Particle Physics

Question Paper

Level	A Level
Subject	Physics
Exam Board	Edexcel
Topic	Nuclear & Particle Physics
Sub Topic	Particle Physics
Booklet	Question Paper
Paper Type	Multiple Choice

Time Allowed: **39 minutes**

Score: **/32**

Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	777.5%	70%	62.5%	57.5%	45%	<45%

1 Which of the following is **not** a unit of mass?

☒ **A** u

☒ **B** MeV

☒ **C** MeV/c^2

☒ **D** $N\ m^{-1}\ s^2$

(Total for Question = 1 mark)

2 The number of neutrons in a nucleus of $^{238}_{92}U$ is

☒ **A** 92

☒ **B** 146

☒ **C** 238

☒ **D** 330

(Total for Question = 1 mark)

3 Which of the following is **not** a valid conclusion from Rutherford's alpha scattering experiment?

☒ **A** The nucleus is charged.

☒ **B** The nucleus contains neutrons and protons.

☒ **C** The nucleus contains most of the mass of the atom.

☒ **D** The nucleus must be very small compared to the atom.

(Total for Question = 1 mark)

4 The equation $\Delta E = c^2 \Delta m$ can be used with data at the back of this paper to calculate

☒ **A** the kinetic energy of an electron.

☒ **B** the energy produced when a lambda particle decays.

☒ **C** the energy of the photons produced when a proton and an antiproton annihilate.

☒ **D** the mass of uranium that produces 50 MJ of energy in a nuclear reactor.

(Total for Question = 1 mark)

5 A radioactive isotope of aluminium is $^{25}_{13}\text{Al}$

Select the row in the table that correctly identifies a neutral atom of this isotope.

	Neutrons	Protons	Electrons
☒ **A**	12	13	12
☒ **B**	13	12	13
☒ **C**	13	12	12
☒ **D**	12	13	13

(Total for Question = 1 mark)

6 An alpha particle moves at right angles to a uniform magnetic field and experiences a force F. A beta particle moves at right angles to a magnetic field of half the magnetic flux density but at ten times the velocity of the alpha particle.
The magnitude of the force on the beta particle will be

☒ **A** 0.25 F

☒ **B** 0.40 F

☒ **C** 2.5 F

☒ **D** 5.0 F

(Total for Question = 1 mark)

7 The nucleus of one of the isotopes of nickel is represented by $^{60}_{28}Ni$.

Which line correctly identifies a neutral atom of this isotope?

	Number of protons	Number of neutrons	Number of electrons
☒ **A**	28	32	28
☒ **B**	28	32	32
☒ **C**	28	60	28
☒ **D**	60	28	28

(Total for Question = 1 mark)

8 $^{208}_{82}Pb$ is the symbol for the heaviest, stable nucleus. The table shows possible numbers of neutrons and protons.

Which line of the table correctly shows the numbers of neutrons and protons for this nucleus?

	Number of neutrons	Number of protons
☒ **A**	82	208
☒ **B**	82	126
☒ **C**	126	82
☒ **D**	208	82

(Total for Question = 1 mark)

9 Which one of the following statements does **not** help to explain why electrons can be used to probe the nuclei of atoms.

☒ **A** Electrons are negatively charged.

☒ **B** Electrons can have wavelengths similar in size to nuclear diameters.

☒ **C** Electrons can be accelerated to high energies.

☒ **D** Electrons can exhibit diffraction effects.

(Total for Question = 1 mark)

10 As a particle accelerates in a linac, it passes through drift tubes of increasing lengths. This is so that

☒ **A** the particle can be given more energy within each tube.

☒ **B** the frequency of the accelerating voltage can be constant.

☒ **C** the accelerating voltage can be as high as possible.

☒ **D** the time spent in the tube by the particle is longer.

(Total for Question = 1 mark)

11 When one system is driven into oscillation by another, the driven system

☒ **A** exhibits resonance.

☒ **B** has a large increase in amplitude.

☒ **C** vibrates at its natural frequency.

☒ **D** vibrates at the driver frequency.

(Total for Question = 1 mark)

12 A positron is found to have a mass of 1.8×10^{-29} kg. It can be concluded that this positron is

☒ **A** a proton.

☒ **B** travelling at close to the speed of light.

☒ **C** travelling at a non-relativistic speed.

☒ **D** travelling in a circle.

(Total for Question = 1 mark)

13 The number of neutrons in a nucleus of $^{197}_{79}Au$ is

☒ **A** 79

☒ **B** 118

☒ **C** 197

☒ **D** 276

(Total for Question = 1 mark)

14 The derivation of the formula $\frac{k}{2m}$ could include the expression

☒ **A** $\frac{1}{2}mv^2 = p^2$

☒ **B** $\frac{1}{2}m^2v^2 = p^2$

☒ **C** $m^2v^2 = \frac{p^2}{m}$

☒ **D** $mv^2 = \frac{p^2}{m}$

(Total for Question = 1 mark)

15 Which of the following is **not** a valid conclusion from Rutherford's alpha particle scattering experiments?

☒ **A** The atom is mainly empty space.

☒ **B** The nucleus contains protons and neutrons.

☒ **C** The nucleus must be charged.

☒ **D** The nucleus must be very small compared to the atom.

(Total for Question = 1 mark)

16 Which one of the following quantities would the de Broglie equation be used to calculate?

☒ **A** The momentum of a moving particle.

☒ **B** The value of the Planck constant.

☒ **C** The wavelength of a moving electron.

☒ **D** The wavelength of a photon of light.

(Total for Question = 1 mark)

17 An alpha particle and a beta particle both move into the same uniform magnetic field which is perpendicular to their direction of motion. The beta particle travels at 15 times the speed of the alpha particle.

The ratio of the force on the beta particle to the force on the alpha particle is

☒ **A** 3.7

☒ **B** 7.5

☒ **C** 30

☒ **D** 60

(Total for Question 9 = 1 mark)

18 The tubes of a linear accelerator (linac) get progressively longer down its length because

☒ **A** the accelerating particles become relativistic.

☒ **B** the frequency of the applied potential difference changes.

☒ **C** the accelerating particles must spend the same time in each tube.

☒ **D** the accelerating particles gain mass.

(Total for Question = 1 mark)

19 Deuterium $^{2}_{1}H$ is an isotope of hydrogen.

An atom of deuterium has

		protons	neutrons	electrons
☒	**A**	1	2	
☒	**B**	1	1	
☒	**C**	2	1	
☒	**D**	1	0	

(Total for Question = 1 mark)

20 The rest mass of a proton is 1.67×10^{-27} kg. This mass, in MeV/c^2 is approximately

☒ **A** 2.4×10^{-20}

☒ **B** 3.1×10^{-6}

☒ **C** 1.0

☒ **D** 940

(Total for Question = 1 mark)

21 The de Broglie wavelength of a moving tennis ball is calculated as 1×10^{-33} m. This means that the moving tennis ball

☒ **A** diffracts through a narrow slit.

☒ **B** does not behave as a particle.

☒ **C** does not display wave properties.

☒ **D** is travelling at the speed of light.

(Total for Question = 1 mark)

22 Which **one** of the following might **not** apply in interactions between sub atomic particles?

☒ **A** charge conservation

☒ **B** energy conservation

☒ **C** matter conservation

☒ **D** momentum conservation

(Total for Question = 1 mark)

23 A particle X has kinetic energy E and momentum p. Another particle Y of the same mass as X has a momentum $2p$. The kinetic energy of Y is

☒ **A** $\frac{1}{2}E$

☒ **B** E

☒ **C** $2E$

☒ **D** $4E$

(Total for Question = 1 mark)

24 A radium nucleus decays by emitting an alpha particle. The speed of the recoiling nucleus is small compared to the speed of the alpha particle. This is because the

☒ **A** force acting on the recoiling nucleus is smaller than the force acting on the alpha particle

☒ **B** momentum is mainly concentrated in the alpha particle

☒ **C** momentum of the recoiling nucleus is smaller than the momentum of the alpha particle

☒ **D** recoiling nucleus has a much larger mass than the alpha particle

(Total for Question = 1 mark)

25 When alpha particles are directed at a thin gold foil it is found that most of the alpha particles go straight through undeflected. However a very small number are scattered through angles greater than 90°.

Which of the following is **not** a valid conclusion?

☒ **A** The atom is mainly empty space.

☒ **B** The nucleus must be positively charged.

☒ **C** The nucleus must contain most of the mass of the atom.

☒ **D** There is a large charge concentration in the centre of the atom.

(Total for Question = 1 mark)

26 As a particle accelerates in a linear accelerator (linac), it passes through tubes that get progressively longer.
Which of the following statements is the correct reason for making the tubes longer?

☒ **A** The particles gain more energy within each tube.

☒ **B** The frequency of the accelerating voltage increases.

☒ **C** The accelerating particles spend the same time in each tube.

☒ **D** The accelerating particles gain mass.

(Total for Question = 1 mark)

27 An electron gun uses a potential difference V to accelerate electrons of mass m and charge e from rest to a speed v.
The potential difference V can be expressed as

☒ **A** $\frac{mv^2}{2e}$

☒ **B** $\frac{2ev^2}{m}$

☒ **C** $\sqrt{\frac{2ev}{m}}$

☒ **D** $\sqrt{\frac{mv}{2e}}$

(Total for Question = 1 mark)

28 The process by which electrons are released from a heated metal filament in an electron beam tube is called

☒ **A** excitation.

☒ **B** ionisation.

☒ **C** photoelectric emission.

☒ **D** thermionic emission.

(Total for Question = 1 mark)

29 The de Broglie wavelength associated with electrons moving at 2.5×10^6 m s^{-1} is

☒ **A** 2.9×10^{-4} m

☒ **B** 2.4×10^{-8} m

☒ **C** 2.9×10^{-10} m

☒ **D** 2.4×10^{-39} m

(Total for Question = 1 mark)

30 Which of the following is **not** a valid conclusion from Rutherford's alpha particle scattering experiment?

☒ **A** The atom is mainly empty space.

☒ **B** The mass of the atom is mostly concentrated in the nucleus.

☒ **C** The nucleus must be positively charged.

☒ **D** The nucleus must be very small compared to the atom.

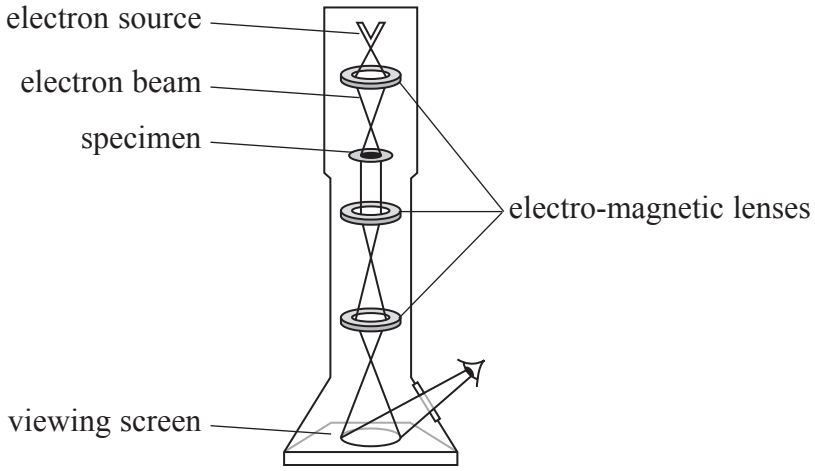
(Total for Question = 1 mark)

31 Select the row in the table that correctly identifies the composition of a $^{235}_{92}U^{+}$ ion.

		Number of protons	Number of neutrons	Number of electrons
☒	**A**	92	143	91
☒	**B**	92	143	92
☒	**C**	92	235	91
☒	**D**	93	235	92

(Total for Question = 1 mark)

32 A transmission electron microscope passes a beam of electrons through a tiny specimen to form an image on a viewing screen.



Due to the wave nature of electrons, diffraction occurs which can blur the image. To reduce this effect when viewing a smaller object the beam must contain

☒ **A** more electrons per second.

☒ **B** fewer electrons per second.

☒ **C** faster moving electrons.

☒ **D** slower moving electrons.

(Total for Question = 1 mark)