24th Asian Physics Olympiad

Malaysia

Geometry of Water Fountain

Part A: Uniformly Distributed Holes on the Surface of the Hemisphere

A.1

[0.5pt] **Write your working here or on the blank answer page for this question. Working written on the blank draft sheet will not be marked.**

$x(t) =$

$y(t) =$

A.2 $y(x, \theta) =$

[1.0pt]

A.3 $y =$
[3.0pt]

A.3

[cont.]

A.4 $R(\theta) =$
[1.0pt]

A.5

[0.5pt]

Part B: Non-Uniformly Distributed Holes on the Surface of the Hemisphere

B.1 $dA_W =$

[1.0pt]

B.2　　$\rho(\theta) \propto$

[2.0pt]

B.3 $\rho(\theta) \propto$

[1.0pt]

B.3

[cont.]

Question 1 - Extra Answer Page

Additional working for question 1 included here will be marked. If you need more space for question 1, please ask an invigilator for a boxed sheet.

Clearly write which part of the question you are attempting.

Snell's Law

Part A: Light Propagation Through a Semi-Sphere

A.1

[0.5pt] **Write your working here or on the blank answer page for this question. Working written on the blank draft sheet will not be marked.**

Ray _____ propagates faster in the semi-sphere.

A.2   The difference between refractive index of ray *a* and ray *b* in the semi-sphere is _____
[1.0pt]

Part B: Light Propagation Through a Cylindrical Rod

B.1 The incident angle, θ, where light is totally reflected back to the polymer is ___$< \theta <$___.
[2.0pt]

B.2
(i)   _____
[0.6pt]

When the other, open end of the rod is now coated with a thick layer of oil, with refractive index of 1.60.

B.2   When the setup is placed in water,
(ii)   _____
[0.9pt]

Part C: Light Propagation Through an Optical Fibre

C.1 The relationship between the acceptance angle θ_a and refractive indices is _____.
[2.0pt]

C.1

[cont.]

C.2 The new acceptance angle when the bending radius is 1 cm is _____.

[2.6pt]

C.2

[cont.]

C.3 The maximum acceptance angle for case **C.1** is _____,

[0.4pt] and the maximum acceptance angle for case **C.2** is _____.

Question 2 - Extra Answer Page

Additional working for question 2 included here will be marked. If you need more space for question 2, please ask an invigilator for a boxed sheet.

Clearly write which part of the question you are attempting.

The First Discovered Quasar: Unveiling the Mysteries of the Astrophysical Source 3C 273

Part A: Moon's Apparent Motion Against the Background Stars

A.1 [1.3pt]	Write your working here or on the blank answer page for this question. Working written on the blank draft sheet will not be marked.

A.2

[0.5pt]

Part B: Using Lunar Occultations to Precisely Determine Radio Source Positions: The Case of 3C 273

B.1

[0.6pt]

B.2

[0.6pt]

B.3

[0.6pt]

Part C: The Breakthrough Discovery of 3C 273's True Nature

C.1

[0.6pt]

C.2

[0.6pt]

C.3

[0.6pt]

Part D: The Intrinsic Luminosity of the Radio Source 3C 273

D.1
[0.6pt]

D.2

[0.6pt]

D.3

[0.6pt]

Part E: The Power Source of 3C 273

E.1
[0.7pt]

E.2

[0.7pt]

Part F: Modern Observations and the Nature of 3C 273's Components

F.1
[0.7pt]

F.2

[0.7pt]

Question 3 - Extra Answer Page

Additional working for question 3 included here will be marked. If you need more space for question 3, please ask an invigilator for a boxed sheet.

Clearly write which part of the question you are attempting.