

SIR ARTHUR LEWIS COMMUNITY COLLEGE
DIVISION OF TECHNICAL EDUCATION AND MANAGEMENT STUDIES
DEPARTMENT OF ENGINEERING

FINAL EXAMINATION 2004

PROGRAMME TITLE(S) : Computer Maintenance and System Engineering
Electronic Service and Communication Engineering
Automotive Engineering
Mechanical Technicians

PROGRAMME CODE(S) : 3EE-CMS-AD 3EE-ESC-AD
3ME-MEC-AD 3ME-AUT-AD

COURSE TITLE : Applied Engineering Science 1

COURSE CODE : ESC 103

DURATION : 3 HOURS

TIME AND DATE : 9:00 p.m. 7th Dec 2004

ROOM : R1, R2, R3, R4, L1, L2 , SME R1

COURSE TUTOR : Mr. Narpaul Heeralall

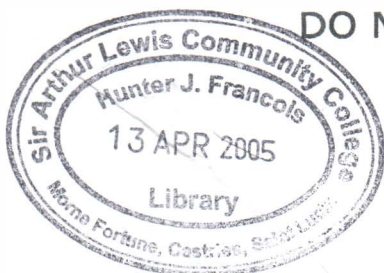
INVIGILATOR(S) : S. Toussaint, C. Antoine, A. Plummer

INSTRUCTIONS

1. This paper has **TWO SECTIONS** six questions each. All questions carry equal marks
2. You are to answer **EIGHT QUESTIONS** choosing **ANY FOUR** from each section.
3. Ensure your answers and pages are numbered correctly
4. You will be rewarded for neat clear explanations and presentation.
5. Ray diagrams **MUST** be neat and clear.
6. Do all work in blue or black ink pen.

Note: Accurate ray constructions are not necessary but your ray diagrams must convey a clear sense of how the final image is formed.

**DO NOT TURN THIS COVER SHEET UNTIL
YOU ARE TOLD TO DO SO**



SECTION A

1. Figure 1 shows a security camera mounted, at A, 2.5 meters above the floor and 3.5 meters away from a vertical plain mirror.

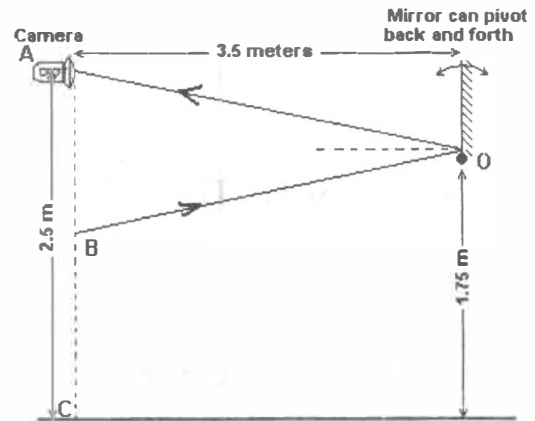


Fig 1

i. If the bottom edge of the mirror O is 1.75 meters above the floor, calculate the distance B vertically below the camera that can be viewed in the mirror. ...(4 marks)

ii. If the mirror is pivoted at O and can be tilted back and forth, then calculate the minimum angle that the mirror must be tilted in order to view the point C on the ground directly below the camera. ...(6 marks)

[Total 10 marks]

2. A certain spherical mirror produces an upright magnified image of an object placed in front of it.

a) Draw the ray diagram to show how the image is formed. Your diagram MUST show:

- i. The type of mirror used. ...(1 mark)
- ii. The location of the object relative to the mirror. ...(1 mark)
- iii. At least two rays forming the image. ...(2 marks)

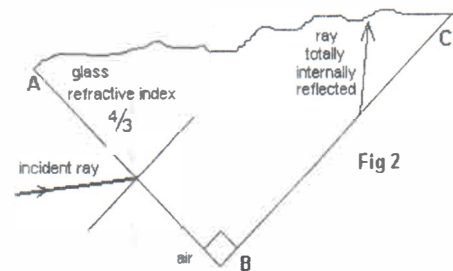
b) When an object 0.75 cm tall is placed in front of a concave mirror a magnified image 2.25 times the object is formed 72 cm away from the mirror. Calculate

- i. The object height ...(2 marks)
- ii. The focal length of the mirror ...(4 marks)

[Total 10 marks]

3. Fig 2 shows a corner of a rectangular piece of glass ABC. If a ray of light strikes the glass on side AB enters the glass, calculate the minimum angle of incidence that would cause the ray to be totally internally reflected at surface BC.

The refractive index of the glass $n_g = \frac{4}{3}$

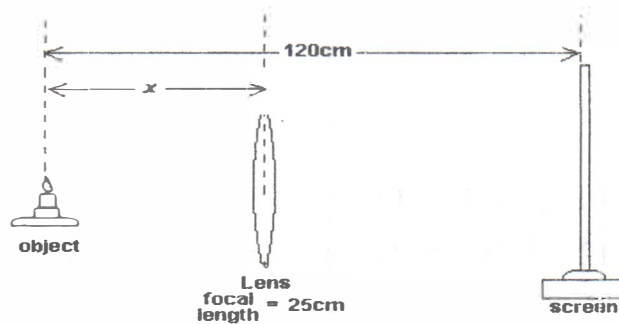


[Total 10 marks]

4 Two lens A and B of power 20 Diopters and 5 Diopters respectively are arranged to form a compound microscope. If an object is placed 11 mm away from the objective lens and the instrument adjusted so that the final image is at the eye's near point, then

- a) Draw a diagram showing how the final image is formed. You must show the following:
- i. Eyepiece and objective lens ... (2 marks)
 - ii. The intermediate image ... (2 marks)
 - iii. The length of the barrel ... (2 marks)
- b) Calculate the magnification of the instrument ... (2 marks)
- c) What is the resolution power of this instrument? ... (2 marks)
- [Total 10 marks]

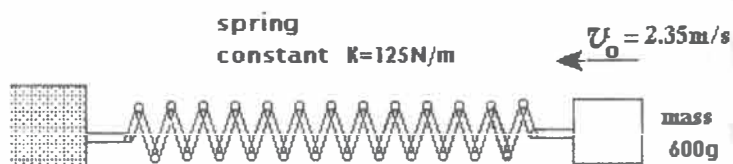
5 A luminous object is placed 120 cm away from a screen as shown in the diagram to the right. A converging lens of focal length 25 cm is placed between the object and the screen and moved left and right until a sharp image is formed on the screen.



- a) What distance from the object should the lens be located to produce the sharp image? ... (8 marks)
- b) What is the magnification in each case? ... (2 marks)
- [Total 10 marks]

- 6 (i) Explain three pieces of evidence that support the wave nature of light. ... (3 Marks)
- (ii) Explain why does a prism separate light into the various colours. ... (2 Marks)
- (iii) Why do residence in mountainous terrain receive AM transmission (long wave) better than FM transmission (short wave). ... (2 Marks)
- (iv) Explain the essential features of optical fibers that allow them to transmit light signal. ... (3 marks)
- [TOTAL 10 MARKS]

SECTION B



- 7 A 600g mass at rest on the end of a horizontal spring ($K=240\text{ N/m}$) is struck by a hammer, which gives it an initial speed of 3.75 m/s. Determine
- The period and frequency of the motion. ...(3 Marks)
 - The amplitude. ...(1 Marks)
 - The maximum acceleration. ...(1 Marks)
 - The total energy. ...(2 Marks)
 - The velocity at a distance of 2.4 cm from its equilibrium position. ...(3 Marks)
- [TOTAL 10 MARKS]
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- 8
- State briefly Maxwell's equations (in worded form). ...(3 Marks)
 - Clearly explain how an alternating source connected to two long straight pieces of conductors produces an electromagnetic wave. ...(4 Marks)
 - Helen FM transmits its broadcast at 101.1MHz FM.
 - What is the wavelength of this signal? ...(1 Marks)
 - What are the limitations of this type of transmission? ...(1 Marks)
 - Explain why it is usually possible for us to see through the glass door into the domestic microwave oven yet the microwave radiation cannot escape through the door and cause harm. ...(1 Marks)
- [TOTAL 10 MARKS]
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- 9 A wire of total length 3500 mm and mass 3.0 grams is clamped between supports 2400 mm apart and is stretched to a tension of 50 Newtons.
- If the wire is plucked, what will be the velocity of a wave as it travels along the wire? ...(3 Marks)
 - What will be the first three resonance frequencies produced by this wire? ...(3 Marks)
 - If, due to an increase in temperature, the tension decreased by 3.5% what will be the corresponding increase in the frequency of the fundamental? ...(4 Marks)
- [TOTAL 10 MARKS]

- 10 A person in a rock concert standing a certain distance from a stack of four identical speakers is feeling a sound level intensity of 90 dB.
- (a) What sound level intensity would this person experience if the sound technicians shut down all but one speaker? ...(5 Marks)
- (b) With all speakers operating, how far should the person move so that the decibel level at the new location is 75dB ...(5 Marks)
[TOTAL 10 MARKS]
- 11 (a) An organ pipe can resonate at frequencies of 234Hz, 390Hz and 546Hz but not at any other frequencies between 234Hz and 546Hz. Show whether this is an open pipe or a closed pipe and calculate the fundamental frequency. ...(4 Marks)
- (b) Two dog whistles, when blown individually produce no audible sound. However, when blown together produces an audible note of 5000Hz. Explain why is it possible to hear a note when blown together but not when blown individually. ...(2 Marks)
- (c) If when one of the whistles is replaced with a third whistle labeled 20000Hz and blown together with the first, a note of 7000Hz is heard, what are the frequencies of the whistles? ...(4 Marks)
- [TOTAL 10 MARKS]
- 12 (a) Explain the apparent change of frequency of a sound as the source and observer move relative to each other. ...(2 Marks)
- (b) The predominant frequency of a certain police car's siren is 1800 Hz when at rest. What frequency would you detect if the police car moves with a speed of 30.0m/s away from you. ...(4 Marks)
- (c) An air traffic controller directs his radar at an approaching aircraft and observes the Doppler shift of the returning signal is 7586Hz. If the radar emits a frequency of 22000Hz, what is the speed of the approaching aircraft. ...(4 Marks)
- Assume the velocity of sound in air $v = 340\text{m/s}$*
- [TOTAL 10 MARKS]

End of exam
Good luck

<<★🐣★Happy Holidays★🐣★>>