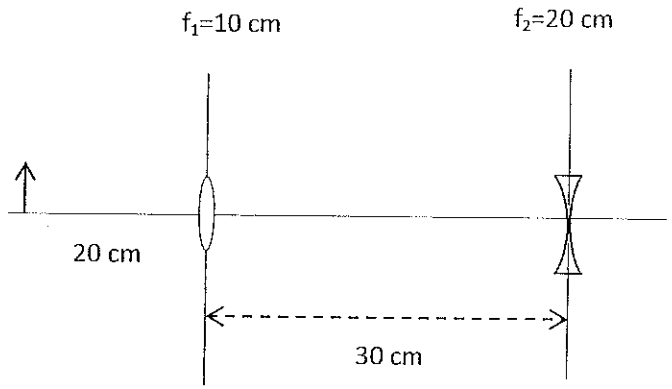
(d) Show that the relationship between the angular magnification and the diameter of the lenses is,

$$Angular\ Magnification = \frac{D(Diameter\ of\ the\ objective\ lens)}{d\ (Diameter\ of\ the\ eyepiece)}$$

(e) The objective lens of an astronomical telescope in normal adjustment has a diameter of 200 mm and a focal length of 4 m. The eyepiece has a focal length of 20 mm. Calculate the diameter of the eyepiece. **(4 Marks)**

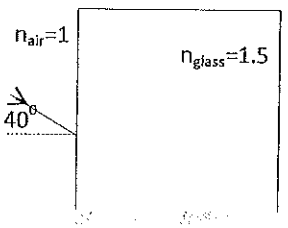
2). (a). Lens formula for the real images produced by a convex lens can be written as $\frac{1}{V}+\frac{1}{U}=\frac{1}{F}$,Plot the variation of the reciprocal of the linear magnification ($\frac{1}{m}$) with the object distance (U) for the real images of a convex lens. (m - Linear magnification) **(5 Marks)**

(b). An object is kept near a system of lenses having a convex lens (f_1=10 cm) and concave lens (f_2=20 cm) as in the following figure. Calculate the distance to the final image from the optical centre of the concave lens. **(10 Marks)**



3). (a) A beaker is filled with water to a height of 8 cm. A microscope is focused on a mark at the bottom of the beaker. Water is now replaced by a liquid with refractive index $(n_l)=\frac{16}{10}$ up to the same height. By what distance would the microscope have to be moved to focus on the mark again? Refractive index of water (n_w) is $\frac{4}{3}$. **(4 Marks)**

(b). A cube of glass of refractive index 1.5 is placed on a horizontal surface separated by a film of liquid at the bottom, as shown in the diagram. A ray of light from outside strikes vertical face of the cube at an incident angle of 40^0 and, after refraction, it is totally reflected at the critical angle at the glass-liquid interface.



(Take $sin^{-1}(0.4)=23^0, \sin 40^0=0.6, sin^{-1}(0.92)=67^0$)

Calculate;

(a). The critical angle at the glass-liquid interface **(8 Marks)**

(b). The angle of emergence of the ray from the cube. **(3 Marks)**

(4) (a) Compare and contrast 'Transverse Waves' and 'Longitudinal Waves' **(3 Marks)**

(b) Compare and contrast 'progressive waves' and 'stationary waves' **(3 Marks)**

(c) Describe the laboratory experiment to determine the velocity of sound in air. **(9 Marks)**

Your answer should include the *apparatus used, experimental procedure, measurements taken, graphs drawn* etc.

(5). (a) Describe how the stationary waves are established in a string. **(2 Marks)**

(b) Explain what is meant by '**nodes**' and '**anti-nodes**' **(2 Marks)**

(c) When a wire of length 'L' and mass per unit length ' m' under tension 'T' is set in transverse vibration. Derive expressions for the

(i) Fundamental frequency and **(2 Marks)**

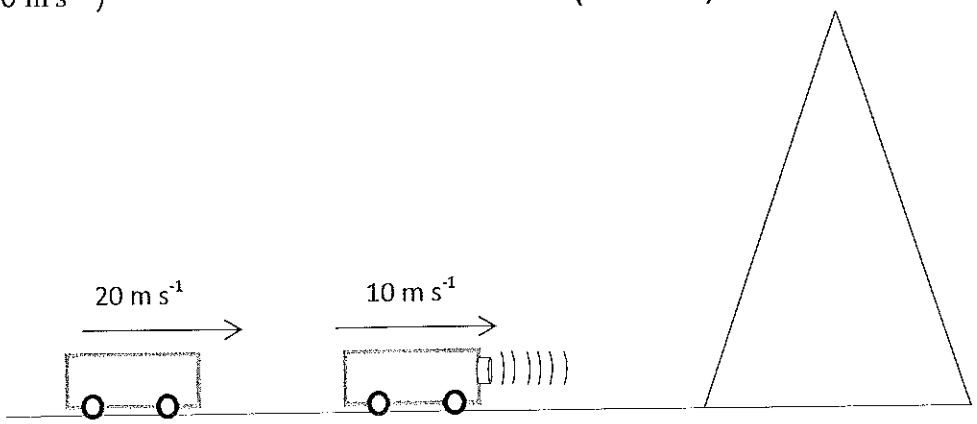
(ii) First overtone **(2 Marks)**

(d) Two steel violin strings of the same length and same tension have fundamental frequencies of 440 Hz and 660 Hz respectively. Calculate the ratio of the diameters of two strings. **(7 Marks)**

(6) (a) Explain what is meant by the 'Doppler Effect' **(3 Marks)**

(b) Give two practical applications of the Doppler effect. **(2 Marks)**

(c) A car travelling towards a large hill at 10 $\mathrm{m\,s^{-1}}$ sounds its horn with frequency of 500 Hz. A second car is also travelling in the same direction, behind the first car with a velocity of 20$\mathrm{m\,s^{-1}}$. The sound of the horn is heard by an observer in the second car due to reflection from the hill. Find the frequency of sound observed by the observer in the second car. (Velocity of sound in air=340 $\mathrm{m\,s^{-1}}$) **(10 Marks)**



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