

## غلاف بنك أسئلة الفيزياء المتقدم



### تم تحميل هذا الملف من موقع المناهج الإماراتية

موقع المناهج ⇨ المناهج الإماراتية ⇨ الصف الثاني عشر المتقدم ⇨ فيزياء ⇨ الفصل الثالث ⇨ ملفات متنوعة ⇨ الملف

تاريخ إضافة الملف على موقع المناهج: 12:10:33 2026-06-07

ملفات اكتب للمعلم اكتب للطالب | اختبارات الكترونية | اختبارات | حلول | عروض بوربوينت | أوراق عمل  
منهج انجليزي | ملخصات وتقارير | مذكرات وبنوك | الامتحان النهائي | للمدرس

المزيد من مادة  
فيزياء:

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### التواصل الاجتماعي بحسب الصف الثاني عشر المتقدم



صفحة المناهج  
الإماراتية على  
فيسبوك

الرياضيات

اللغة الانجليزية

اللغة العربية

التربية الاسلامية

المواد على تلغرام

### المزيد من الملفات بحسب الصف الثاني عشر المتقدم والمادة فيزياء في الفصل الثالث

أهم وحدات القياس والتحويلات في هيكل الفيزياء - بريدج

1

مراجعة الهيكل الوزاري لمادة الفيزياء

2

Physics Inspire - Grade 12 General

3

Physics Inspire Grade 12 General

4

: MODEL SIMULATION FOR THE END-OF-TERM 3 EXAMINATION 2 2025/2026

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وزارة التربية والتعليم  
MINISTRY OF EDUCATION



# Question Bank

## Physics Inspire Grade 12 Advanced

### Third Term of 2025- 2026

احجز مكانك واستعد للامتحان بثقة كاملة

احصل على الشرح الكامل للصف من خلال:

التواصل والحجز عبر الـ Whatsapp  
اضغط على الرقم: 0566410429

للتواصل والحجز



للانتقال إلى المواقع  
اضغط هنا

شرح الدروس



انضم للقناة



NOLOGIA

## يمكنكم الحصول على

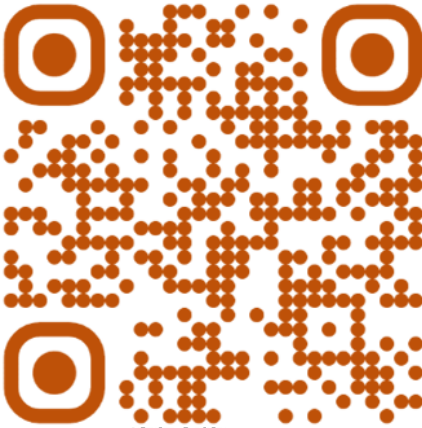
شرح مفصّل  
للدروس كامل

جلسات امتحانية  
مع ملاحظات  
هامة للامتحان

ملزمة محلولة  
بالكامل

ملف يحتوي  
على أهم الأسئلة  
المتوقعة

**بـ 199**  
درهم فقط



لا تتردد في التواصل  
معنا قم بمسح الـ QR

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اضغط على الرقم: 0566410429

## Module 22: QUANTUM THEORY AND THE ATOM

## MCQ

## A Particle Model of Waves

1. Which phenomenon could not be explained by classical electromagnetic wave theory?

- A. Reflection of light.
- B. Diffraction of light.
- C. Emission spectrum.
- D. Polarization of light.

2. Which of the following equations represents the momentum of a photon?

- A.  $E = mc^2$
- B.  $\lambda = \frac{h}{mv}$
- C.  $p = hf$
- D.  $p = h/\lambda$

3. The ..... is the minimum frequency of radiation required in order to eject electrons from a metal.

- |                           |
|---------------------------|
| A. kinetic frequency.     |
| B. photon momentum.       |
| C. de Broglie wavelength. |
| D. threshold frequency.   |

4. As the temperature of an object increases, the frequency at which maximum energy is emitted:

- |                   |
|-------------------|
| A. Decreases.     |
| B. Stay constant. |
| C. Increases.     |
| D. Becomes zero.  |

5. The vibrating object emits energy in the form of light with a frequency of  $5.0 \times 10^{14} \text{ Hz}$ . If the energy is emitted in a single step, find the energy lost by the object.

- |                                      |
|--------------------------------------|
| A. $3.3 \times 10^{-19} \text{ J}$ . |
| B. $3.3 \times 10^{-20} \text{ J}$ . |
| C. $1.3 \times 10^{-19} \text{ J}$ . |
| D. $6.6 \times 10^{-34} \text{ J}$ . |

6. If frequency doubles, the photon energy will:

A. Remain constant.

B. Double.

C. Decrease.

D. Becomes zero.

7. Which radiation carries the highest photon energy?

A. Radio wave.

B. Ultraviolet.

C. Visible red light.

D. Infrared.

8. If an atom changes from energy level  $3hf$  to  $2hf$ , the atom:

A. Absorbs  $5hf$ .

B. Emits  $5hf$ .

C. Absorbs  $hf$ .

D. Emits  $hf$ .

9. Which statement best supports quantum theory?

- |                                            |
|--------------------------------------------|
| A. Light travels as waves only.            |
| B. Energy is emitted in discrete packets.  |
| C. Energy is emitted continuously.         |
| D. Radiation does not depend on frequency. |

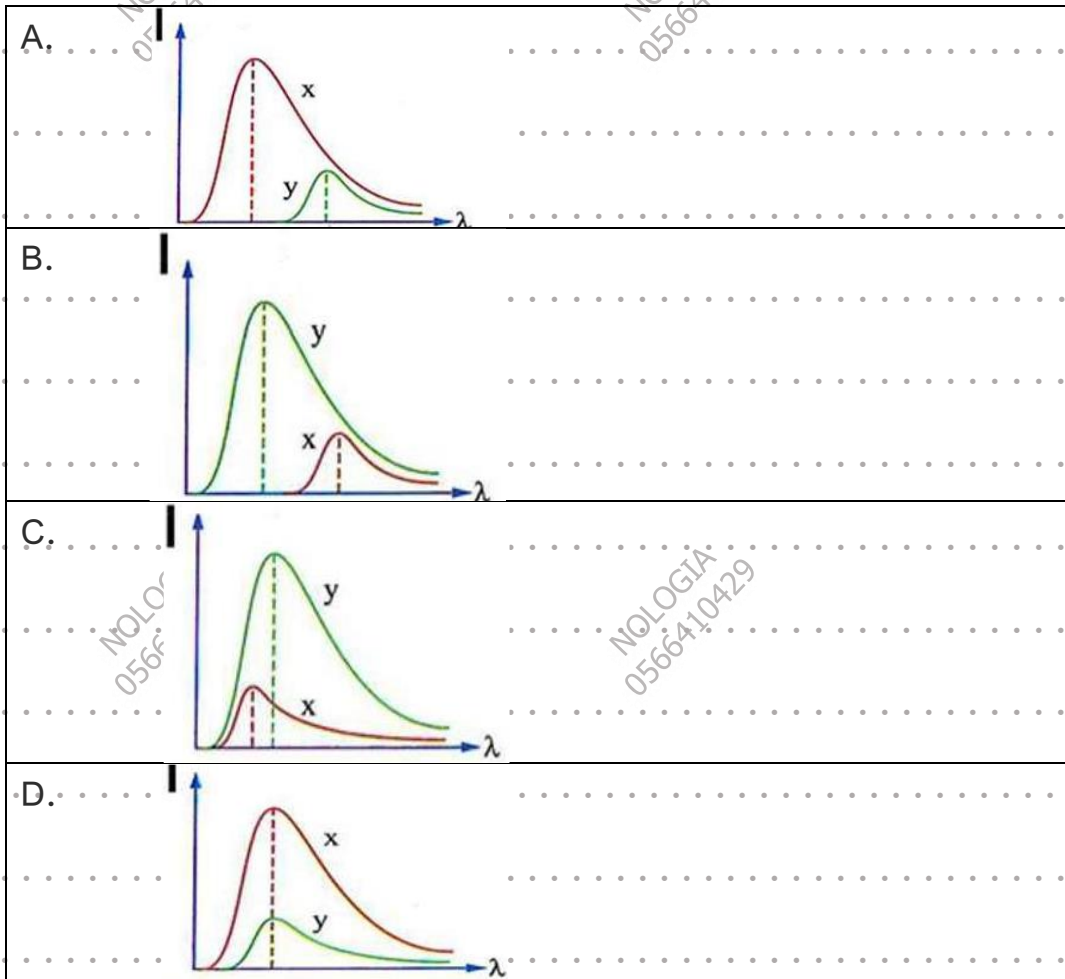
10. The frequency of light beam A is twice that of light beam B. The ratio  $E_A/E_B$  of photon energies is:

- |                    |
|--------------------|
| A. $\frac{1}{2}$ . |
| B. $\frac{1}{4}$ . |
| C. 2.              |
| D. 4.              |

11. If the temperature of an object doubles, what factor changes the energy emitted by the object?

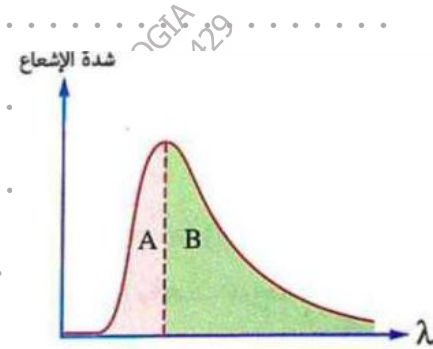
- |        |
|--------|
| A. 16. |
| B. 8.  |
| C. 4.  |
| D. 2.  |

12. Which of the following graphs represents the planck curve for radiation emitted by two identical bodies, x and y, with constant temperature at  $T_x$  and  $T_y$ , where:  $T_x > T_y$



13. The graph opposite represents the planck curve for the radiation of an ideal blackbody. Which of the two regions shown contradicts the principles of classical physics?

- |             |
|-------------|
| A. A.       |
| B. B.       |
| C. Both.    |
| D. Neither. |



14. What is a photon's energy if the photon's wavelength is 515nm?

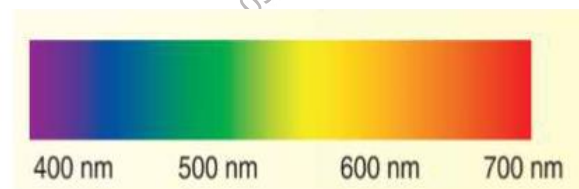
- |                              |
|------------------------------|
| A. $3.85 \times 10^{-19}$ J. |
| B. 2.41 J.                   |
| C. 5 J.                      |
| D. 3.85 J.                   |

15. A photon's energy is 2.03 eV. What is the photon's wavelength?

|                                       |
|---------------------------------------|
| A. $6.11 \times 10^{-7} \text{ m}$ .  |
| B. 611 m.                             |
| C. 6.11 nm.                           |
| D. $6.11 \times 10^{-7} \text{ nm}$ . |

16. The diagram shows the visible light spectrum. What is the range of energies associated with photons in the visible light spectrum?

|                                                        |
|--------------------------------------------------------|
| A. $E = 1.9 \text{ eV} \rightarrow 4.1 \text{ eV}$     |
| B. $E = 1.77 \text{ eV} \rightarrow 3.1 \text{ eV}$    |
| C. $E = 17.7 \text{ eV} \rightarrow 31 \text{ eV}$     |
| D. $E = 0.564 \text{ eV} \rightarrow 0.322 \text{ eV}$ |



17. The energy level of an atom changes when it adsorbs and emits energy.

Which of the following options cannot represent the energy level of an atom?

|                     |
|---------------------|
| A. $3 hf$           |
| B. $2 hf$           |
| C. $hf$             |
| D. $\frac{2}{3} hf$ |

18. The emission of electrons from the surface of a metal when illuminated by a specific light depends on:

|                        |
|------------------------|
| A. Angle of incidence. |
| B. The wavelength.     |
| C. The intensity.      |
| D. The speed of light. |

19. When a light falls on the surface of potassium and photoelectrons are emitted from it, the number of electrons emitted from the potassium surface is directly proportional to:

|                                         |
|-----------------------------------------|
| A. the intensity of the incident light. |
| B. the frequency of the incident light. |
| C. the work function.                   |
| D. the threshold frequency.             |

20. Electromagnetic rays with a wavelength of 510 nm fall on the surface of a metal, releasing electrons with a maximum kinetic energy of 0.297 eV. If other rays with a wavelength of 515 nm fall on the surface of the same metal, the electrons:

- |                                                                      |
|----------------------------------------------------------------------|
| A. are released with a maximum kinetic energy greater than 0.297 eV. |
| B. are released with a maximum kinetic energy equal to 0.297 eV.     |
| C. are released with a maximum kinetic energy less than 0.297 eV.    |
| D. are not released from the surface of the metal.                   |

21. The work function for cesium is 1.95 eV. What is the maximum kinetic energy, in eV, of photoelectrons ejected when 425 nm violet light falls on the cesium?

- |            |
|------------|
| A. 1.60 eV |
| B. 0.97 eV |
| C. 97 eV   |
| D. 3.6 eV  |

22. If light with a photon energy of  $2.9 \text{ eV}$  is shone on three metals, based on the photoelectric effect, which of the following statements is true, given

that:  $\phi_{\text{Calcium}} = 2.9 \text{ eV}$ ,  $\phi_{\text{Cu}} = 4.7 \text{ eV}$ ,  $\phi_{\text{Cesium}} = 2.1 \text{ eV}$

- |                                                            |
|------------------------------------------------------------|
| A. Electrons are released from all three metals.           |
| B. No electrons are released from any of the three metals. |
| C. Only electrons are released from calcium.               |
| D. Electrons are released from both calcium and cesium.    |

23. Light with photon energy of  $2.5 \times 10^{-19} \text{ J}$  falls on a piece of metal, causing photoelectrons with kinetic energy of  $1.92 \times 10^{-20} \text{ J}$  to be emitted.

a. calculate the wavelength of the incident light.

- |                                     |
|-------------------------------------|
| A. $7.96 \times 10^{-7} \text{ nm}$ |
| B. $7.96 \times 10^{-7} \text{ m}$  |
| C. $4.42 \times 10^{-20} \text{ m}$ |
| D. $4.96 \times 10^{-7} \text{ m}$  |

b. calculate the threshold frequency of the metal.

- |                                     |
|-------------------------------------|
| A. $34.8 \times 10^{14} \text{ Hz}$ |
| B. $3.48 \times 10^{14} \text{ Hz}$ |
| C. $3.48 \times 10^{14} \text{ Hz}$ |
| D. $5 \times 10^5 \text{ Hz}$       |

c. calculate the maximum speed of the emitted electrons.

A.  $1.2 \times 10^5 \text{ m/s}$

B.  $2.1 \times 10^5 \text{ m/s}$

C.  $2.1 \times 10^{-5} \text{ m/s}$

D.  $1.2 \times 10^{-5} \text{ m/s}$

24. When a photon collides with an electron, as in Compton effect, the photon:

A. loses some of its energy and its speed decreases.

B. loses some of its energy and its speed increases.

C. loses some of its energy and its speed remains constant.

D. disappears and its energy is transferred to the electron.

25. The Compton effect shows that, compared to an incident photon, a scattered photon has:

A. greater speed.

B. greater frequency.

C. Shorter wavelength.

D. Lower frequency.

26. A photon of electromagnetic radiation with an energy of (24 eV) falls on the surface of a metal. What is the momentum of the incident photon?

|                                       |
|---------------------------------------|
| A. $8.0 \times 10^{-8} \text{ N.s}$   |
| B. $7.81 \times 10^{25} \text{ N.s}$  |
| C. $12.5 \times 10^6 \text{ N.s}$     |
| D. $1.28 \times 10^{-26} \text{ N.s}$ |

## Matter Waves

1. What did de Broglie propose about particles?

|                                             |
|---------------------------------------------|
| A. That they can exhibit wave properties.   |
| B. How to establish their mass.             |
| C. That they are in constant motion.        |
| D. An equation to determine their position. |

2. Why is it that you cannot observe the wave properties of everyday objects?

|                                                 |
|-------------------------------------------------|
| A. Only tiny particles exhibit wave properties. |
| B. The wavelengths are too short.               |
| C. They don't get diffracted.                   |
| D. They travel too slowly.                      |

3. How does shorter-wavelength light or radiation make it easier to determine the exact location of a particle?

- |                                                               |
|---------------------------------------------------------------|
| A. Shorter wavelengths have higher energy.                    |
| B. Shorter wavelengths have fewer photons.                    |
| C. Shorter wavelengths decrease diffraction.                  |
| D. Shorter wavelengths can fit through a diffraction grating. |

4. The Heisenberg uncertainty principle states that it is impossible to measure the \_\_\_\_\_ and \_\_\_\_\_ of a particle at the same time.

- |                          |
|--------------------------|
| A. wavelength, frequency |
| B. mass, velocity        |
| C. position, frequency   |
| D. position, momentum    |

5. How are the de Broglie wavelength and momentum related?

- |                                                    |
|----------------------------------------------------|
| A. They are directly proportional.                 |
| B. They are inversely related.                     |
| C. Wavelength is proportional to momentum squared. |
| D. Momentum is proportional to wavelength squared. |

6. A 7.0-kg bowling ball rolls with a velocity of 8.5 m/s.

a. What is the de Broglie wavelength of the bowling ball?

A.  $1.1 \times 10^{-35}$  m

B.  $11 \times 10^{-35}$  mm

C.  $2 \times 10^{-34}$  m

D.  $1.1 \times 10^{-35}$  cm

b. Why does the bowling ball exhibit no observable wave behaviour?

A. Its velocity is too low to produce a wave.

B. The wavelength is too small to show observable effects.

C. Only charged particles like electrons can exhibit wave properties.

D. The ball's kinetic energy is too high to allow for wave-particle duality.

7. What is the de Broglie wavelength and speed of an electron accelerated by a potential difference of 250 V?

|                             |
|-----------------------------|
| A. $7.7 \times 10^{-11}$ m  |
| B. $7.5 \times 10^{-11}$ m  |
| C. $8.9 \times 10^{-11}$ m  |
| D. $7.7 \times 10^{-11}$ cm |

8. What potential difference is needed to accelerate an electron so it has a 0.125 nm wavelength?

|            |
|------------|
| A. 95.8 V  |
| B. 0.958 V |
| C. 9.58 V  |
| D. 65.4 V  |

9. An electron is accelerated by a potential difference of 75 V, Calculate: . . . . .

a. The speed of the electron

|                           |
|---------------------------|
| A. $5.13 \times 10^5$ m/s |
| B. $6.5 \times 10^3$ m/s  |
| C. $3.4 \times 10^2$ m/s  |
| D. $5.13 \times 10^6$ m/s |

b. The momentum of the electron

|                                 |
|---------------------------------|
| A. $6.4 \times 10^{-24}$ Kg.m/s |
| B. $4.7 \times 10^{-21}$ Kg.m/s |
| C. $5.2 \times 10^{-23}$ Kg.m/s |
| D. $4.7 \times 10^{-24}$ Kg.m/s |

c. What is the de Broglie wavelength of the electron?

A.  $2.4 \times 10^{-9} \text{ m}$

B.  $1.4 \times 10^{-10} \text{ m}$

C.  $3.2 \times 10^{-12} \text{ m}$

D.  $14 \times 10^{-13} \text{ m}$

d. What is the kinetic energy, in eV, of a proton with the same wavelength?

A.  $4.2 \times 10^{-2} \text{ J}$

B.  $4.2 \times 10^{-2} \text{ eV}$

C.  $6.7 \times 10^{-21} \text{ eV}$

D.  $6.7 \times 10^{-22} \text{ J}$

10. An alpha particle (helium nucleus) has a mass of  $6.6 \times 10^{-27}$  Kg and is moving at a speed of 120 m/s. What is this alpha particle's de Broglie wavelength?

A. 0.837 m

B. 0.837 nm

C. 8.95 nm

D. 1.1 m

11. An object has a de Broglie wavelength of  $(2.3 \times 10^{-34}$  m) when its velocity is 45 m/s. What is the mass, in kilograms of the object?

A. 0.65 kg

B. 0.0064 kg

C. 0.064 kg

D. 0.46 kg

12. A hydrogen atom moves at a speed of ( $v$ ) and a de Broglie wavelength of ( $\lambda$ ). Given that the mass of a helium atom is four times that of a hydrogen atom, what is the de Broglie wavelength of the helium atom if it moves at the same speed as the hydrogen atom?

A.  $\lambda/4$

B.  $\lambda$

C.  $2\lambda$

D.  $4\lambda$

13. Two photons, the first with a wavelength of ( $\lambda$ ) and the second with a wavelength of ( $3\lambda$ ). Which of the following is a correct relationship for the momentum of the two photons?

A.  $P_1 = 9 P_2$

B.  $P_1 = P_2$

C.  $P_1 = 1/3 P_2$

D.  $P_1 = 3 P_2$

14. An electron and a proton move at the same speed ( $v$ ). Which of the following is a correct relationship for the de Broglie wavelength?

|                                    |
|------------------------------------|
| A. $\lambda_p = 2 \cdot \lambda_e$ |
| B. $\lambda_p < \lambda_e$         |
| C. $\lambda_p > \lambda_e$         |
| D. $\lambda_p = \lambda_e$         |

## The Bohr Model of the Atom

1. Why is Rutherford's atomic model called the nuclear model?

|                                                                                                    |
|----------------------------------------------------------------------------------------------------|
| A. Because it predicted a dense central core or nucleus.                                           |
| B. Because it determined the mass of a nucleus.                                                    |
| C. Because it predicted a massive positively-charged nucleus with electrons distributed within it. |
| D. Because the alpha particles passed through the gold foil without being deflected.               |

2. What can emission spectra be used to analyze?

|                                                                 |
|-----------------------------------------------------------------|
| A. The wavelengths of a gas.                                    |
| B. The number of electrons in the atom of a particular element. |
| C. The structure of an atom.                                    |
| D. The composition of a mixture of elements.                    |

## 3. What did Bohr theorize about the energy levels of atoms?

- |                                                          |
|----------------------------------------------------------|
| A. That they cannot be measured.                         |
| B. That they cause electrons to spiral into the nucleus. |
| C. That they cause the atom to radiate light.            |
| D. That they are quantized.                              |

## 4. The change in energy of an atom equals the energy of the \_\_\_\_\_.

- |                              |
|------------------------------|
| A. emitted photon.           |
| B. nucleus.                  |
| C. electromagnetic spectrum. |
| D. ground state.             |

## 5. Why does the energy of an atom have a negative value?

- |                                                                    |
|--------------------------------------------------------------------|
| A. Because an atom is normally in its ground state.                |
| B. Due to the effects of electromagnetic radiation.                |
| C. Because work has to be done to remove an electron from an atom. |
| D. Because energy is constantly emitted.                           |

6. Calculate the energy difference between E3 and E2 in the hydrogen atom. . . .

|                       |
|-----------------------|
| A. $-1.89 \text{ eV}$ |
| B. $1.89 \text{ eV}$  |
| C. $3 \text{ eV}$     |
| D. $4.23 \text{ eV}$  |

7. Calculate the energy difference between E4 and E2 in the hydrogen atom. . . .

|                       |
|-----------------------|
| A. $-2.55 \text{ eV}$ |
| B. $2.7 \text{ eV}$   |
| C. $2.55 \text{ eV}$  |
| D. $4.3 \text{ eV}$   |

8. Find the wavelength of the light emitted in Questions 6 and 7.

|                                                                                                |
|------------------------------------------------------------------------------------------------|
| A. $\lambda_{3 \rightarrow 2} = 658 \text{ nm}$ , $\lambda_{4 \rightarrow 2} = 488 \text{ nm}$ |
| B. $\lambda_{3 \rightarrow 2} = 658 \text{ m}$ , $\lambda_{4 \rightarrow 2} = 488 \text{ m}$   |
| C. $\lambda_{3 \rightarrow 2} = 234 \text{ nm}$ , $\lambda_{4 \rightarrow 2} = 864 \text{ nm}$ |
| D. $\lambda_{3 \rightarrow 2} = 1316 \text{ m}$ , $\lambda_{4 \rightarrow 2} = 976 \text{ m}$  |

9. The text shows the solution of the equation  $r_n = \frac{h^2 n^2}{4\pi^2 k m q^2}$  for  $n = 1$ , the innermost orbital radius of the hydrogen atom. Note that with the exception of  $n^2$ , all factors in the equation are constants. The value of  $r_1$  is  $5.3 \times 10^{-11} \text{ m}$ , or  $0.053 \text{ nm}$ . Use this information to calculate the radii of the second, third, and fourth allowable energy levels in the hydrogen atom.

|                                                                                |
|--------------------------------------------------------------------------------|
| A. $r_2 = 0.21 \text{ nm}$ , $r_3 = 0.48 \text{ nm}$ , $r_4 = 0.85 \text{ nm}$ |
| B. $r_2 = 0.21 \text{ m}$ , $r_3 = 0.48 \text{ m}$ , $r_4 = 0.85 \text{ m}$    |
| C. $r_2 = 2.50 \text{ m}$ , $r_3 = 4.51 \text{ m}$ , $r_4 = 6.850 \text{ m}$   |
| D. $r_2 = 0.40 \text{ m}$ , $r_3 = 0.51 \text{ m}$ , $r_4 = 0.850 \text{ m}$   |

10. For a particular transition, the energy of a mercury atom drops from 8.82 eV to 6.67 eV.

a. What is the energy of the photon emitted by the mercury atom?

A. -2.15 eV

B. 2.15 eV

C. 3.55 eV

D. 4.21 eV

b. What is the wavelength of the photon emitted by the mercury atom?

A. 0.578 nm

B. 578 nm

C. 3.55 eV

D. 4.21 eV

11. The ground state of a helium ion is  $-54.4 \text{ eV}$ . A transition to the ground state emits a  $304 \text{ nm}$  photon. What was the energy of the excited state?

A.  $50.3 \text{ eV}$

B.  $-50.3 \text{ eV}$

C.  $33.2 \text{ eV}$

D.  $87.2 \text{ eV}$

12. Hydrogen has been detected transitioning from the  $101^{\text{st}}$  to the  $100^{\text{th}}$  energy levels. What is the radiation's wavelength? Where in the electromagnetic spectrum is this emission?

A.  $4.63 \text{ m}$

B.  $4.63 \text{ cm}$

C.  $3.56 \text{ cm}$

D.  $2.14 \text{ cm}$

13. The nucleus of the hydrogen atom has a radius of about  $1.5 \times 10^{-15}$  m. If you were to build a model of the hydrogen atom using a softball ( $r = 5$  cm) to represent the nucleus, where would you locate an electron in the  $n=1$  Bohr orbit? Would it be in your classroom?

A.  $1.8 \times 10^2$  m

B.  $2.7 \times 10^4$  cm

C.  $1.8 \times 10^5$  cm

D. 40.31 m

## The Quantum Model of the Atom

1. Which physicist extended de Broglie's wave model to create a quantum theory of particles, such as electrons, based on waves?

A. Niels Bohr

B. Erwin Schrödinger

C. Ernest Rutherford

D. Max Planck

2. The region in which there is a high probability of finding an electron is known as the:

|                   |
|-------------------|
| A. Bohr orbit     |
| B. Nucleon shell  |
| C. Electron cloud |
| D. Quantum radius |

3. The study of the properties of matter based on its wave properties is called:

|                               |
|-------------------------------|
| A. Quantum mechanics          |
| B. Classical electromagnetism |
| C. Nuclear dynamics           |
| D. Thermodynamics             |

4. Why is laser light monochromatic?

|                                                  |
|--------------------------------------------------|
| A. because all the light is of one wavelength    |
| B. because the temperature is kept constant      |
| C. because the light is coherent                 |
| D. because it is produced by stimulated emission |

5. For stimulated emission to occur, how long must atoms remain in the excited state?

- |                                          |
|------------------------------------------|
| A. the lifetime of a photon.             |
| B. several days.                         |
| C. one hour or more.                     |
| D. long enough to be struck by a photon. |

6. Gallium arsenide lasers are commonly used in CD players. If such a laser emits at 840 nm, what is the difference in eV between the two lasing energy levels?

- |            |
|------------|
| A. 1.5 eV  |
| B. 2.5 eV  |
| C. 4.21 eV |
| D. 5.01 eV |

7. The lasing energy levels of a laser are separated by 1.96 eV. What wavelength of light does it emit? What color is this light?

A. 242 nm; ultraviolet

B. 420 nm; violet

C. 633 nm; red

D. 845 nm; infrared

8. For stimulated emission to occur, how long must atoms remain in the excited state?

A. the lifetime of a photon.

B. several days.

C. one hour or more.

D. long enough to be struck by a photon.

9. Which is not a use of laser light?

A. measure the movement of Earth's tectonic plates.

B. provide light for reading.

C. check the straightness of long tunnels.

D. transmit electronic communication information.

## Module 24: NUCLEAR AND PARTICLE PHYSICS

### MCQ

#### The Nucleus

1. Three isotopes of uranium have mass numbers of 234, 235, and 238. The atomic number of uranium is 92. How many neutrons are in the nuclei of each of these isotopes?

- |                                             |
|---------------------------------------------|
| A. 142 neutrons, 143 neutrons, 146 neutrons |
| B. 144 neutrons, 145 neutrons, 146 neutrons |
| C. 142 neutrons, 143 neutrons, 145 neutrons |
| D. 142 neutrons, 144 neutrons, 143 neutrons |

2. How many neutrons are in the mercury isotope  $^{200}_{80}\text{Hg}$ ?

- |                 |
|-----------------|
| A. 280 neutrons |
| B. 120 neutrons |
| C. 122 neutrons |
| D. 225 neutrons |

3. An isotope of oxygen has a mass number of 15. How many neutrons are in the nucleus of this isotope?

A. 23 neutrons

B. 7 neutrons

C. 8 neutrons

D. 6 neutrons

4. Write the symbols for the three isotopes of hydrogen that have zero, one, and two neutrons in the nucleus.

A.  ${}^1_1\text{H}$   ${}^2_1\text{H}$   ${}^4_1\text{H}$

B.  ${}^1_1\text{H}$   ${}^2_1\text{H}$   ${}^3_1\text{H}$

C.  ${}^1_1\text{H}$   ${}^3_1\text{H}$   ${}^5_1\text{H}$

D.  ${}^1_1\text{H}$   ${}^2_1\text{H}$   ${}^6_1\text{H}$

Use these values to solve the following problems: mass of hydrogen = 1.007825 u, mass of neutron = 1.008665 u, 1 u = 931.49 MeV:

5. The carbon isotope  ${}^{12}_6\text{C}$  has a mass of 12.0000 u

a. Calculate its mass defect.

A. 0.098940 u

B. -0.098940 u

C. 0.099840 u

D. -0.0098940 u

b. Calculate its binding energy in MeV.

A. 92.161 MeV

B. -92.161 MeV

C. 9.2161 MeV

D. -9.2161 MeV

6. The isotope of hydrogen that contains one proton and one neutron is called deuterium. The mass of the atom is 2.014102 u.

a. What is its mass defect?

A. 0.002388 u

B. - 0.002388 u

C. - 0.02388 u

D. 4.030592 u

b. What is the binding energy of deuterium in MeV?

A: 2.2244 MeV

B. -2.2244 MeV

C. 4.0213 MeV

D. -0.22244 MeV

7. A nitrogen isotope,  $^{15}_7\text{N}$ , has seven protons and eight neutrons. It has a mass of 15.010109 u.

a. Calculate the mass defect of this nucleus.

A: 0.113986 u

B. -0.113986 u

C. 1.13986 u

D. 2.4831 u

b. Calculate the binding energy of the nucleus.

A. 106.18 MeV

B. -106.18 MeV

C. 2.031 MeV

D. -10.618 MeV

8. An oxygen isotope,  $^{16}_8\text{O}$ , has a nuclear mass of 15.994915 u.

a. What is the mass defect of this isotope?

A. 0.137005 u

B. -0.137005 u

C. 13.7005 u

D. 5.3672 u

b. What is the binding energy of its nucleus?

A. +127.62 MeV

B. -127.62 MeV

C. 12.762 MeV

D. -127.62 u

9. Consider these two pairs of nuclei:  $^{12}_6\text{C}$  and  $^{13}_6\text{C}$  and  $^{11}_5\text{B}$  and  $^{11}_6\text{C}$ . In which way are the two alike? In which way are they different?

A. The first pair has the different number of protons

B. The first pair has the same number of nucleons.

C. The second pair has the different number of nucleons

D. The first pair has the same number of protons, but a different number of nucleons. The second pair has the same number of nucleons but a different number of protons.

10. Which of the following quantities identifies the number of protons in a nucleus?

- |                      |
|----------------------|
| A. Mass number.      |
| B. Atomic mass unit. |
| C. Atomic number.    |
| D. Binding energy.   |

11. What is the term for atoms that have the same number of protons but different numbers of neutrons?

- |              |
|--------------|
| A. Nucleons. |
| B. Isotopes. |
| C. Hadrons.  |
| D. Leptons.  |

12. The force that binds the nucleus together despite the electrostatic repulsion between protons is known as the:

- |                           |
|---------------------------|
| A. Weak nuclear force.    |
| B. Electromagnetic force. |
| C. Gravitational force.   |
| D. Strong nuclear force.  |

13. The sum of the number of protons and neutrons in a nucleus is referred to as the:

|                   |
|-------------------|
| A. Mass number.   |
| B. Atomic weight. |
| C. Charge number. |
| D. Isotope index. |

14. What is "mass defect" in the context of nuclear physics?

|                                                                                                                |
|----------------------------------------------------------------------------------------------------------------|
| A. The mass lost during alpha decay.                                                                           |
| B. The total mass of all protons in the nucleus.                                                               |
| C. The difference between the sum of the masses of the individual nucleons and the actual mass of the nucleus. |
| D. The mass of a neutron compared to a proton.                                                                 |

15. Which equation is used to calculate the binding energy (E) equivalent of the mass defect (m)?

|               |
|---------------|
| A. $E = hf$   |
| B. $E = mc^2$ |
| C. $F = Bqv$  |
| D. $V = IR$   |

16. What is the isotopic symbol (the one used in nuclear equations) of a zinc atom composed of 30 protons and 34 neutrons?

|                          |
|--------------------------|
| A. $^{30}_{34}\text{Zn}$ |
| B. $^{34}_{30}\text{Zn}$ |
| C. $^{30}_{64}\text{Zn}$ |
| D. $^{64}_{30}\text{Zn}$ |

17. The sulfur isotope  $^{32}_{16}\text{S}$  has a nuclear mass of 31.97207 u?

a. What is the mass defect of this isotope?

|                |
|----------------|
| A. +32.26384 u |
| B. +0.29177 u  |
| C. -0.29177 u  |
| D. -2.29177 u  |

b. What is the binding energy of its nucleus?

|                |
|----------------|
| A. -271.78 MeV |
| B. +271.78 MeV |
| C. -931.5 MeV  |
| D. +723.23 MeV |

c. What is the binding energy per nucleon?

A.  $+8.494 \text{ MeV/nucleon}$

B.  $+16.9875 \text{ MeV/nucleon}$

C.  $-16.9875 \text{ MeV/nucleon}$

D.  $-8.494 \text{ MeV/nucleon}$

18. The strong nuclear force is:

A. weaker than the electromagnetic force, but has more range.

B. stronger than the electromagnetic force, but has more range.

C. stronger than the electromagnetic force, but has less range.

D. weaker than the electromagnetic force, but has less range.

19. What first started scientists looking for neutrons?

A. neutral particle beams used in the lab.

B. the existence of electrons outside the nucleus.

C. atomic radiation.

D. the mass of the nucleus being larger than the mass of the protons.

20. A nucleus is made of protons and neutrons, each with a mass of 1 u. Why are the masses of many elements as given by the periodic table not whole numbers?

- |                                                                                                                      |
|----------------------------------------------------------------------------------------------------------------------|
| A. The atomic mass is determined from an average sample of the element, which includes naturally occurring isotopes. |
| B. The mass of electrons is accounted for.                                                                           |
| C. The mass given often changes as more accurate measurements are made.                                              |
| D. The nuclides of elements can change over time.                                                                    |

21. What is the energy equivalent of a neutron ( $m = 1.673 \times 10^{-27} \text{ kg}$ ;  $1 \text{ eV} = 1.60 \times 10^{-19} \text{ J}$ )?

- |             |
|-------------|
| A. 241 MeV  |
| B. 2.41 MeV |
| C. 941 MeV  |
| D. 9.41 MeV |

22. The term "nucleon" refers to which particle(s) found in the nucleus?

- |                                      |
|--------------------------------------|
| A. Only protons.                     |
| B. Only neutrons.                    |
| C. Both protons and neutrons.        |
| D. Protons, neutrons, and electrons. |

23. Based on the Binding Energy per Nucleon graph, which element is considered the most stable because it has the highest binding energy per nucleon?

- |                |
|----------------|
| A. Uranium-238 |
| B. Iron-56     |
| C. Helium-4    |
| D. Hydrogen-1  |

## NUCLEAR DECAY AND REACTION

1. Write the nuclear equation for the transmutation of a radioactive radium isotope,  $^{226}_{88}\text{Ra}$ , into a radon isotope,  $^{226}_{86}\text{Rn}$ , by  $\alpha$  decay.

- |                                                                            |
|----------------------------------------------------------------------------|
| A. $^{226}_{88}\text{Ra} \rightarrow ^{226}_{86}\text{Rn} + ^0_{-1}e$      |
| B. $^{226}_{88}\text{Ra} \rightarrow ^{226}_{86}\text{Rn} + ^0_0\bar{\nu}$ |
| C. $^{226}_{88}\text{Ra} \rightarrow ^{226}_{86}\text{Rn} + ^4_2\text{He}$ |
| D. $^{226}_{88}\text{Ra} \rightarrow ^{226}_{86}\text{Rn} + ^4_1\text{He}$ |

2. A radioactive lead isotope,  $^{214}_{82}\text{Pb}$ , can change to a radioactive bismuth isotope,  $^{214}_{83}\text{Bi}$ , by the emission of a  $\alpha$  particle and an antineutrino. Write the nuclear equation.

|                                                                                       |
|---------------------------------------------------------------------------------------|
| A. $^{214}_{82}\text{Pb} \rightarrow ^{214}_{83}\text{Bi} + ^4_2\text{He}$            |
| B. $^{214}_{82}\text{Pb} \rightarrow ^{214}_{83}\text{Bi}$                            |
| C. $^{214}_{82}\text{Pb} \rightarrow ^{214}_{83}\text{Bi} + ^0_{-1}e$                 |
| D. $^{214}_{82}\text{Pb} \rightarrow ^{214}_{83}\text{Bi} + ^0_{-1}e + ^0_0\bar{\nu}$ |

3. Which type of radioactive decay involves the emission of a high-energy photon and does not result in the transmutation of the element?

|                      |
|----------------------|
| A. Alpha decay       |
| B. Beta decay        |
| C. Gamma decay       |
| D. Positron emission |

4. If a nucleus undergoes alpha decay, how do its mass number (A) and atomic number (Z) change?

|                                        |
|----------------------------------------|
| A. A decreases by 2, Z decreases by 4. |
| B. A decreases by 4, Z decreases by 2. |
| C. A remains same, Z increases by 1.   |
| D. A increases by 4, Z increases by 2. |

5. What occurs within the nucleus during beta-minus ( $\beta^-$ ) decay to produce an electron?

- |                                                                     |
|---------------------------------------------------------------------|
| A. A proton turns into a neutron and a positron.                    |
| B. A neutron turns into a proton, an electron, and an antineutrino. |
| C. Two protons and two neutrons are emitted as a package.           |
| D. An electron is captured from the inner shell.                    |

6. The time required for half of the atoms in any given quantity of a radioactive isotope to decay is known as the:

- |                    |
|--------------------|
| A. Decay constant  |
| B. Activity rate   |
| C. Nuclear period. |
| D. Half-life       |

7. Which of the following describes a "chain reaction" in a nuclear context?

- |                                                                                           |
|-------------------------------------------------------------------------------------------|
| A. A series of alpha decays following one after another.                                  |
| B. Electrons moving through a wire to create current.                                     |
| C. Neutrons released by a fissioned nucleus strike other nuclei, causing further fission. |
| D. Two hydrogen nuclei joining together to form helium.                                   |

8. In a nuclear reactor, what is the primary purpose of "control rods" made of materials like cadmium?

- |                                                                   |
|-------------------------------------------------------------------|
| A. To speed up neutrons to increase the reaction rate.            |
| B. To provide the primary fuel for the reactor.                   |
| C. To absorb neutrons and control the rate of the chain reaction. |
| D. To convert thermal energy into electricity.                    |

9. Which process describes the combining of small nuclei to form a larger, more stable nucleus with the release of energy?

- |                          |
|--------------------------|
| A. Nuclear fission       |
| B. Nuclear fusion        |
| C. Radioactive shielding |
| D. Neutron bombardment   |

10. Why is lead a poor choice for a moderator in a nuclear reactor?

- |                                                           |
|-----------------------------------------------------------|
| A. It speeds up neutrons too much.                        |
| B. It absorbs neutrons instead of just slowing them down. |
| C. It is too stable to interact with particles.           |
| D. It melts too easily at reactor temperatures.           |

11. What is the SI unit for "activity," representing the number of decays per second?

A. Becquerel (Bq)

B. Joule (J)

C. Atomic Mass Unit (u)

D. MeV

12. Which statement best explains why fusion is difficult to replicate on Earth?

A. There is no fuel available for fusion

B. Fusion results in extremely dangerous radioactive waste.

C. Fusing nuclei requires extremely high kinetic energy to overcome electrostatic repulsion.

D. Fusion reactions cannot be stopped once they begin.

13. Cobalt-60 has a half-life of 30 years. If you start with a 100-g sample, how much will remain after 90 years?

A. 200

B. 12.5

C. 25

D. 50

14. A radioactive isotope has a half-life of 3.0 days. If the current radiation is 8 times the maximum permissible limit, how many days must workers wait before entering?

A. 10 days

B. 9 days

C. 6 days

D. 13 days

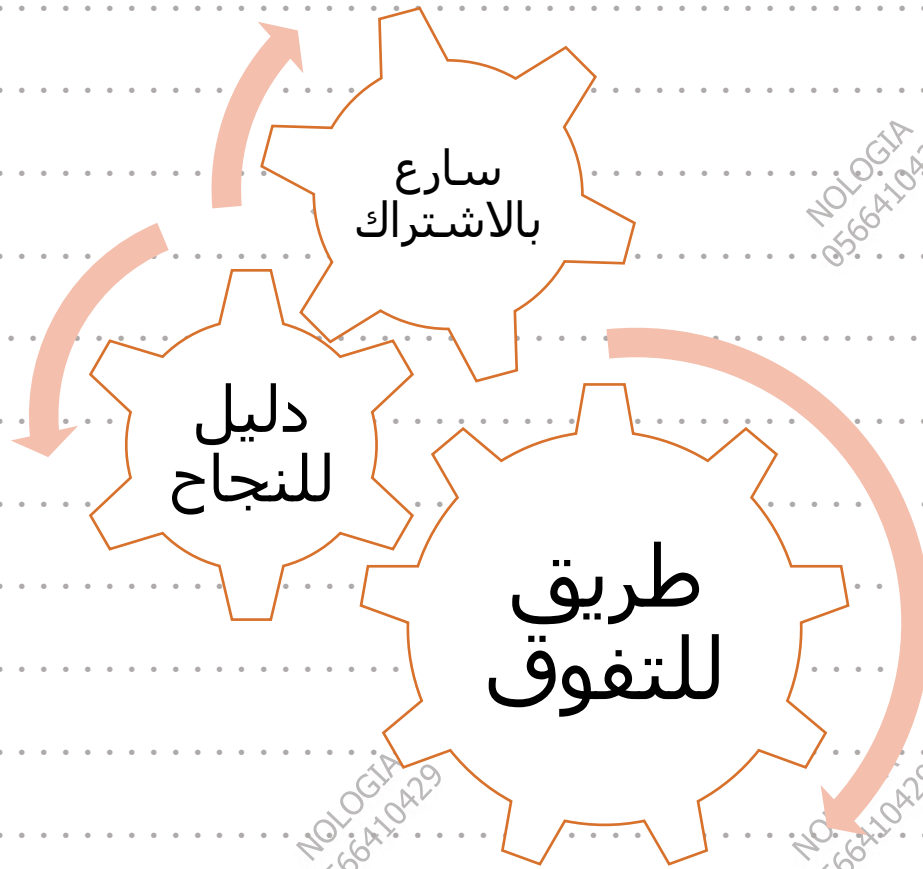
15. In a fission reaction, the total mass of the products is 0.186 u less than the reactants. Calculate the energy released in MeV.

A. -173.26 MeV

B. 173.26 MeV

C. 17.326 MeV

D. 546.32 MeV



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