BINDURA UNIVERSITY OF SCIENCE EDUCATION
FACULTY OF SCIENCE & ENGINEERING
DEPARTMENT OF OPTOMETRY
BACHELOR OF SCIENCE HONOURS DEGREE IN OPTOMETRY

JUN 2025

OPTC209: PHYSIOLOGICAL OPTICS II

3 HOURS **(100 MARKS)**

CANDIDATE NUMBER:

INSTRUCTIONS: This paper has THREE sections.
Attempt **ALL** questions in all sections

SECTION A. Attempt all questions. (64 Marks)

1. What is dark adaptation? [2 mark]
2. Outline **six** ocular conditions in which dark adaptation has proven useful in their diagnosis. [6 marks]
3. Outline **four** mechanisms that allows vision over a range of light intensities? [4 marks]
4. What do you understand by the term **Purkinje Shift?** [2 mark]
5. How is the duplicity theory of the retina different from weber's law? [4 marks]
6. State the Gestalt principles of grouping. [4 marks]
7. Write down the eight cues of monocular depth perception? [8 marks]
8. What is the distinction between Stiles-Crawford effect of the first kind and of the second kind? [4 marks]
9. Define the following terms? [10 marks]
10. Stiles-Crawford effect-1 is attributed to what **three** factors? [3 marks]
11. What is modulation transfer function? [2 marks]
12. What is the distinction between luminance and brightness? [3 marks
13. What are the measures of image quality? [4 marks]
14. State two theories of colour vision. [2 marks]
15. State the perceptual constancies. [6 marks]

SECTION B. Choose the most appropriate option from A-D. (26 MARKS)

1. Which entoptic phenomenon would be most useful in diagnosing an incipient retinal branch vein occlusion:
   (A) Haidinger's brushes
   (B) Moore's Lightning Streaks
   (C) Purkinje Tree
   (D) Yellow dancing spots.

2. Flashing spots of light reported by a patient in the temporal visual field may indicate:
   (A) retinal haemorrhage in the nasal retina
   (B) retinal detachment in the nasal retina
   (C) vitreous detachment from the nasal retina
   (D) acute angle closure glaucoma.

3. Using relative entoptic parallax, a patient notices one shadow that moves slowly with and another that moves slowly against the direction of the point source. The two opacities are most likely located respectively in:
   (A) posterior vitreous and cornea
   (B) central lens and anterior vitreous
   (C) anterior chamber and anterior vitreous
   (D) cornea and posterior vitreous.

4. Blue arcs of the retina are the result of:
   (A) leukocytes circulating in the pre-retinal vasculature
   (B) the presence of a blue-sensitive radial analyser at the macula
   (C) secondary electrical activity in the retina
   (D) branch vein occlusion in the retina.

5. Patients will usually be "entoptically unaware" of cataracts or corneal opacities because:
   (A) under everyday lighting conditions, only posterior opacities in the ocular media cast distinct retinal shadows
   (B) the lenticular halo is only present under darkened conditions, so no retinal shadows will be evident
   (C) corneal oedema causes the corneal halo to become indistinct
   (D) the reduced visual acuity caused by these conditions renders retinal shadows indistinct

6. The colours seen in a lenticular halo are primarily the result of:
   (A) interference
   (B) diffraction at multiple slits (diffraction grating)
   (C) chromatic aberration
   (D) diffraction at a circular aperture.

7. One way to differentiate a lenticular halo from the halo produced by corneal oedema is to:
   (A) use the stenopaic slit test
   (B) view a rotating polarizer through a blue filter
   (C) use the entoptic perimetry test
   (D) view a bright blue background through a reticle that divides the visual field into four segments.

8. A patient reports the perception of vertical streaks of lightning. When she first noticed them, she also became aware of some floaters. This patient most likely has:
   (A) macular oedema
   (B) branch retinal vein occlusion
   (C) vitreous detachment
   (D) retinal detachment

9. Identify the following statement as a requirement for perfect spatial coherence, perfect temporal coherence, or both: "The light source must be a true point source: which does not exist."
   (A) Spatial coherence
   (B) Temporal coherence
   (C) Spatial and temporal coherence.
   (D) Neither.

10. For total destructive interference to occur when two light waves interact, the waves must be:
   (A) 180° out of phase
   (B) Of equal amplitude
   (C) Of equal amplitude and either 90° or 270° out of phase
   (D) Of equal amplitude and 180° out of phase

11. A positive lens produces convergent light from plane incident waves because:
(A) the curvature of the lens front surface is greater than the back surface
(B) refractive index is greater at the center of the lens than the edge
(C) the lens curvature deviates peripheral parts of waves toward the optical axis
(D) the lens has greater central thickness than edge thickness.

12. A virtual image plane corresponds to:
(A) the location toward which light rays are converging after refraction by a lens
(B) the location of a point source to the left of a negative lens
(C) the centre of curvature of waves diverging in image space
(D) the centre of curvature of waves converging toward a lens

13. An optical system has been corrected for all, but one, monochromatic aberration. The system consists of a positive spherical lens and an aperture stop to the right of the lens. For a monochromatic plane object, this system will produce:
(A) Curvature of field
(B) Pincushion distortion
(C) Barrel distortion
(D) Transverse chromatic aberration

14. An ametropic eye is spectacle-corrected for distance vision. As the eye rotates around its center of rotation, a surface is traced out that corresponds to "where the retina is actually focused". This surface is:
(A) the Far point sphere
(B) the tangential image shell
(C) the sagittal image shell
(D) Petzval's surface

15. An ametropic eye is spectacle-corrected for distance vision. As the eye rotates around its centre of rotation, a surface is traced out that corresponds to the location of the image produced by the spectacle lens. This surface is:
(A) the Far point sphere
(B) the tangential image shell
(C) the sagittal image shell
(D) Petzval's surface

16. A spectacle lens will fully correct oblique astigmatism if:
   (A) the tangential and sagittal focal lines coincide
   (B) The spectacle correction has a very high positive power (~ +19 D)
   (C) Petzval's surface is flat (plane)
   (D) Petzval's surface matches the far point sphere

17. Many patients who have had photorefractive keratectomy (PRK) experience a significant glare problem at night. The basis of the glare problem is primarily:
   (A) Spherical aberration
   (B) coma
   (C) oblique astigmatism
   (D) chromatic aberration

18. The main reason that the Rayleigh criterion breaks down for larger pupil diameters is:
   (A) the fact that diffraction ceases to occur when pupil diameter exceeds 3.5 mm
   (B) paraxial defocus
   (C) chromatic aberration
   (D) spherical aberration

19. A broad slit-lamp beam is directed into the eye of a patient with anterior uveitis. "Aqueous flare" is observed due to the presence of numerous aqueous inflammatory cells in the path of the beam. Aqueous flare is a result of:
   (A) Rayleigh scatter
   (B) Mie scatter
   (C) Diffraction
   (D) Veiling glare

20. The Tyndall Effect allows clinicians to detect "aqueous flare" with a broad slit lamp beam, due to the presence of inflammatory cells. It is the result of:
   (A) non-directional Rayleigh scatter in the aqueous humor
   (B) directional Rayleigh scatter in the aqueous humor
   (C) non-directional Mie scatter in the aqueous humor
   (D) directional Mie scatter in the aqueous humor.

21. Transverse chromatic aberration:
   (A) increases with aperture diameter at the same rate as transverse spherical aberration, but at a lower rate than longitudinal spherical aberration
   (B) increases at the same rate with aperture diameter as longitudinal chromatic aberration since both have the same linear dependence on aperture diameter
   (C) increases with aperture diameter, but not as rapidly as longitudinal spherical aberration
   (D) increases with aperture diameter, but at a lower rate than longitudinal chromatic aberration.

22. The aberration that causes variable transverse magnification with incident height is:
   (A) spherical aberration
   (B) coma
   (C) oblique astigmatism
   (D) curvature of field

23. Two light waves have amplitudes of 4 units and 9 units respectively. The relative intensities of the two waves are:
   (A) 64 and 243
   (B) 16 and 81
   (C) 4 and 9
   (D) 2 and 3

24. Monochromatic light of wavelength 415.4 nm in the vitreous (n = 1.336) elicits the maximum sensitivity response from retinal cones under daylight (photopic) conditions. What wavelength in air will elicit the maximum photopic cone response?
   (A) 310.9 nm
   (B) 415.4 nm
   (C) 555.0 nm
   (D) 751.4 nm

25. What is the frequency of light in vitreous (n = 1.336) that elicits the maximum photopic cone response (λ = 415.4 nm)??
   (A) 300 THz (3.00×10^{14}) Hz
   (B) 541 THz (5.41×10^{14}) Hz
   (C) 722 THz (7.22×10^{14}) Hz
   (D) 965 THz (9.65×10^{14}) Hz

26. A virtual image plane corresponds to:

(A) the location toward which light rays are converging after refraction by a lens
(B) the location of a point source to the left of a negative lens
(C) the center of curvature of waves diverging in image space
(D) the center of curvature of waves converging toward a lens

SECTION C. Attempt all questions in this section your answer booklet. (10 MARKS)

1. Enumerate **six** factors that account for inter-subject variability in visual acuity measurement. [6 marks]

2. List **four** phenomena associated with colour sense. Ans. [4 marks}

END OF PAPER