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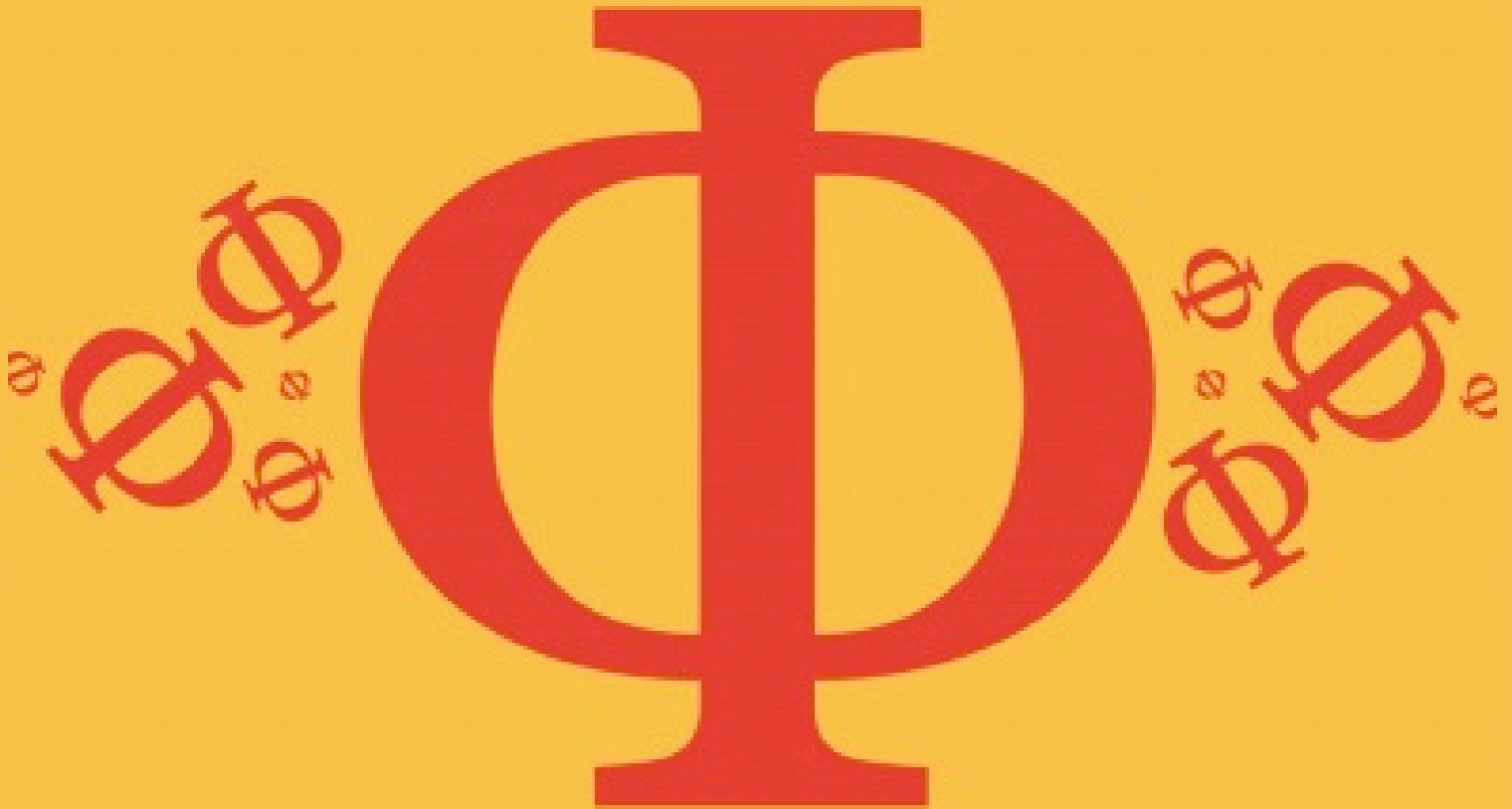Detailed mark scheme

Suitable for all boards

Designed to test your ability and thoroughly prepare you

9.4 Resolution
Medium

Φ

PHYSICS

IB HL

9.4 Resolution

Question Paper

Course	DP IB Physics
Section	9. Wave Phenomena (HL only)
Topic	9.4 Resolution
Difficulty	Medium

Time allowed: 20

Score: /10

Percentage: /100

Question 1

Two galaxies emitting light of wavelength 500 nm are observed through a telescope to have angular separation of 1×10^{-6} rad.

The telescope can just resolve the images of the two galaxies. What is the diameter of the telescope's circular collecting dish?

    A. 0.61 mm

    B. 0.61 m

    C. 0.61×10^{-6} m

    D. 0.61 cm

[1 mark]

Question 2

A diffraction grating can be used to resolve two emission wavelengths from an element in the 2nd order of the spectrum. The wavelengths for a certain element are 400 nm and 500 nm.

How many slits on the diffraction grating are illuminated by the beam?

    A. 2.25 lines

    B. 9.0 lines

    C. 0.25 lines

    D. 4.5 lines

[1 mark]

Question 3

An object to be viewed by a microscope is irradiated with red light.

Which of the following changes would enable two features on the microscope slide to be resolved more clearly?

    A. Use blue light

    B. Decrease the diameter of the lens

    C. Decrease the distance between the microscope lens and the object

    D. Change the lens material without changing the refractive index

[1 mark]

Question 4

An astronomical telescope has a circular collecting dish of diameter 30 cm. It is used to observe two stars that are both emitting electromagnetic radiation of wavelength 3 mm. The images of the stars are just resolved by the telescope.

What angle is subtended by the galaxies at the telescope?

    A. 0.01 rad

    B. 0.122 rad

    C. 0.0122 rad

    D. 0.008 rad

[1 mark]

Question 5

Two car headlights of wavelength λ, have an angular separation of θ, as measured by a person standing a distance d from the car. The radius of the person's pupils is given by r.

Which of the following conditions must be satisfied for the two headlights to be resolved by the person?

    A. $\theta \geq 1.22 \dfrac{\lambda}{r}$

    B. $\theta \geq 1.22 \dfrac{\lambda}{r^2}$

    C. $\theta \geq 0.61 \dfrac{\lambda}{r}$

    D. $\theta \leq 1.22 \dfrac{\lambda}{2r}$

Question 6

Two blue laser beams of identical wavelength pass through a circular aperture. The images of the two sources just fail to be resolved by an observer.

Which change allows for resolution of the images?

    A. Moving the two lasers further from the aperture

    B. Using red light

    C. Decreasing the size of the aperture

    D. Replacing the circular aperture with a narrow slit

[1 mark]

Question 7

A person stands on a cliff at in sunlight with an average wavelength of 600 nm and can just resolve two bushes located on an island in the distance. The distance from the cliff to the island is 2 km. The diameter of the person's pupils is 2.0 mm.

What is the separation of the two bushes?

    A. 3.66×10^{-4} m

    B. 7.32×10^{-4} m

    C. 0.732 m

    D. 366 m

[1 mark]

Question 8

A diffraction grating with 100 lines per mm is used to just resolve two wavelengths of light in the third order spectrum. The beam of light has a width of 0.2 mm. The average of the two wavelengths is 600 nm.

What are the values of two wavelengths of light?

    A. 590 nm and 610 nm

    B. 585 nm and 615 nm

    C. 595 nm and 605 nm

    D. 570 nm and 630 nm

[1 mark]

Question 9

Which one of the following combinations of beam width, *W* and number of lines per mm, *L* will give maximum resolvance?

	W / mm	L / mm^{-1}
A.	3.0	200
B.	4.0	100
C.	1.0	350
D.	1.5	500

[1 mark]

Question 10

A car with two headlights approaches a stationary observer. The light passes through their circular pupils. Under what conditions would the resolution of the two headlights be better?

	Pupil diameter	Frequency of headlights
A.	increased	increased
B.	increased	decreased
C.	decreased	increased
D.	decreased	decreased

[1 mark]