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Sample assessment 2020

Physics

Paper 1

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Section 1

Instructions

- Answer all questions in the question and response book.
- This book will not be marked.

QUESTION 1

The correct definition of *lepton number* is

(A) the total number of leptons in a particle interaction.

(B) a conserved quantum number defined by $L = n_l - n_{\bar{l}}$.

(C) the number of leptons remaining after a particle interaction.

(D) a strictly conserved additive quantum number of a system defined by $B = \frac{1}{2}(n_q - n_{\bar{q}})$.

QUESTION 2

The weight of an object on Earth is 550 N. The mass of the object is approximately

(A) 56 kg.

(B) –56 kg.

(C) 5400 kg.

(D) –5400 kg.

QUESTION 3

Select the option that contains the two correct postulates of special relativity.

(A) The laws of physics are the same in all inertial frames of reference and the speed of light in a vacuum has the same value c in all inertial frames of reference.

(B) The laws of physics are the same in all inertial frames of reference and the relation between two events is assumed to happen at the same time in all inertial frames of reference.

(C) The relation between two events is assumed to happen at the same time in all inertial frames of reference and the laws of physics are not the same in all inertial frames of reference.

(D) The relation between two events is assumed to happen at the same time in all inertial frames of reference and the speed of light in a vacuum has the same value c in all inertial frames of reference.
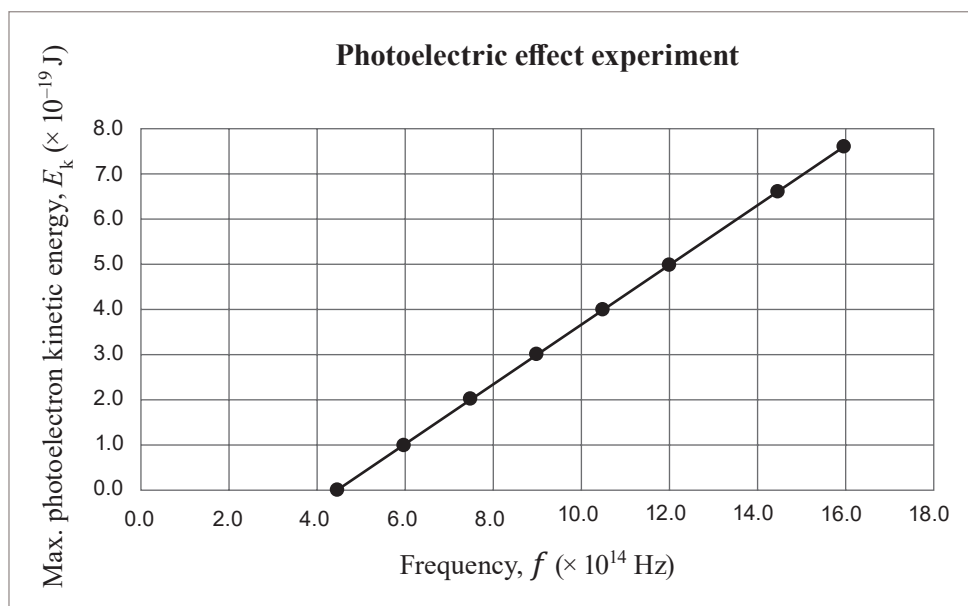
QUESTION 4

The correct definition of *Coulomb's law* is

(A) the total electric charge of an isolated system remains constant regardless of changes within the system.

(B) the direction of an induced electric current always opposes the change in the circuit or the magnetic field that produces it.

(C) when the magnetic flux linking a circuit changes, an electromotive force (EMF) is induced in the circuit proportional to the rate of change of the flux linkage.

(D) like electric charges repel and opposite electric charges attract, with a force proportional to the product of the electric charges and inversely proportional to the square of the distance between them.

QUESTION 5

The graph below presents the results of a photoelectric effect experiment. It shows the maximum kinetic energy of photoelectrons (E_k) with respect to the frequency of incident photons (f).

The gradient of the linear trend line shown in the graph above represents

(A) Planck's constant.

(B) the work function.

(C) the threshold frequency.

(D) the power of the light incident on the metal surface.

QUESTION 6

Select the words that correctly complete the description of *uniform circular motion*.

The motion of an object travelling at a _____ _____ in a circle due to a force acting on the object in a _____ direction to the velocity of the object.

(A) varied speed, parallel

(B) varied acceleration, parallel

(C) constant speed, perpendicular

(D) constant velocity, perpendicular

QUESTION 7

Calculate the electric field strength (E) at 2 cm from a charge of 2.5 C.

(A) 5.6×10^9 N C^{-1}

(B) 2.3×10^{10} N C^{-1}

(C) 1.1×10^{12} N C^{-1}

(D) 5.6×10^{13} N C^{-1}

QUESTION 8

Which of the following is a correct consequence of the speed of light in a vacuum being the same for all observers?

(A) The frame of reference of the observer is always the real frame of reference.

(B) Observations of events in distant galaxies are observations of events that occurred in the past.

(C) A clock that is moving relative to an observer will tick faster than a clock that is at rest in the observer's own frame of reference.

(D) When measured by a stationary observer, the length of a moving object is smaller than the length of the object when it is measured in its own frame of reference.

QUESTION 9

The diagram below shows a wire that is carrying an electric current.
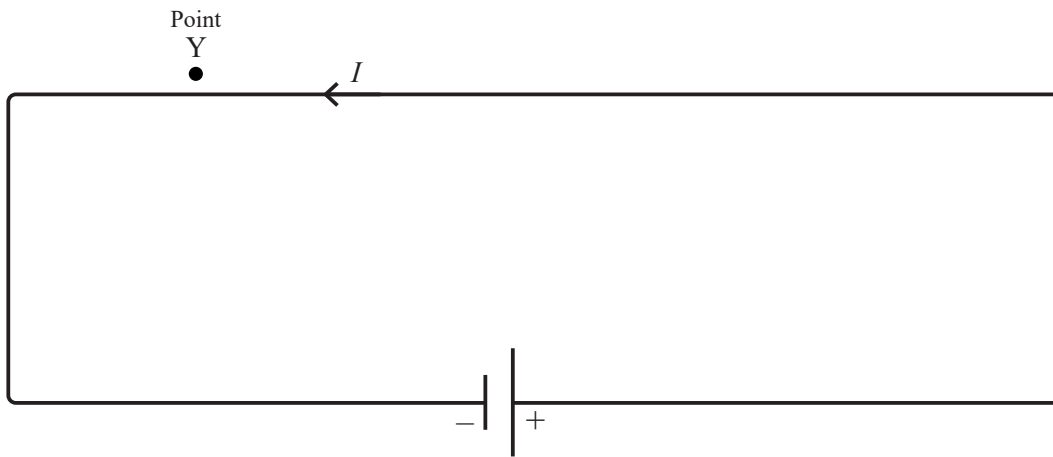
The direction of the magnetic field around the wire at point Y is

(A) up the page.

(B) into the page.

(C) down the page.

(D) out of the page.

QUESTION 10

Which model of the atom would predict the continuous emission of electromagnetic energy, resulting in the instability of the atom?

(A) Bohr's model of the atom

(B) Dalton's model of the atom

(C) Rutherford's model of the atom

(D) Thomson's plum pudding model of the atom

QUESTION 11

A rocket with a velocity of 0.9 c journeys from Earth to a distant planet. An observer on Earth measures the journey to have taken 3.00 years. Calculate the time taken for the journey as measured by a clock on the rocket.

(A) 0.95 years

(B) 1.31 years

(C) 6.88 years

(D) 9.48 years

QUESTION 12

Which two gauge bosons mediate the weak nuclear forces?

(A) gluon and photon

(B) gluon and Z boson

(C) photon and Z boson

(D) W boson and Z boson

QUESTION 13

Calculate the resulting radius of circular motion when a 150 g mass travelling at 3.0 m s^{-1} experiences a centripetal force of 15 N.

(A) 3.0 cm

(B) 9.0 cm

(C) 11 cm

(D) 20 cm

QUESTION 14

The correct definition of the term *antiparticle* is

(A) a particle with a known substructure.

(B) a particle with no known substructure.

(C) a particle with the same mass and opposite charge and/or spin as a corresponding particle.

(D) a particle with a different mass and the same charge and/or spin as a corresponding particle.

QUESTION 15

Calculate the gravitational field strength at a distance of 3.63×10^8 m from the centre of the Earth.

(A) 4.96×10^{-27} m s^{-2}

(B) 1.80×10^{-18} m s^{-2}

(C) 3.02×10^{-3} m s^{-2}

(D) 1.10×10^{6} m s^{-2}

QUESTION 16

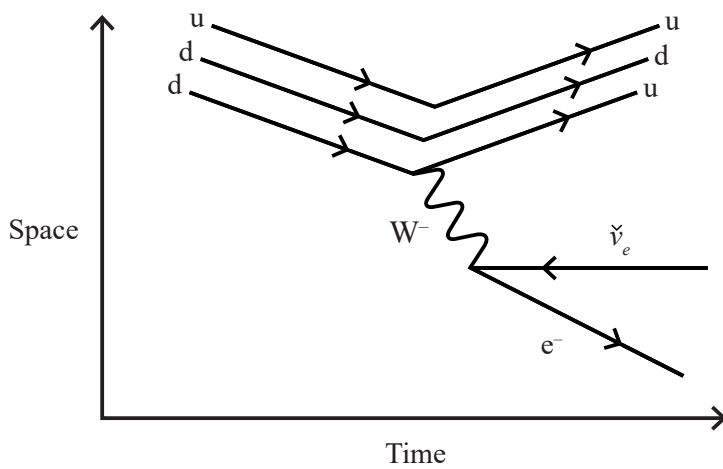Complete the following definition of *magnetic flux density* by identifying the two missing words.

The strength of a magnetic field or the number of _____ _____ lines per unit area.

(A) magnetic field

(B) magnetic force

(C) electromagnetic field

(D) electromagnetic force

QUESTION 17

The Feynman diagram below represents an interaction of particles.

Select which particle interaction is represented by the diagram above.

   (A)   a neutron decaying into a proton

   (B)   a proton decaying into a neutron

   (C)   an electron and electron interaction

   (D)   an electron and positron interaction

QUESTION 18

Select the list that only contains quarks.

   (A)   down, charm, top, and strange

   (B)   muon, up, down, and neutrino

   (C)   meson, gluon, photon, and boson

   (D)   anti-up, anti-neutrino, charm, and strange

QUESTION 19

Select the two formulas that, along with $v = \frac{2\pi r}{T}$, can be used to derive Kepler's third law of planetary motion.

(A) $F_g = mg$ and $g = \frac{F}{m}$

(B) $F = \frac{GMm}{r^2}$ and $F_g = mg$

(C) $a_c = \frac{v^2}{r}$ and $F_{net} = \frac{mv^2}{r}$

(D) $F = \frac{GMm}{r^2}$ and $F_{net} = \frac{mv^2}{r}$

QUESTION 20

Complete the following.

A moving electric charge generates a _____ _____.

(A) meson field.

(B) baryon field.

(C) magnetic field.

(D) gravitational field.

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