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**University Examinations 2016/2017**

FIRST YEAR, FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE PHYSICS AND BACHELOR OF EDUCATION SCIENCE

**SPH 3101: GEOMETRICAL OPTICS**

**DATE: December, 2016 TIME: HOURS**

**INSTRUCTIONS:** *Answer questions* ***one*** *and any other* ***two*** *questions.*

**QUESTION ONE - (30 MARKS)**

1. Define geometrical optics. (2 Marks)
2. State the two laws of reflection. (2 Marks)
3. Two mirrors $m\_{1}m\_{2}$ make an angle of 120$°$ with each other. A ray is incident on mirror$ m\_{1}$ at an angle of 65$°$ to the normal. Find the angle the ray makes with the normal to mirror $m\_{2}$ after it is reflected from both mirrors. (5 Marks)
4. Given that a certain concave, spherical mirror has a focal length of 10.0cm, locate the image and find;
5. the magnification for an object distance of 25.0 cm. (2 Marks)
6. Determine whether the image is real or virtual, inverted or upright and larger or smaller. (3 Marks)
7. An observer on the west-facing beach of a large lake is watching the beginning of a sunset. The water is very smooth except for some areas with small ripples. The observer notices that some areas of the water are blue and some are pink. Explain the reason as to why the water appears to be of different colours in different areas. (4 Marks)
8. State the Huygen’s principle. (3 Marks)
9. A fish is swimming at a depth d below the surface of a water pond. Given that the refractive indices of air and water are 1 and 1.33 respectively;
10. Determine the apparent depth of the fish as viewed from directly overhead.

(3 Marks)

1. If the fish is 12cm long, how long is its image? (3 Marks)
2. Briefly explain the myopic condition of the eye in relation with optical instruments.

(3 Marks)

**QUESTION TWO (20 MARKS)**

1. State the Snell’s law of refraction. (2 Marks)
2. A light ray of wavelength 589nm travelling through air is incident on a smooth flat slab of crown glass at an angle of 30$°$ to the normal. Given that the refractive index of the glass is 1.52, find the angle of refraction,$θ\_{2}$ (3 Marks)
3. Light of wavelength 589nm in vacuum passes through a piece of fused quartz of index of refraction n= 1.458.
4. Find the speed of light in fused quartz (3 Marks)
5. What is the wavelength of this light in fused quartz? (3 Marks)
6. What is the frequency of the light in fused quartz? (3 Marks)
7. The dispersion of light into a spectrum is demonstrated vividly in nature through the formation of a rainbow, often seen by an observer positioned between the sun and a rain shower. Precisely explain how the colours of the rainbow appear distinct in the eyes of the observer. (6 Marks)

**QUESTION THREE (20 MARKS)**

1. State the properties of the image formed by a flat mirror. (2 Marks)
2. A man 1.80m tall stands infront of a mirror and sees his full height, no more and no less. If his eyes are 0.14m from the top of his head, with the help of a sketch determine the minimum height of the mirror. (8 Marks)
3. Large trucks often have a sign on the back saying “If you can’t see my mirror, I cant see you”. Explain this sign (3 Marks)
4. A coin 2.0cm in diameter is embedded in a solid glass ball of radius 30.0cm as shown in the diagram below. The index of the refraction of the ball is 1.50 and the coin is 20.0cm from the surface.
5. Explain whether the image is real or virtual. (2 Marks)
6. Find the position of the image of the coin and the height of the coin’s image

(5 Marks)

**QUESTION FOUR (20 MARKS)**

1. A converging lens of focal length 10.0cm forms images of an object situated at various distances.
2. If the object is placed 30.0cm from the lens, locate the image, state whether it’s real or virtual and find its magnification. (7 Marks)
3. Repeat the problem in (i) when the object is at 10.0cm and 5.0 cm. (7 Marks)
4. Two bright lines in the spectrum of sodium have wavelengths of 589.00nm and 589.59nm, respectively.
5. What must the resolving power of a grating be so as to distinguish these wavelengths? (3 Marks)
6. To resolve these lines in the second-order spectrum, how many lines of the grating must be illuminated? (3 Marks)