Question Bank Physics Inspire محلول

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موقع المناهج ⇦ المناهج الإماراتية ⇦ الصف الثاني عشر المتقدم ⇦ فيزياء ⇦ ⇦ ملفات متنوعة ⇦ الملف

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التواصل الاجتماعي بحسب الصف الثاني عشر المتقدم

صفحة المناهج الإماراتية على فيسبوك					
المواد على تلغرام	التربية الاسلامية	اللغة العربية	اللغة الانجليزية	الرياضيات	

المزيد من الملفات بحسب الصف الثاني عشر المتقدم والمادة فيزياء في

1	Question Bank Physics Inspire
2	Question Bank Physics Inspire محلول
3	ملخص الوحدة الأولى: القوى الكهروستاتيكية
4	MODEL SIMULATION FOR THE END-OF-TERM 3 EXAMINATION 2025/2026

وزارة التربية والتعليم
MINISTRY OF EDUCATION

Question Bank

Physics Inspire Grade 12 Advanced

First Term of 2026- 2027

اِحجِزْ مَكانَكَ وَاستَعِدَّ لِلْامتِحَانِ بِثِقَةٍ كَامِلَةٍ

احصل على الشرح الكامل للصف من خلال:

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اضغط على الرقم: 0566410429

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اضغط على الاسم لتحصل على مزيد من الملفات في تلغرام: MR.MOHAMAD

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Mohammed Khresani

يمكنكم الحصول على

شرح مفصّل للدروس كامل

جلسات امتحانية مع ملاحظات هامة للامتحان

ملزمة محلولة بالكامل

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Module 10: ENERGY AND ITS CONSERVATION

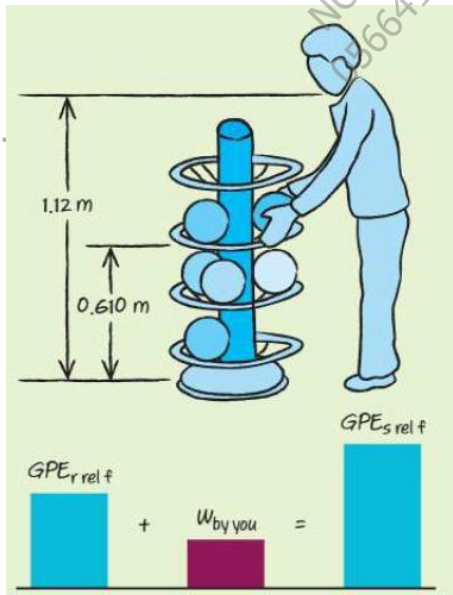
MCQ

The Many Forms Of Energy

1. **GRAVITATIONAL POTENTIAL ENERGY** You lift a 7.30-kg bowling ball from the storage rack and hold it up to your shoulder. The storage rack is 0.610 m above the floor and your shoulder is 1.12 m above the floor.

   a. When the bowling ball is at your shoulder, what is the ball-Earth system's gravitational potential energy relative to the floor?

A. $8.0 \times 10^1 J$
B. $3.6 \times 10^1 J$
C. $5.4 \times 10^1 J$
D. $9.2 \times 10^1 J$



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b. When the bowling ball is at your shoulder, what is the ball-Earth system's gravitational potential energy relative to the rack?

A. $18\ J$
B. $80\ J$
C. $36\ J$
D. $72\ J$

c. How much work was done by gravity as you lifted the ball from the rack to shoulder level?

A. $+36\ J$
B. $-18\ J$
C. $+80\ J$
D. $-36\ J$

2. what is the potential energy of the ball-Earth system when the bowling ball is on the floor? Use the rack as your reference level.

A. $+43.6\ J$
B. $-43.6\ J$
C. $0\ J$
D. $-80.1\ J$

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3. If you slowly lower a 20.0-kg bag of sand 1.20 m from the trunk of a car to the driveway, how much work do you do?

A. $+235\ J$
B. $0\ J$
C. $-235\ J$
D. $-118\ J$

4. A boy lifts a 2.2-kg book from his desk, which is 0.80 m high, to a bookshelf that is 2.10 m high. What is the potential energy of the book-Earth system relative to the desk when the book is on the shelf?

A. $28\ J$
B. $17\ J$
C. $45\ J$
D. $56\ J$

5. You are walking around an old building and notice that it is falling apart. If a 1.8-kg brick falls to the ground from the building's chimney, which is 6.7 m high, what is the change in the potential energy of the brick-Earth system?

A. $+118\ J$
B. $0\ J$
C. $-59\ J$
D. $-118\ J$

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6. **A worker picks up a 10.1-kg box from the floor and sets it on a table that is 1.1 m high. He slides the box 5.0 m along the table and then lowers it back to the floor. What were the changes in the box-Earth system's energy, and how did the system's total energy change? (Ignore friction.)**

A. The change in potential energy is $+109\ J$, and total energy increased
B. The change in potential energy is $+545\ J$, and total energy remained constant
C. The change in potential energy is zero, and the system's total energy did not change
D. The change in potential energy is $-109\ J$, and total energy decreased

7. **Elastic Potential Energy You compress the spring in a jumping toy, then release it. The toy then flies straight up. Draw bar graphs that show the forms of energy present in the following instances. Assume the system includes the spring toy and Earth.**

   a. **The toy is pushed down thereby compressing the spring.**

A. High elastic potential energy, zero kinetic energy, and low gravitational potential energy
B. High kinetic energy and zero elastic potential energy
C. Equal amounts of kinetic and gravitational potential energy
D. Zero energy across all forms

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b. The spring expands and the toy jumps.

A. Only elastic potential energy is present
B. Kinetic energy and gravitational potential energy increase as elastic potential energy decreases
C. All forms of energy drop to zero immediately
D. Only thermal energy is present

c. The toy reaches the top of its flight.

A. High kinetic energy and zero gravitational potential energy
B. High elastic potential energy and zero potential energy
C. Zero kinetic energy, zero elastic potential energy, and maximum gravitational potential energy
D. Equal bars for all three types of energy

d. Describe how energy manifests itself in different ways in this system.

A. Energy only exists as chemical energy inside the plastic toy
B. Energy is completely destroyed once the toy leaves the ground
C. Energy manifests as elastic potential energy, kinetic energy, and gravitational potential energy, transforming from one form to another
D. Energy manifests exclusively as thermal and sound energy

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8. **Potential Energy A 25.0-kg shell is shot from a cannon at Earth's surface. The reference level is Earth's surface.**

a. **What is the shell-Earth system's gravitational potential energy when the shell's height is** $425\ m$?

A. $1.04 \times 10^5\ J$
B. $5.20 \times 10^4\ J$
C. $2.08 \times 10^5\ J$
D. $4.15 \times 10^4\ J$

b. **What is the change in the system's potential energy when the shell falls to a height of** $225\ m$?

A. $+4.90 \times 10^4\ J$
B. $0\ J$
C. $-4.90 \times 10^4\ J$
D. $-1.04 \times 10^5\ J$

c. **What motions and interactions does this system depend on**?

A. It depends solely on the horizontal velocity and wind resistance
B. It depends on the gravitational interaction between the shell and Earth, and the vertical position (height) of the shell
C. It depends entirely on the elastic force of the cannon spring
D. It depends on the internal chemical reactions inside the shell

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9. **Rotational Kinetic Energy On a playground, some children push a merry-go-round so that it turns twice as fast as it did before they pushed it. What are the relative changes in angular momentum and rotational kinetic energy of the merry-go-round?**

A. Angular momentum doubles, and rotational kinetic energy remains unchanged
B. Angular momentum doubles, and rotational kinetic energy increases by a factor of four
C. Angular momentum increases by a factor of four, and rotational kinetic energy doubles
D. Both angular momentum and rotational kinetic energy double

10. **Critical Thinking In the school lab, Karl uses an air hose to exert a constant horizontal force to move a puck a fixed distance on a frictionless air table.**

a. **Explain what happens in terms of work and energy. Draw bar graphs.**

A. The work done is converted entirely into thermal energy due to friction
B. The work done by the constant force on the frictionless table is completely converted into kinetic energy $(W = \Delta KE)$
C. The work done is converted entirely into gravitational potential energy
D. No work is done because the puck moves horizontally

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b. Karl uses a different puck with half the first one's mass. All other conditions remain the same. How do the kinetic energy and work done differ from the kinetic energy and work done in part a?

A. Both work done and kinetic energy are halved
B. Work is doubled, and kinetic energy is quadrupled
C. The work done remains the same, and the final kinetic energy also remains the same because the same work is transferred to the system
D. Work is halved, but kinetic energy remains the same

c. Describe what happened in parts a and b in terms of impulse and momentum.

A. Both cases result in identical velocities and identical times
B. The lighter puck in part b requires a smaller impulse to travel the fixed distance
C. In both cases, the impulse changes the momentum, but the lighter puck in part b reaches a higher final velocity and shorter time while achieving the same final momentum magnitude
D. Momentum is completely conserved and does not change in either case

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11. A 12.0-kg box is lifted from the floor to a shelf 2.50 m high. What is the gravitational potential energy of the box-Earth system relative to the floor?

A. $147\ J$
B. $294\ J$
C. $441\ J$
D. $588\ J$

12. You slowly lower a 15.0-kg crate by 2.00 m from a truck bed to the ground. How much work do you do on the crate?

A. $-147\ J$
B. $+294\ J$
C. $0\ J$
D. $-294\ J$

13. A spring with a spring constant of $k = 400\ N/m$ is compressed by $0.050\ m$. What is the elastic potential energy stored in the spring?

A. $0.50\ J$
B. $1.00\ J$
C. $0.25\ J$
D. $2.00\ J$

14. If the angular velocity of a rotating disk triples (increases by a factor of 3), how does its rotational kinetic energy change?

A. It triples (increases by a factor of 3)
B. It increases by a factor of 6
C. It increases by a factor of nine (9 times)
D. It remains unchanged

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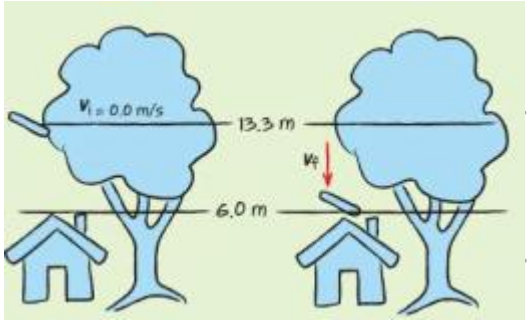
Conservation Of Energy

1. A 22.0-kg tree limb is 13.3 m above the ground. During a tropical storm, it falls on a roof that is 6.0 m above the ground.

   a. Find the kinetic energy of the limb when it reaches the roof. Assume that the air does no work on the tree limb.

A. $8 \times 10^2\ J$
B. $1.6 \times 10^3\ J$
C. $2.4 \times 10^3\ J$
D. $3.2 \times 10^3\ J$



   b. What is the limb's speed when it reaches the roof?

A. $8\frac{m}{s}$
B. $10\frac{m}{s}$
C. $12\frac{m}{s}$
D. $15\frac{m}{s}$

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2. **A bike rider approaches a hill at a speed of 8.5 m/s. The combined mass of the bike and the rider is 85.0 kg. Assuming friction is negligible (isolated system), what is the initial kinetic energy of the system, and to what vertical height will the bike coast before coming to rest?**

A. Initial kinetic energy = $3.1 \times 10^3\ J, Height = 3.7\ m$
B. Initial kinetic energy = $6.1 \times 10^3\ J, Height = 7.4\ m$
C. Initial kinetic energy = $1.5 \times 10^3\ J, Height = 1.8\ m$
D. Initial kinetic energy $3.1 \times 10^3\ J, Height = 5.2\ m$

3. **Suppose that the bike rider in the previous problem pedaled up the hill and never came to a stop. In what system is energy conserved? From what form of energy did the bike gain additional mechanical energy?**

A. System: (bike + Earth); gained mechanical energy from gravitational potential energy.
B. System: (rider + bike + Earth); gained mechanical energy from the biochemical (chemical) energy stored in the rider's body.
C. System: (bike only); gained mechanical energy from rotational kinetic energy.
D. System: (rider + bike); gained mechanical energy from external work done by gravity.

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4. **A skier starts from rest at the top of a hill that is 45.0 m high, skis down a 30° incline into a valley, and continues up a hill that is 40.0 m high (both heights measured from the valley floor). Assuming friction and air resistance are negligible:**

   a. **What is the skier's speed at the bottom of the valley?**

   b. **What is the skier's speed at the top of the second hill?**

   c. **Do the angles of the hills affect these speeds?**

A. Speed at bottom = 29.7 m/s, Speed at second hill = 9.9 m/s, and the angles do affect the results.
B. Speed at bottom = 19.8 m/s, Speed at second hill = 5.4 m/s, and the angles do not affect the results.
C. Speed at bottom = 29.7 m/s, Speed at second hill = 9.9 m/s, and the angles do not affect the results.
D. Speed at bottom = 45.0 m/s, Speed at second hill = 40.0 m/s, and the angles do affect the results.

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5. In a belly-flop diving contest, the winner is the diver who makes the biggest splash upon hitting the water, which depends on the amount of kinetic energy the diver has. Diver 1 has a mass of 136 kg and steps off a 3.00 m platform (free fall). Diver 2 has a mass of 100 kg and leaps upward from the same platform. To what vertical height above the platform must Diver 2 leap so that their impact kinetic energy (splash size) equals that of Diver 1?

A. 0.54 m
B. 1.08 m
C. 1.50 m
D. 2.16 m

6. The spring in a pinball machine exerts an average force of 2 N on a 0.08 kg pinball over 5 cm. As a result, the ball acquires both translational and rotational kinetic energy as it rolls without slipping. What is the linear speed of the ball after leaving the spring? (Note: Use $I = \frac{2}{5}mr^2$ for the solid sphere. If calculating with the printed textbook typo $I = \frac{5}{2}mr^2$, see the secondary value).

A. 0.85 m/s (Value obtained using the printed typo: $I = \frac{5}{2}mr^2$
B. 1.15 m/s
C. 1.34 m/s (Correct scientific value obtained using physical reality: $I = \frac{5}{2}mr^2$
D. 1.79 m/s

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7. An 8.00-g bullet is fired horizontally into a 9.00-kg block of wood on an air table and is embedded in it. After the collision, the block and bullet slide along the frictionless surface together with a speed of 10.0 cm/s. What was the initial speed of the bullet?

A. 10.0 m/s
B. 90.1 m/s
C. 113 m/s
D. $1.13 \times 10^3 m/s$

8. A 91.0-kg hockey player is skating on ice at 5.50 m/s. Another hockey player of equal mass, moving at 8.1 m/s in the same direction, hits him from behind. What are the total momentum (P_i) and total mechanical energy (KE_i) of the system before the collision?

A. $P_i = 1.24 \times 10^3 Kg.\frac{m}{s}$ and $KE_i = 2.18 \times 10^3 J$
B. $P_i = 1.24 \times 10^3 Kg.\frac{m}{s}$ and $KE_i = 4.36 \times 10^3 J$
C. $P_i = 2.48 \times 10^3 Kg.\frac{m}{s}$ and $KE_i = 2.18 \times 10^3 J$
D. $P_i = 5.00 \times 10^3 Kg.\frac{m}{s}$ and $KE_i = 3.25 \times 10^3 J$

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9. If the two hockey players of equal mass (91.0 kg each) slide off together after the collision, what is their final velocity (v_f)?

A. $5.50\frac{m}{s}$
B. $6.15\frac{m}{s}$
C. $6.80\frac{m}{s}$
D. $8.10\frac{m}{s}$

10. How much did the kinetic energy of the two-player system decrease as a result of this inelastic collision?

A. $75.0\ J$
B. $154\ J$
C. $308\ J$
D. $4.21 \times 10^3 J$

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11. **In the challenge problem where a magnetic dart strikes a suspended target and they swing upwards together like a pendulum, which physical quantities are conserved during each stage of the process?**

A. Momentum is conserved during the swing, and mechanical energy is conserved during the collision.
B. Momentum is conserved during the short collision, and mechanical energy is conserved during the swing up.
C. Both momentum and mechanical energy are conserved in both stages.
D. Neither momentum nor mechanical energy are conserved.

12. **A 0.73-kg magnetic target is suspended on a string. A 0.025-kg magnetic dart is shot horizontally and strikes the target head-on. If the dart and target swing up together to a height of 12.0 cm above the initial level, what was the initial velocity of the dart?** $(Use\ g = 9.80 m/s^2)$

A. $1.53 \frac{m}{s}$
B. $23.1 \frac{m}{s}$
C. $46.3 \frac{m}{s}$
D. $92.6 \frac{m}{s}$

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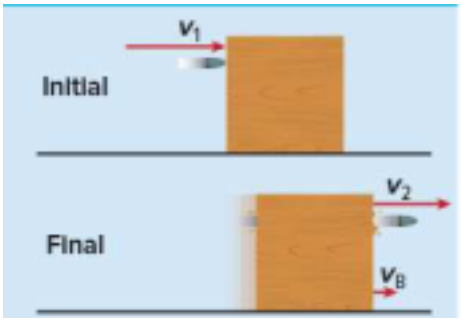
13. A bullet of mass m, moving at speed v_1, goes through a motionless wooden block and exits with speed v_2. After the collision, the block, which has mass m_B, is moving.

a. What is the final speed (v_B) of the block?

A. $\frac{m_B(v_1-v_2)}{m}$
B. $\frac{m(v_1-v_2)}{m_B}$
C. $\frac{m(v_1+v_2)}{m_B}$
D. $\frac{m_B v_1}{m}$



b. What was the change in the bullet's mechanical energy?

A. $\frac{1}{2}m({v_1}^2-{v_2}^2)$
B. $\frac{1}{2}m({v_2}^2-{v_1}^2)$
C. $\frac{1}{2}m_B({v_1}^2-{v_2}^2)$
D. $\frac{1}{2}m(v_1-v_2)^2$

c. How much energy was lost to friction inside the block?

A. $\frac{1}{2}m({v_1}^2-{v_2}^2)$
B. $\frac{1}{2}m_B{v_B}^2$
C. $\frac{1}{2}m({v_1}^2-{v_2}^2)$
D. $\frac{1}{2}(m+m_B(v_1-v_2)^2$

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14. A child jumps up and down on a trampoline. If the system is defined as (child + Earth + trampoline), which of the following correctly describes the primary forms of energy present at the highest point of the jump and the lowest point of the dip?

A. Highest point: maximum kinetic energy (KE); Lowest point: maximum gravitational potential energy (PE_g).
B. Highest point: maximum elastic potential energy (PE_{sp}); Lowest point: maximum kinetic energy (KE).
C. Highest point: maximum gravitational potential energy (PE_g); Lowest point: maximum elastic potential energy (PE_{sp}).
D. Both points have equal amounts of kinetic energy (KE) and thermal energy.

15. Why is energy considered a single quantity in physics, despite manifesting in many different forms (such as kinetic, gravitational, elastic, and thermal)?

A. Because all forms of energy can be converted directly into physical mass.
B. Because any form of energy can be transformed into another, they are all measured in Joules (J), and the total energy of a closed, isolated system remains constant.
C. Because energy can only exist when an object is actively in motion.
D. Because gravitational potential energy is the only true form of energy, and all other forms are temporary.

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16. Suppose a glob of chewing gum and a small rubber ball collide head-on in midair and then rebound apart. Would you expect kinetic energy (KE) to be conserved in this collision? If not, what happens to the energy?

A. Yes, kinetic energy is always conserved in midair collisions.
B. No, kinetic energy is not conserved; some of it is transformed into thermal energy and the work required to deform the chewing gum.
C. No, kinetic energy is not conserved; the lost energy is completely destroyed and disappears from the universe.
D. Yes, because both objects rebound and continue to move after the collision.

17. A rubber ball is dropped from a height of 8.0 m onto a concrete floor and bounces repeatedly. Each time it hits the floor, the ball-Earth system loses $\frac{1}{5}$ (or 20%) of its mechanical energy (ME). How many times will the ball bounce before it rebounds to a maximum height of less than 4.0 m?

A. 2 times
B. 3 times
C. 4 times
D. 5 times

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18. In Figure 27, a 36.0-kg child slides down a playground slide from an initial height of 2.5 m. At the bottom of the slide, she is moving at a speed of 3.0 m/s. How much energy was transformed into thermal energy by friction as she slid down? ($Use\ g = 9.80\ m/s^2$).

A. $162\ J$
B. $720\ J$
C. $882\ J$
D. $1044\ J$

Figure 27

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19. Your friend wants to solve the world's energy problems by inventing a mechanical device that will output ten times more energy than the energy put into it. Can this device work? Explain.

A. Yes, if we use high-efficiency magnetic levitation and superconductors.
B. Yes, because energy conservation laws only apply to astronomical bodies.
C. No, because it violates the Law of Conservation of Energy, which states that energy can neither be created nor destroyed.
D. No, because a device can only output exactly 100% of the input energy, never less.

20. A ball drops from a height of 20 m. When it has fallen halfway down (10 m), half of its energy is potential energy and half is kinetic energy. When the ball has fallen for half the amount of time it takes to reach the ground, will more, less, or exactly half of its total energy be potential energy?

A. Exactly half of the energy will be potential energy.
B. Less than half of the energy will be potential energy.
C. More than half of the energy will be potential energy.
D. The potential energy will be zero.

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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. $p = h/\lambda$

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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 $5.0 \times 10^{14}\ Hz$. If the energy is emitted in a single step, find the energy lost by the object.

A. 3.3×10^{-19} J.
B. 3.3×10^{-20} J.
C. 1.3×10^{-19} J.
D. 6.6×10^{-34} J.

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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 $5\ hf$.
B. Emits $5\ hf$.
C. Absorbs hf.
D. Emits hf.

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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. ½.
B. ¼.
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.

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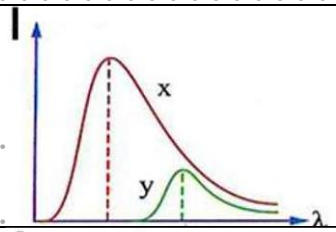
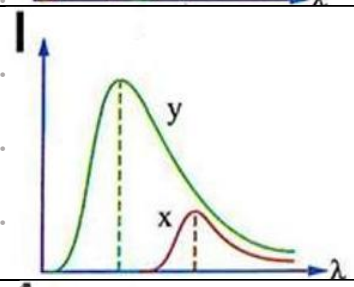
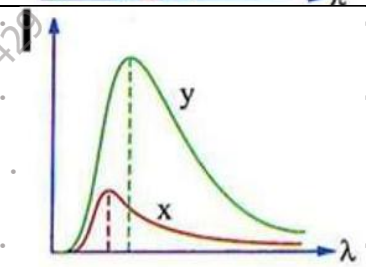
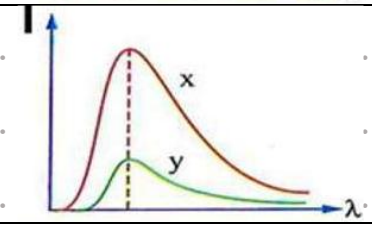
12. Which of the following graphs represents the plank curve for radiation emitted by two identical bodies, x and y, with constant temperature at T_x and T_y, where: $T_x > T_y$

A.


B.


C.


D.


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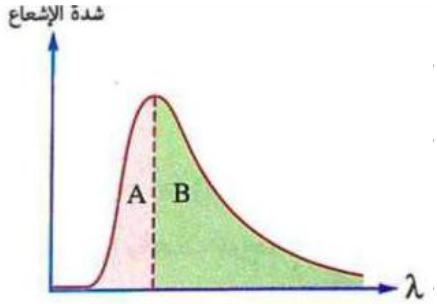
13. The graph opposite represents the plank curve for the radiation of an ideal blackbody. Which of the two regions shown contradicts the principles of classical physics?



A. A.
B. B.
C. Both.
D. Neither.

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

A. 3.85×10^{-19} J.
B. 2.41 J.
C. 5 J.
D. 3.85 J.

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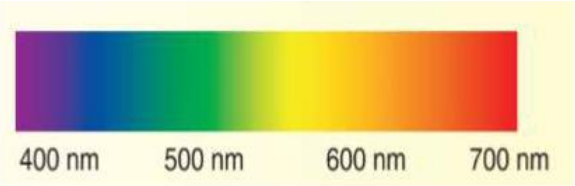
15. A photon's energy is 2.03 eV. What is the photon's wavelength?

A. 6.11×10^{-7} m.
B. 611 m.
C. 6.11 nm.
D. 6.11×10^{-7} 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 eV → 4.1 eV
B. E= 1.77 eV → 3.1 eV
C. E = 17.7 eV → 31 eV
D. E = 0.564 eV → 0.322 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.

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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. $3.6\ eV$

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22. **If light with a photon energy of 2.9 eV is shone on three metals, based on the photoelectric effect, which of the following statements is true, given that:** $\phi_{Calcium} = 2.9\ eV,\ \phi_{Cu} = 4.7\ eV,\ \phi_{Cesium} = 2.1\ eV$

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

a. calculate the wavelength of the incident light.

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

b. calculate the threshold frequency of the metal.

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

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c. calculate the maximum speed of the emitted electrons.

A. $1.2 \times 10^5\ m/s$
B. $2.1 \times 10^5\ m/s$
C. $2.1 \times 10^{-5}\ m/s$
D. $1.2 \times 10^{-5}\ m/s$

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.

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

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.

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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.

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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. 1.1×10^{-35} m
B. 11×10^{-35} mm
C. 2×10^{-34} m
D. 1.1×10^{-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.

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

A. 7.7×10^{-11} m
B. 7.5×10^{-11} m
C. 8.9×10^{-11} m
D. 7.7×10^{-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

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

a. The speed of the electron

A. 5.13×10^{5} m/s
B. 6.5×10^{3} m/s
C. 3.4×10^{2} m/s
D. 5.13×10^{6} m/s

b. The momentum of the electron

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

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

A. 2.4×10^{-9} m
B. 1.4×10^{-10} m
C. 3.2×10^{-12} m
D. 14×10^{-13} m

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

A. 4.2×10^{-2} J
B. 4.2×10^{-2} eV
C. 6.7×10^{-21} eV
D. 6.7×10^{-22} J

10. An alpha particle (helium nucleus) has a mass of 6.6 x 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 x 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

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12. A hydrogen atom moves at a speed of (v) and a de Broglie wavelength of (λ). 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. λ
C. 2λ
D. 4λ

13. Two photons, the first with a wavelength of (λ) and the second with a wavelength of (3λ). 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. $P_1 = 3\ P_2$

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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. $\lambda_p = 2\,\lambda_e$
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.

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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 eV
B. 1.89 eV
C. 3 eV
D. 4.23 eV

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

A. −2.55 eV
B. 2.7 eV
C. 2.55 eV
D. 4.3 eV

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

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

9. The text shows the solution of the equation $r_n = \frac{h^2n^2}{4\pi^2kmq^2}$ 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 5.3×10^{11} m, or 0.053 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 nm,	r_3 = 0.48 nm,	r_4 = 0.85 nm
B. r_2 = 0.21 m,	r_3 = 0.48 m,	r_4 = 0.85 m
C. r_2 = 2.50 m,	r_3 = 4.51 m,	r_4 = 6.850 m
D. r_2 = 0.40 m,	r_3 = 0.51 m,	r_4 = 0.850 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

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

A. 50.3 eV
B. −50.3 eV
C. 33.2 eV
D. 87.2 eV

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

A. 4.63 m
B. 4.63 cm
C. 3.56 cm
D. 2.14 cm

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13. The nucleus of the hydrogen atom has a radius of about 1.5×10^{-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. 1.8×10^{2} m
B. 2.7×10^{4} cm
C. 1.8×10^{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

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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

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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

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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.

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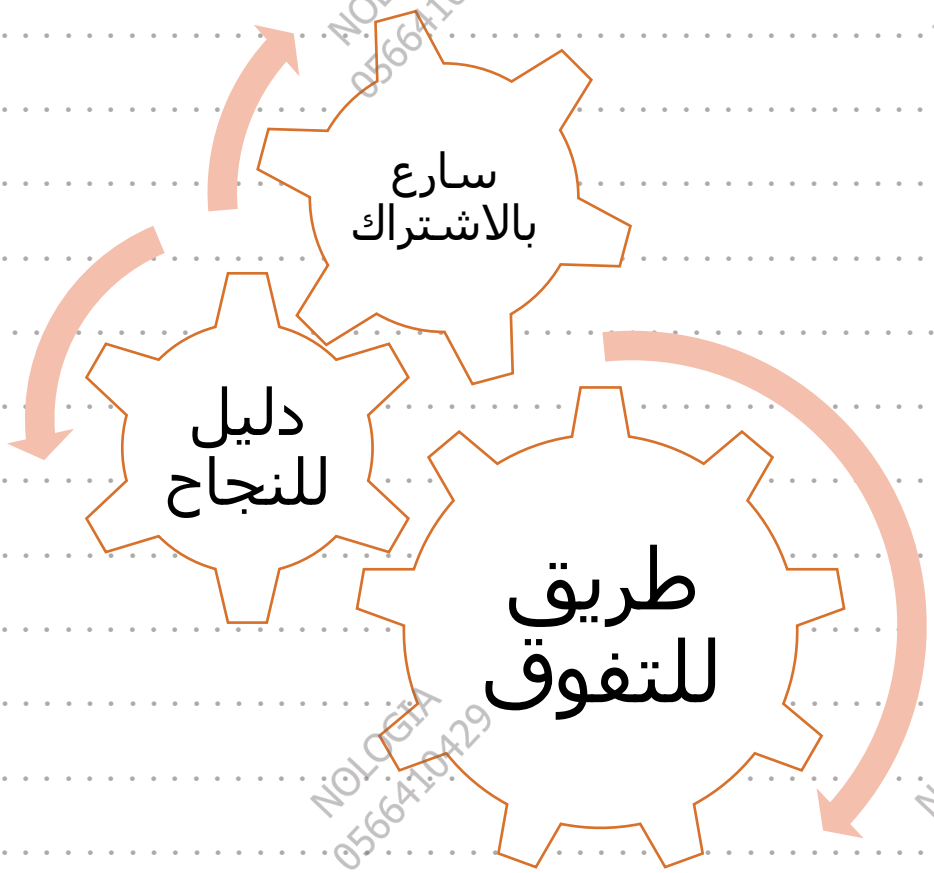

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