

# 12.1 The Interaction of Matter with Radiation

## Question Paper

Course	DIPB Physics
Section	12. Quantum & Nuclear Physics (HL only)
Topic	12.1 The Interaction of Matter with Radiation
Difficulty	Easy

**Time allowed:** 20  
**Score:** /10  
**Percentage:** /100

### Question 1

Which of the following is evidence for the wave nature of electrons?

- A. Electron diffraction from crystals
- B. The photoelectric effect
- C. Continuous energy spectrum in  $\beta^-$  decay
- D. Pair production

[1 mark]

### Question 2

Which of the following experiments provides evidence for the particle nature of light?

- A. Gamma decay
- B. Young's double slit
- C. The photoelectric effect
- D. Electron diffraction

[1 mark]

### Question 3

According to the de Broglie equation, the wavelength of the electron is

- A. directly proportional to the mass of the electron
- B. inversely proportional to the square of the velocity of the electron
- C. directly proportional to the velocity of the electron
- D. inversely proportional to the mass of the electron

[1 mark]

### Question 4

Which expression states the minimum energy of a photon before undergoing pair production?

- A.  $mc^2$
- B.  $2mc^2$
- C.  $\frac{1}{2}mc^2$
- D.  $3mc^2$

[1 mark]

### Question 5

As a consequence of the uncertainty principle, which two quantities cannot be known at the same time?

- A. Energy and momentum
- B. Position and energy
- C. Energy and time
- D. Time and momentum

[1 mark]

### Question 6

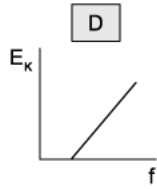
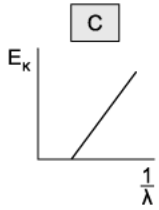
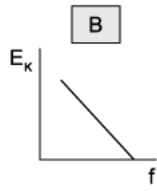
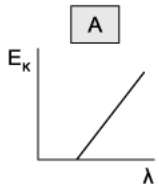
Which of the following statements about quantum tunnelling is incorrect?

- A. Increasing the barrier length decreases the effect of tunnelling probability
- B. The wavefunction can travel through a finite barrier
- C. The probability of finding a particle in a particular region is its wavefunction squared
- D. The wavefunction can travel through an infinite barrier

[1 mark]

### Question 7

Which graph has a gradient equal to  $hc$ ?



### Question 8

Which of the following metals will exhibit the photoelectric effect most readily?

	metal	work function / eV
A	sodium	2.3
B	caesium	2.1
C	calcium	2.9
D	silver	4.3

[1 mark]

[1 mark]

### Question 9

Three statements about the wavefunction are

- I. It is normalised
- II. The square of the wavefunction gives the probability of finding the particle in that region
- III. The wavefunction is equal to 1 outside an infinite square well

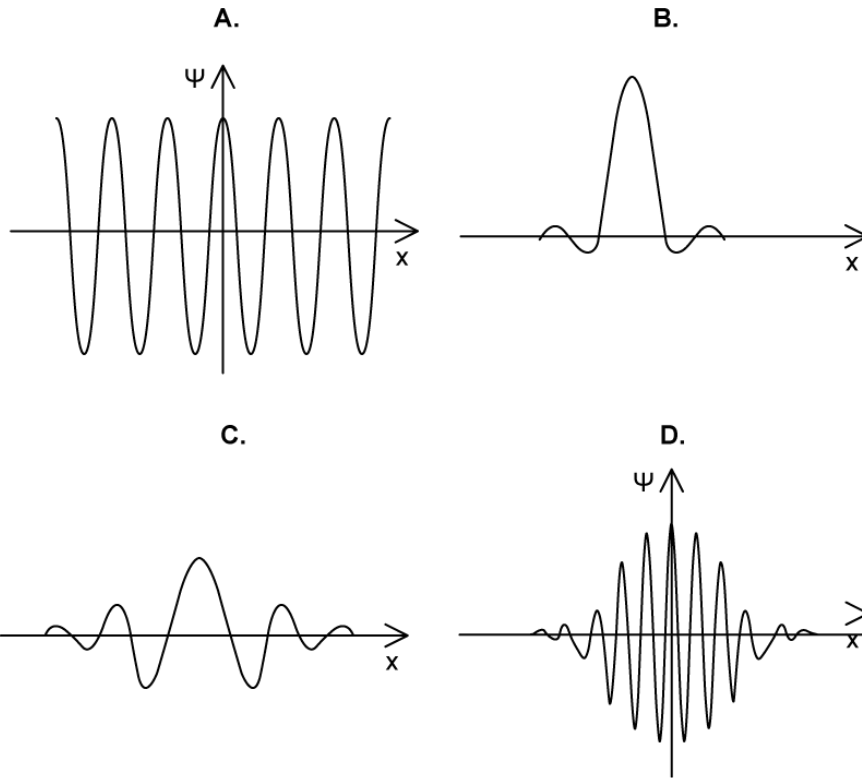
Which of the statement(s) are true?

- A. I and III
- B. I and II
- C. II and III
- D. II only

[1 mark]

### Question 10

Identify the electron with the lowest uncertainty in momentum.



[1 mark]