## ULTIMATE KCET CRASH COURSE 2026

## PHYSICS

### Nuclei

**DPP: 1**

**Q1** The nuclei $_6C^{13}$ and $_7N^{14}$ can be described as
(A) isotones
(B) isobars
(C) isotopes of carbon
(D) nitrogen.

**Q2** When a slow neutron is captured by a $(^{92}{}_{235})U$ nucleus, a fission energy releasing 200 MeV. If power of nuclear reactor is 100 W then rate of nuclear fission is
(A) $3.6 \times 10^6\ s^{-1}$
(B) $3.1 \times 10^{12}\ s^{-1}$
(C) $1.8 \times 10^4\ s^{-1}$
(D) $4.1 \times 10^6\ s^{-1}$

**Q3** The Rutherford's $\alpha$-particle experiment shows that most of the $\alpha$-particles pass through almost unscattered while some are scattered through large angles. What information does it give about the structure of the atom?
(A) Alom mostly consists of empty space
(B) The whole muss of the atom is concentrated in a small centre called nucleus.
(C) Nucleus is positively charged.
(D) All of the above.

**Q4** In a fission reaction
$^{236}_{92}U \quad {}^{117}X + {}^{117}Y + n + n$
the binding energy per nucleon of X and Y is 8.5 MeV whereas that of $^{236}U$ is 7.6 MeV. The total energy liberated will be about
(A) 2000 MeV
(B) 200 keV
(C) 2 MeV
(D) 200 MeV

**Q5** The binding energy of nucleus is a measure of its:
(A) Mass
(B) Stability
(C) Charge
(D) Momentum

**Q6** In the reaction: $_{92}U^{234} \quad _{90}Th^{230} + X + Q$; 'X' is
(A) $_1H^2$
(B) $_2He^4$
(C) $_3Li^6$
(D) $_4He^2$

**Q7** Energy released in nuclear fission is due to
(A) Total binding energy of fragments is more than the binding energy of parental element
(B) Total binding energy of fragments is less than the binding energy of parental element
(C) Total binding energy of fragments is equal to the binding energy of parental element
(D) Some mass is converted into energy

**Q8** The end product of decay of $_{90}Th^{232}$ is $_{82}Pb^{208}$. The number of a and b particle emitted are respectively
(A) 6, 4
(B) 4, 6
(C) 3, 3
(D) 6, 0

**Q9** Which reaction is responsible for the production of light energy from the sun?
(A) Nuclear
(B) Fusion
(C) Emission
(D) Fission

**Q10** If radius of the $_{13}Al^{27}$ nucleus is estimated to be 3.6 fermi, then the radius of $_{53}Te^{125}$ nucleus is nearly

(A) 6 fermi. (B) 8 fermi
(C) 4 fermi (D) 5 fermi

**Q11** The mass of a $^{7}_{3}\mathrm{Li}$ nucleus is 0.042 u less than the sum of the masses of all its nucleons. The binding energy per nucleon of $^{7}_{3}\mathrm{Li}$ nucleus is nearly

(A) 46 MeV
(B) 5.6 MeV
(C) 3.9 MeV
(D) 23 MeV

**Q12** A nucleus with mass number *A*=240 and *B.E.* /*A*=7.6 MeV breaks into two fragments each of *A*=120 with *B.E./A*=8.5MeV. Calculate the released energy.

(A) 115 MeV (B) 25 MeV
(C) 150 MeV (D) 216 MeV

**Q13** **Statement I:** The energy equivalence of 0.5 g of a substance is $4.5 \times 10^{13}$ J.
**Statement II:** 1 atomic mass unit is nearly equivalent to 230 MeV energy.

(A) Statement I and Statement II both are correct.
(B) Statement I is correct but Statement II is incorrect.
(C) Statement I is incorrect but Statement II is correct.
(D) Statement I and Statement II both are incorrect

**Q14** A and B are isotopes , B and C are isobars . if $d_A, d_B$ and $d_C$ are the densities of nucleiA,B and C respectively then,

(A) $d_A > d_B > d_C$
(B) $d_A < d_B < d_C$
(C) $d_A = d_B = d_C$
(D) $d_A = d_B < d_C$

**Q15** If the nucleus of $^{27}_{13}\mathrm{Al}$ has a nuclear radius of about $3.6$ fm, then $^{125}_{52}\mathrm{Te}$ would have its radius approximately as

(A) 9.6 fm (B) 12 fm
(C) 4.8 fm (D) 6 fm

**Q16** **A nucleus with mass number 220 initially at rest emits an α-particle. If the Q value of the reaction is 5.5 MeV then the kinetic energy of the α–particle is**

(A) 4.4 MeV (B) 5.4 MeV
(C) 5.6 MeV (D) 6.5 MeV

**Q17** If the binding energy of the deuterium is 2.23 MeV, the mass defect given in a.m.u. is

(A) –0.0024 (B) –0.0012
(C) 0.0012 (D) 0.0024

**Q18** Isotopes have

(A) same number of protons
(B) same number of nucleons
(C) same number of neutrons
(D) same number of positrons

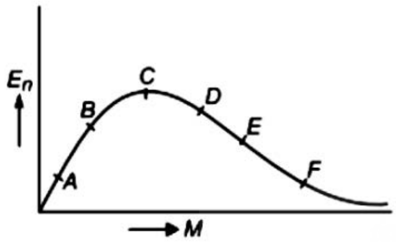
**Q19** Figure shows a plot of binding energy per nucleon $E_n$ against the nuclear mass *M*. *A, B, C, D, E, F* correspond to different nuclei. Consider four reactions:

(i) $A + B \rightarrow C + e$

(ii) $C + A \rightarrow B + e$

(iii) $D + E \rightarrow F + e$

(iv) $F \rightarrow D + E + e$




where $\varepsilon$ is the energy released. In which reaction $\varepsilon$ is positive?

(A) (i) and (iv)

(B) (i) and (iii)

(C) (ii) and (iv)

(D) (ii) and (iii)

**Q20** The binding energy per nucleon is almost constant for many nuclei. It shows that nuclear forces are

(A) charge independent

(B) short range in nature

(C) attractive in nature

(D) saturated in nature

**Q21** One milligram of matter converted into energy, will give

(A) 9 joule

(B) $9 \times 10^3$ joule

(C) $9 \times 10^5$ joule

(D) $9 \times 10^{10}$ joule

**Q22** A nuclear fusion reaction is given below:

$$_1H^2 + {}_1H^2 \rightarrow {}_2He^3 + n + 3.2\,MeV$$

How much energy willbe generated when 2kg of deuterons are fused :

(A) $10^{33}\,eV$

(B) $5 \times 10^{23}\,MeV$

(C) $22^{22}\,MeV$

(D) $10^{30}\,eV$

**Q23** In nuclear reaction, there is conservation of

(A) mass only

(B) energy only

(C) Mementum only

(D) mass, energy and momentum

**Q24** Mass defect of a nucleus is the

(A) difference between mass of proton and mass of neutron

(B) difference between mass of nucleus and mass of electrons

(C) difference between sum of masses of constituent nucleons and mass of electron.

(D) difference between actual mass of nucleus and sum of masses of constituent nucleons.

**Q25** **If the energy released in the fission of one nucleus is 200 MeV, then the number of nuclei required per second in a power plant of 16 kW will be:**

(A) $0.5 \times 10^{14}$

(B) $0.5 \times 10^{12}$

(C) $5 \times 10^{12}$

(D) $5 \times 10^{14}$

**Q26** The volume occupied by an atom is greater than the volume of the nucleus by a factor of about

(A) $10^1$ (B) $10^5$

(C) $10^{10}$ (D) $10^{15}$

**Q27** In Rutherford experiment, for head-on collision of α-particles with a gold nucleus, the impact parameter is

(A) of the order of $10^{-14}$ m

(B) of the order of $10^{-6}$ m

(C) zero

(D) of the order of $10^{-10}$ m

**Q28** The size of nucleus of an atom of mass number  is proportional to

(A) $A^{3/4}$ (B) $A^{2/3}$

(C) $A^{1/3}$ (D) $A^{5/3}$

**Q29** $^{228}_{92}$ U first emits an α-particle and then a β-particle. The resultant nuclei will have mass number A and atomic number Z. The values of A and Z are

(A) 234,91 (B) 234,92

(C) 234,93 (D) 234,94

**Q30** Mass numbers of two nuclei are in the ratio of 4: 3. Their nuclear densities will be in the ratio of

(A) 4: 3 (B) $\left(\frac{3}{4}\right)^{\frac{1}{3}}$

(C) 1: 1 (D) $\left(\frac{4}{3}\right)^{\frac{1}{3}}$

**Q31** The mass number of a nucleus is:

(A) always less than its atomic number

(B) always more than its atomic number

(C) always equal to its atomic number

(D) sometimes more than and sometimes equal to its atomic number

# Answer Key

| | |
|---|---|
| Q1 | A |
| Q2 | B |
| Q3 | D |
| Q4 | D |
| Q5 | B |
| Q6 | B |
| Q7 | A |
| Q8 | A |
| Q9 | B |
| Q10 | A |
| Q11 | B |
| Q12 | D |
| Q13 | B |
| Q14 | C |
| Q15 | D |
| Q16 | B |
| Q17 | D |
| Q18 | A |
| Q19 | A |
| Q20 | D |
| Q21 | D |
| Q22 | A |
| Q23 | D |
| Q24 | D |
| Q25 | D |
| Q26 | D |
| Q27 | C |
| Q28 | C |
| Q29 | A |
| Q30 | C |
| Q31 | B |

# Hints & Solutions

Note: scan the QR code to watch video solution

**Q1 Text Solution:**

Nuclei $_6C^{13}$ and $_7N^{14}$ are isotones as they have same number of neutrons.

**Video Solution:**

**Q2 Text Solution:**

Number of fission per second

$= \frac{\text{total power}}{\text{energy/fission}}.$

Here, total power = 100 W

Energy/fission

$= 200 MeV = 200 \times 10^6 \times 1.6 \times 10^{-19} J$

fission rate $= \frac{100}{3.2\times10^{-11}} = 3.1510^{12} s^{-1}$

**Video Solution:**

**Q3 Text Solution:**

All of the above options are correct about structure of atom

**Video Solution:**

**Q4 Text Solution:**

(d) 200 MeV

Explanation:

Energy released

= B.E. (X) + B.E. (Y)- B.E. (U)

= 8.5 × 117 + 8.5 × 117 - 236 × 7.6

= 994.5 + 994.5 - 1793.6

= 195.4 MeV ≈ 200 MeV

**Video Solution:**

**Q5 Text Solution:**

stability

**Video Solution:**

**Q6 Text Solution:**

By L.C Charge

L.C. Mass

$X \rightarrow_2 He^4$

**Video Solution:**

**Q7 Text Solution:**

Total binding energy of garments is more than the binding energy of parental element

**Video Solution:**

**Q8 Text Solution:**

$_{90}Th^{232} \rightarrow _{82}Pb^{208}$

Hence Mass number changes by 24 this implies 6 $\alpha$ particles are emitted as 1 $\alpha$ particle emitted decreases mass number by 4, then proton number should decrease by 12, but change in proton number is by 8 only, this implies 4 $\beta$ particles have been emitted.

**Video Solution:**

**Q9 Video Solution:**

**Q10 Text Solution:**

We know that,

$R = R_0 A^{1/3}$

Nor for Al, $\mathrm{R} = \mathrm{R}_0 (27)^{1/3}$

For Te $\mathrm{R}' = \mathrm{R}_0 (125)^{1/3}$

After solving the both above equation,

We got, $R' = 6\ fermi.$

**Video Solution:**

**Q11 Text Solution:**

For $_3^7\mathrm{Li}$ nucleus,

Mass defect, $\Delta M = 0.042\mathrm{u}$

$\because\ 1\mathrm{u} = 931.5\mathrm{MeV/c^2}$

$\therefore\ \Delta M = 0.042 \times 931.5\mathrm{MeV}/c^2 = 39.1\mathrm{MeV/c^2}$

binding

energy $E_b = \Delta M c^2$

$= \left(39.1 \frac{\mathrm{MeV}}{c^2}\right) c^2 = 39.1\mathrm{MeV}$

Binding energy per nucleon,

$E_{bn} = \frac{E_b}{A} = \frac{39.1\mathrm{MeV}}{7} \approx 5.6\mathrm{MeV}$

**Video Solution:**

**Q12 Text Solution:**

For a big nucleus, $A$ = 240 $BE/A$=7.6$MeV$

Initial binding energy = 240 × 7.6 = 1824$MeV$

For two small nuclei, $A$ = 120 $BE/A$ = 8.5$MeV$

Final binding energy = 2 × 120 × 8.5 = 2040$MeV$

Energy released during fission

= (Final B.E.) – (Initial B.E.)

= 2040 – 1824 = 216MeV

**Video Solution:**

**Q13 Video Solution:**

**Q14 Text Solution:**

All nuclei have same density.

**Video Solution:**

**Q15 Text Solution:**

$$\frac{R_2}{R_1} = \left(\frac{125}{27}\right)^{\frac{1}{3}} = \frac{5}{3}$$

**Video Solution:**

**Q16 Text Solution:**

$$K_a = \left(\frac{A-4}{A}\right)Q = \frac{216}{220} \times 5.5 = 5.4MeV$$

**Video Solution:**

**Q17 Text Solution:**

$$\Delta m = \frac{2.23}{931} \cong 0.0024amu$$

**Video Solution:**

**Q18 Text Solution:**

Isotopes are atoms of same element having same atomic number which means same number of protons.

**Video Solution:**

**Q19 Text Solution:**

Fusion of lighter nuclei to form heavy nucleus and fission of heavier nuclei into lighter nuclei release energy.

**Video Solution:**

**Q20 Text Solution:**

(d) saturated in nature Explanation: saturated in nature

**Video Solution:**

**Q21 Text Solution:**

$E = mC^2$

**Video Solution:**

**Q22 Text Solution:**

For 2 atoms of deutrons energy released 3.2 MeV

$2 \text{ kg deutrons } = \frac{2\times10^3}{2} = 10^3 \text{ moles}$

$= 10^3 \times N_A \ atoms$

$= 6.23 \times 10^{23} 0 + 10^3 \ atoms$

$2 atoms = 3.2 MeV$

$1 \ atom = \frac{3.2}{2} MeV$

$So, \ 6.23 \times 10^{23} = \frac{3.2}{2} \times 6.23 \times 10^{26} MeV$

$= 9.968 \times 10^{26} \times 10^6 eV$

$= 9.968 \times 10^{32} eV$

$= 10 \times 10^{32} eV$

$= 10^{33} eV$

**Video Solution:**

**Q23 Text Solution:**

mass, energy and momentum

**Video Solution:**

**Q24 Text Solution:**

difference between actual mass of nucleus and sum of masses of constituent nucleons.

**Video Solution:**

**Q25 Text Solution:**

Energy release is the fission of one nucleus = 200MeV

$200 \times 1.6 \times 10^{-19} \times 10^6 \ J = 3.2 \times 10^{-11} \ J$

$P = 16 \ kW = 16 \times 10^3 \text{ watt}$

Now, number of nuclei required per second.

$n = \frac{P}{E} = \frac{16\times10^3}{3.2\times10^{-11}} = 5 \times 10^{14}$

**Video Solution:**

**Q26** **Text Solution:**

$V_{atom} = 10^{15}\ V_{nucleus}$

**Video Solution:**

**Q27** **Text Solution:**

For Head collision *b* = 0

**Video Solution:**

**Q28** **Text Solution:**

We know that-

Volume×density=mass , Volume of sphere = $\frac{4}{3}\pi R^3$

So $\frac{4}{3}\pi R^3 \times \rho = M$

M= mass of proton ×A

$R^3$ A

So Nuclear radius is proportional to $A^{\frac{1}{3}}$,

where A is the mass number of nucleus,

$R \propto A^{\frac{1}{3}}$

**Video Solution:**

**Q29** **Text Solution:**

When the nucleus emits an $\alpha$ particle, it loses $2$ protons and $2$ neutrons. This means that the atomic number has been reduced by $2$. The release of $\alpha$ particle a reduces the atomic number by $2$ and the mass number by $4$, whereas in the release of $\beta$ particle, the atomic number an increases by one without changing the mass number. As a result, the final product will have a mass number A of $234$ and an atomic number Z of $91$.

**Video Solution:**

**Q30** **Text Solution:**

Radius of nucleus, $R = R_0 A^{1/3}$

$\rho = \frac{\text{mass}}{\text{Volume}} = \frac{mA}{\frac{4}{3}\pi R^3} = \frac{mA}{\frac{4}{3}\pi R_0^3 A}$

⇒ Density is independent of mass number

**Video Solution:**

**Q31** **Text Solution:**

In hydrogen, atomic number and mass number are equal.

**Video Solution:**