

## PART I

Answer all questions ( 6 best out of 7 count toward your final mark)

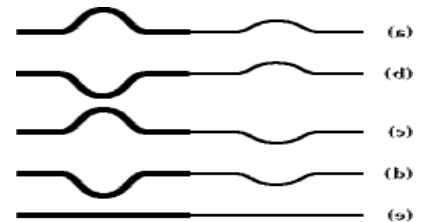
1. A 200-m long transmission cable is suspended between two towers. If the mass density is  $2.01 \text{ kg/m}$  and the tension in the cable is  $4.00 \times 10^4 \text{ N}$ , what is the speed of transverse waves on the cable?

a. 122 m/s                      b. 141 m/s                      c. 244 m/s                      d. 310 m/s                      e. 1500 m/s

2. Two ropes are spliced together as shown.



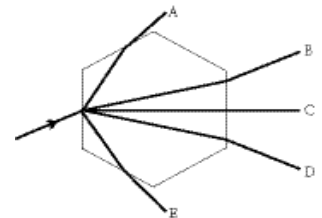
A short time after the incident pulse shown in the diagram reaches the splice, the ropes appearance will be that in



3. A car moves at  $36 \text{ m/s}$ . with respect to the police car .The frequency of the siren (relative to the police car) is  $500 \text{ Hz}$ . What is the frequency (in Hz) heard by an observer in the moving car as he moves away from the police car? (Assume the velocity of sound in air is  $343 \text{ m/s}$ .)

a. 220                      b. 448                      c. 526                      d. 552                      e. 38

4. A light ray strikes a hexagonal ice crystal floating in the air at a  $30^\circ$  angle to one face, as shown below. The hexagonal faces of the crystal are perpendicular to the plane of the page. All the rays shown are in the plane of the page, and  $n_{\text{ice}} = 1.30$ . Which outgoing ray is the correct one?



a. A                      b. B                      c. C                      d. D                      e. E

5. A convex mirror has a radius of curvature of  $2.0 \text{ m}$ . An object is placed  $1.0 \text{ m}$  in front of the mirror. Determine the location of the image (in cm).

a. 127                      b. 83                      c. -67                      d. -50                      e. none of the above

6. Two slits separated by  $0.10 \text{ mm}$  are illuminated with green light ( $\lambda = 540 \text{ nm}$ ). Calculate the distance (in cm) from the central bright-region to the seventh bright band if the screen is  $1.0 \text{ m}$  away.

a. 2.3                      b. 2.5                      c. 2.7                      d. 3.8                      e. 2.0

7. A binary star system in the constellation Orion has an angular separation between the two stars of  $1.2 \times 10^{-6}$  radians. If  $\lambda = 5 \times 10^{-7} \text{ m}$ , what is the smallest aperture (diameter) telescope that may be used to resolve the two stars?

a. 10 cm                      b. 5 cm                      c. 50 cm                      d. 1 m                      e. 4 cm

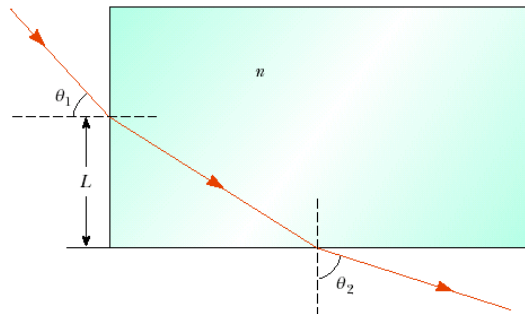
PART II

Solve 3 out of following 4 problems ( 52 %of the test mark)

Present the full solution with the clear diagram when it is appropriate (10points)

- 1 A piano is mounted on the block that is driven on the frictionless horizontal surface by the powerful spring attached to a wall. The piano player is striking one note only (600Hz,) Emitted sound has power of 8W.  
a)What are the highest and lowest frequencies heard by the audience? ( Mass of the piano=300kg, mass of the block 130kg mass of the pianist 70kg . Spring constant is  $10^6\text{N}$ ). Initial stretching of the spring is 0.5m. (10p).  
b)What are the minimum and the maximum loudness in dB as heard by a person in the audience 14 meters away from the piano equilibrium position?

- 2 A light ray enters a rectangular block of plastic at an angle  $\theta_1 = 43.0^\circ$  and emerges at an angle  $\theta_2 = 72.0^\circ$ , as shown.  
(a) Determine the index of refraction of the plastic. (10)  
(b) If the light ray enters the plastic at a point  $L = 50.0$  cm from the bottom edge, how long does it take the light ray to travel through the plastic? (7)



- 3 An object 3.00 cm high is placed 40.0 cm to the left of a converging lens having a focal length of 35.0 cm. A diverging lens with a focal length of -15.0 cm is placed 100 cm to the right of the converging lens.  
(a) Determine the position and magnification of the final image. (5)  
(b) Is the image upright or inverted? (5)  
(c) **What If?** Repeat parts (a) and (b) for the case where the second lens is a converging lens having a focal length of +25.0 cm. (7)

- 4 An air wedge is formed between two glass plates separated at one edge by a very fine wire, as shown. When the wedge is illuminated from above by 500-nm light and viewed from above, 20 dark fringes are observed. Calculate the radius of the wire.

