EXAM PAPERS PRACTICE

Boost your performance and confidence with these topic-based exam questions

Practice questions created by actual examiners and assessment experts

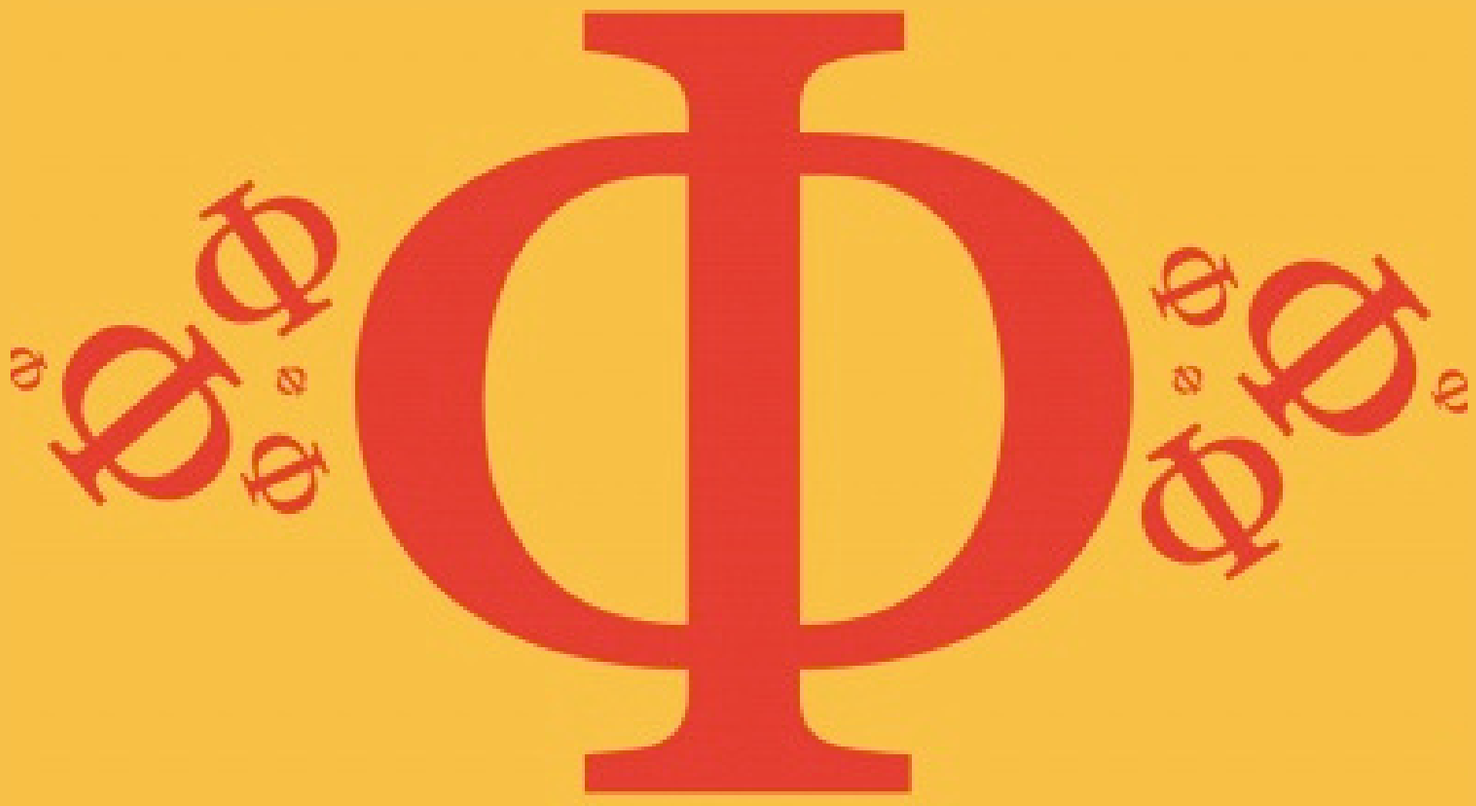
Detailed mark scheme

Suitable for all boards

Designed to test your ability and thoroughly prepare you

9.4 Resolution

Hard



PHYSICS

IB HL

EXAM PAPERS PRACTICE

9.4 Resolution

Question Paper

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

EXAM PAPERS PRACTICE

Time allowed: 20

Score: /10

Percentage: /100

Question 1

The Hubble space telescope has a mirror of diameter 2 m and works with cameras that operate with wavelengths between 100 nm - 1000 nm. It can be pointed at a distant star with an accuracy of of about 4×10^{-8} rad.

What is the theoretical limit of resolution using each of the wavelengths quoted?

	$\lambda = 100$ nm	$\lambda = 1000$ nm
A.	6.1×10^{-6} rad	6.1×10^{-5} rad
B.	1.0×10^{-7} rad	5.7×10^{-7} rad
C.	3.4×10^{-5} rad	4.5×10^{-8} rad
D.	2.1×10^{-8} rad	6.5×10^{-7} rad

[1 mark]

EXAM PAPERS PRACTICE

Question 2

A driver with normal eyesight sees a vehicle approaching in the distance with its headlights on. The road is long and straight, and the sun has just set behind the driver. The driver cannot tell if the approaching vehicle is a car or a motorbike.

What is a fair estimation of the maximum distance between the approaching vehicle and the driver at which the object will become clear?

A. 6 km

B. 8 km

C. 10 km

D. 12 km

[1 mark]

Question 3

The Jodrell Bank radio telescope is used to form images of astronomical objects. However, the telescope's resolving power is less than that of the human eye.

What is a fair estimation of the difference in the resolving power between the Jodrell Bank telescope and the human eye given to the nearest order of magnitude?

A. 10^1

B. 10^2

C. 10^3

D. 10^4

EXAM PAPERS PRACTICE

[1 mark]

Question 4

The Arecibo radio telescope has a diameter of 300 m and detects wavelengths of approximately 8 cm. Astronomers can use it to view the Andromeda galaxy at a distance of 3×10^6 light years from Earth. The Andromeda galaxy has a diameter of 2×10^5 light years. Which is the most likely description of the image of the andromeda galaxy as seen by the astronomers.

A. A single point source

B. A single circular smudge

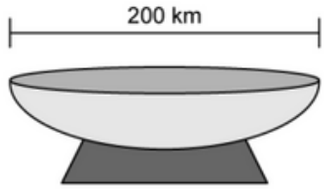
C. An oval smudge

D. A resolved image

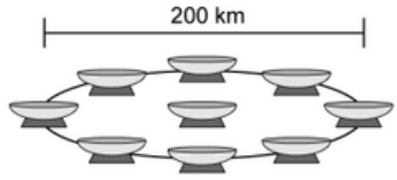
[1 mark]

Question 5

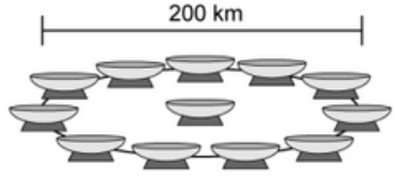
The ability of a telescope to resolve two closely spaced objects is called its resolving power. The diagram below shows two different structures of telescope.



Single paraboloid



An array of 9 parabolic dishes



An array of 12 parabolic dishes

Which structure of telescope has the greatest resolving power?

A. The single paraboloid

B. The array of parabolic dishes containing nine dishes

C. The array of parabolic dishes containing twelve dishes

D. The resolving power of all the structures is the same

EXAM PAPERS PRACTICE

[1 mark]

Question 6

Images like the one below can be used to determine to what extent the human eye can resolve different frequencies of light.

The human eye can detect wavelength between 740 nm and 380 nm represented by the 44 colours in the diagram.

What is the resolving power of the human eye at the following colours?

	Red λ = 740–625 nm	Orange λ = 625–590 nm	Yellow λ = 590–565 nm	Green λ = 565–520 nm
A.	85	72	76	68
B.	68	85	72	76
C.	68	72	85	85
D.	85	76	72	68

[1 mark]

EXAM PAPERS PRACTICE

Question 7

The Hale telescope uses a diffraction grating to resolve objects. A diffraction grating of 10 cm is used containing 200 lines per mm. Assuming the wavelength of incident light to to be 5 μm, what is the resolving power of the telescope?

A. $R = 5 \times 10^7$

B. $R = 2 \times 10^7$

C. $R = 1 \times 10^6$

D. $R = 5 \times 10^6$

[1 mark]

Question 8

A binary star system containing star X and star Y are viewed from Earth and are known to be 5 light years from Earth and 20 AU from one another. What is a fair estimate of the angular separation of the two stars as seen from Earth?

A. 6×10^{-5} rad

B. 6×10^{-4} rad

C. 6×10^{-3} rad

D. 6×10^{-2} rad

[1 mark]

Question 9

On a sunny day, a person stands on a beach looking at two mountains on the horizon.

A person of average height can see approximately 5 km before the curvature of the Earth removes objects from view.

What is a reliable estimate of the minimum distance between the mountains?

A. 1.3 m

B. 1.8 m

C. 2.3 m

D. 2.8 m

EXAM PAPERS PRACTICE

[1 mark]

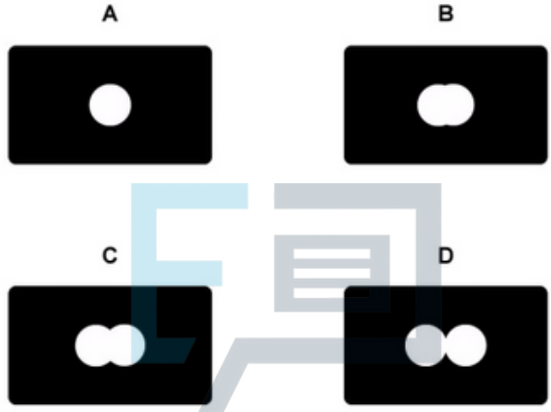
Question 10

The centre of the galaxy S5742–b is 2×10^{10} light years away from the Earth. The black hole at its centre has a mass of 9×10^{50} kg. Its two brightest stars are located on opposite sides of the black hole as viewed from Earth and astronomers are hoping to observe the moment that the stars are pulled in. The Effelsberg 100 m radio telescope is one of several being used to monitor the galaxy. It detects radio waves of wavelengths of approximately 1 m.

The radius of a black hole is given by:

$$R_s = \frac{2GM}{c^2}$$

Which is the most likely image that the Effelsberg telescope is most likely to resolve?



EXAM PAPERS PRACTICE

[1 mark]