Conservation Laws & Particle Interactions

TOPIC QUESTIONS

Level	A Level
Subject	Physics
Exam Board	AQA
Paper Type	Multiple Choice

Time Allowed : 30min

1. The gravitational force is one of the four fundamental forces.
The ticks in the table match particles with the other fundamental forces.

In which row is the particle matched to the only other fundamental forces it experiences?

	Particle	Electromagnetic force	Weak nuclear force	Strong nuclear force
A	μ^+	✓	✓	
B	$\overline{p}$	✓		✓
C	π^0	✓	✓	✓
D	ν_e		✓	✓

2. The proton number of uranium is 92 and the proton number of radon is 88Which series of decays turns a uranium nucleus into a radon nucleus?

A $\alpha + \beta^- + \beta^- + \alpha + \alpha$

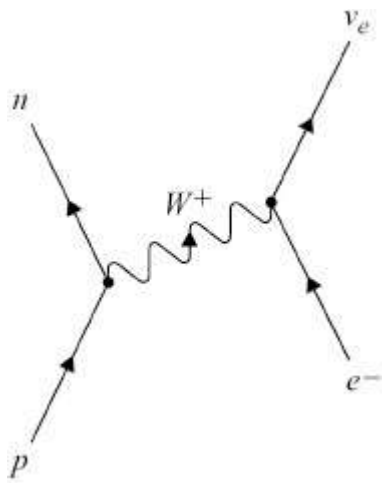
B $\beta^- + \beta^- + \alpha + \beta^- + \alpha$

C $\alpha + \alpha + \alpha + \alpha + \beta^-$

D $\beta^- + \beta^- + \beta^- + \beta^- + \alpha$

3. Which diagram represents electron capture?

A



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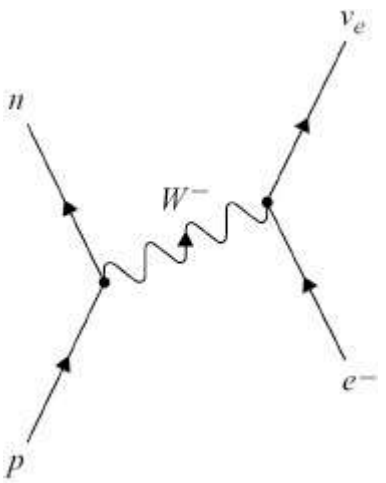

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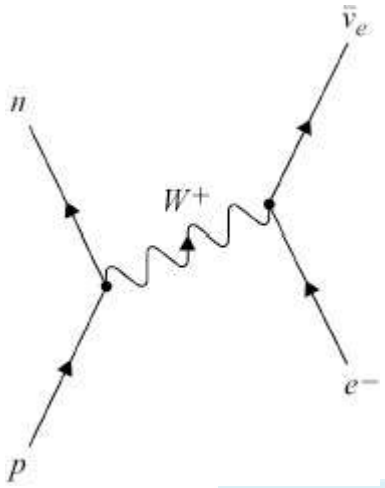

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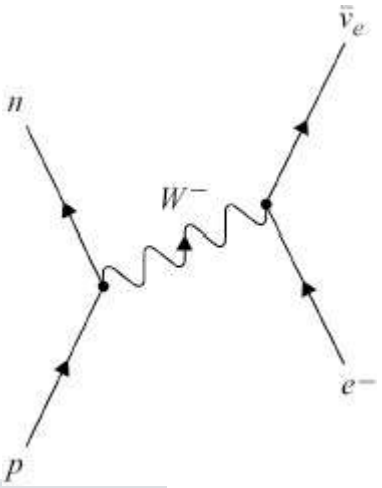


4. ${}^{x}_{81}\mathrm{Tl}$ decays to ${}^{206}_{82}\mathrm{Pb}$ by a series of four radioactive decays.

Each decay involves the emission of either a single α particle or a single β^- particle.What is x?

A 207

B 209

C 210

D 212

5. What is the number of up quarks and down quarks in a ${}^{9}_{4}\mathrm{Be}$ nucleus?

	Number of up quarks	Number of down quarks
A	11	16
B	13	14
C	14	13
D	16	11

6. An electron collides with an isolated atom and raises an orbiting electron to a higher

energy level.Which statement is correct?

A The colliding electron is captured by the nucleus of the atom.

B A photon is emitted when the electron rises to the higher energy level.

C An electron is emitted when the excited electron returns to the ground state.

D Energy is transferred from the colliding electron to the orbiting electron.

7. Photons of wavelength 290 nm are incident on a metal plate. The work function of the metal is
eV

What is the maximum kinetic energy of the emitted electrons?

A 0.19 eV

B 4.3 eV

C 6.9 eV

D 8.4 Ev

8. When light of a certain frequency greater than the threshold frequency of a metal is directed atthe metal, photoelectrons are emitted from the surface.

The power of the light incident on the metal surface is doubled.

Which row shows the effect on the maximum kinetic energy and the number of photoelectronsemitted per second?

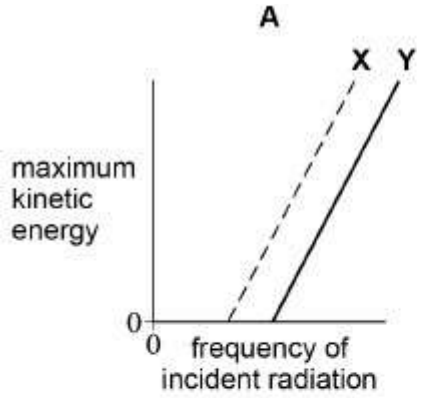
	Maximum kinetic energy	**Number of photoelectrons emitted per second**	
A	remains unchanged	remains unchanged	
B	doubles	remains unchanged	
C	remains unchanged	doubles	
D	doubles	doubles	

9. Line **X** on the graphs below shows how the maximum kinetic energy of emitted

photoelectronsvaries with the frequency of incident radiation for a particular metal.

Which graph shows the results for a metal **Y** that has a higher work function than **X**?

A



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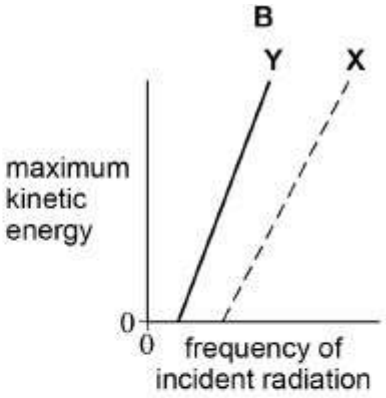

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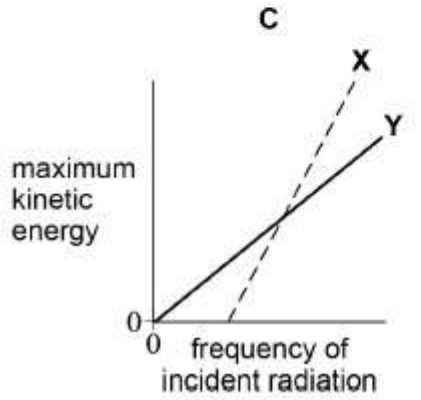

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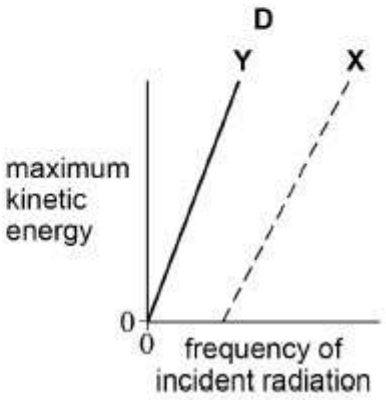


10. In a Young's double slit interference experiment, monochromatic light placed behind a single slit illuminates two narrow slits and the interference pattern is observed on a screen placed some distance away from the slits. Which one of the following **decreases** the separation of the fringes?

A increasing the width of the single slit

B decreasing the separation of the double slits

C increasing the distance between the double slits and the screen

D using monochromatic light of higher frequency

11. Interference fringes, produced by monochromatic light, are viewed on a screen placed a distance D from a double slit system with slit separation s. The distance between the centres of two adjacentfringes (the fringe separation) is w. If both s and D are doubled, what will be the new fringe separation?

A $\frac{w}{4}$

B w

C $2w$

D $4w$

12. Artificial radioactive nuclides are manufactured by placing naturally-occurring nuclides in a nuclearreactor. They are made radioactive in the reactor as a consequence of bombardment by

A α particles.

B β particles.

C protons.

D Neutron

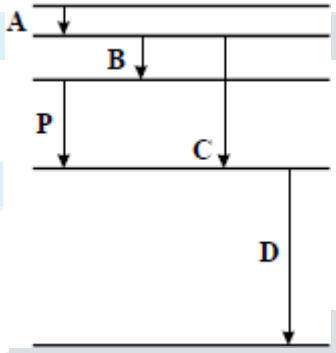
13. In a double slit interference arrangement the fringe spacing is w when the wavelength of the radiation is λ, the distance between the double slits is s and the distance between the slits andthe plane of the observed fringes is D. In which one of the following cases would the fringe spacing also be w?

	wave length	distance between slits	distance betweenslits and fringes
A	2λ	$2s$	$2D$
B	2λ	$4s$	$2D$
C	2λ	$2s$	$4D$
D	4λ	$2s$	$2D$

14. In a Young's double slits interference arrangement the fringe separation is s when the wavelength of the radiation is λ, the slit separation w and the distance between the slits and the plane of theobserved fringes D. In which one of the following cases would the fringe separation also be s?

	wavelength	slit separation	distance between slits and fringes
A	2λ	$2w$	$2D$
B	2λ	$4w$	$2D$
C	2λ	$2w$	$4D$
D	4λ	$2w$	$2D$

15. The diagram **drawn to scale** shows some of the energy levels of an atom. Transition **P** results in the emission of a photon of wavelength 4×10^{-7} m.



Which one of the transitions **A**, **B**, **C**, or **D** could result in the emission of a photon of wavelength 8×10^{-7} m?

16. For which of the following relationships is the quantity y related to the quantity x by the relationship

	x	y
A	energy stored in a spring	extension of the spring
B	gravitational field strength	distance from a point mass
C	de Broglie wavelength of an electron	momentum of the electron
D	period of a mass-spring system	spring constant (stiffness) of the spring

17. The diagram shows some of the energy levels for a hydrogen atom.

0 _____

first excited state _____ -5.4×10^{-19} J

ground state _____ -21.8×10^{-19} J

A free electron of kinetic energy 20.0×10^{-19} J collides with a hydrogen atom in its ground state. The hydrogen atom is excited from its ground state to the first excited state. The kinetic energy ofthe free electron after the collision is

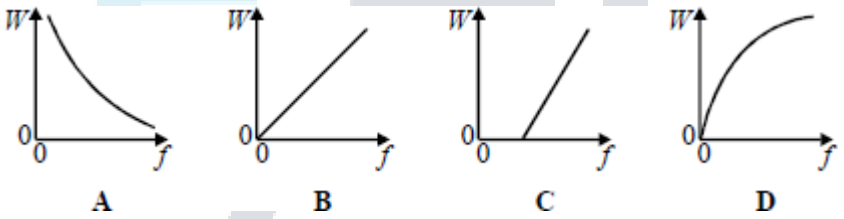
A 1.8×10^{-19} J

B 3.6×10^{-19} J

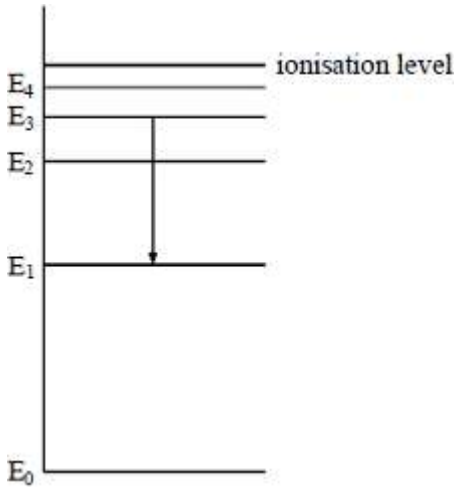
C 5.4×10^{-19} J

D 16.4×10^{-19} J

18. Which one of the graphs best represents the relationship between the energy W of a photon andthe frequency f of the radiation?



19. The diagram shows some energy levels of an atom.



The transition E_3 to E_1 corresponds to the emission of visible light.

A transition corresponding to the emission of infrared radiation could be

A E_1 to E_0

B E_4 to E_1

C E_1 to E_2

D E_3 to E_2

20. An electron initially at rest is accelerated through a potential difference. It is then brought to rest ina collision, and all of its kinetic energy is converted into a single photon of electromagnetic radiation. Which one of the following quantities is **not** required to find a value for the wavelengthof the photon?

A The mass of the electron

B The charge on the electron

C The velocity of electromagnetic waves

D The value of the potential difference