External assessment 2023

Multiple choice question book

Physics

Paper 1

General instruction

- Work in this book will not be marked.

Queensland Government | QCAA Queensland Curriculum & Assessment Authority

Section 1

Instruction

- Respond to these questions in the question and response book.

QUESTION 1

An object is unable to accelerate to the speed of light because

(A) length contraction will change the height of the object.

(B) time dilation will decrease the velocity of the object.

(C) the object will gain infinite momentum.

(D) the inertia of the object will decrease.

QUESTION 2

Photons are

(A) gauge bosons that exhibit wave characteristics.

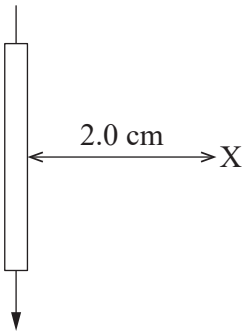
(B) particles that can only travel in a medium.

(C) mediators of the weak nuclear force.

(D) leptons with no charge.

QUESTION 3

A current-carrying wire is shown.



Not to scale $I = 0.5$ A

Determine the magnetic field strength at X.

(A) 5×10^{-6} T out of the page

(B) 5×10^{-6} T into the page

(C) 5×10^{-8} T out of the page

(D) 5×10^{-8} T into the page

QUESTION 4

Kepler's third law

(A) describes the elliptical orbit of planets.

(B) combines Newton's first law of motion with uniform circular motion.

(C) equates the area of the arc sweep of a planet to the time taken to complete it.

(D) describes the relationship between uniform circular motion and the Law of Universal Gravitation.

QUESTION 5

Young's double slit experiment demonstrates that light

(A) behaves differently in different frames of reference.

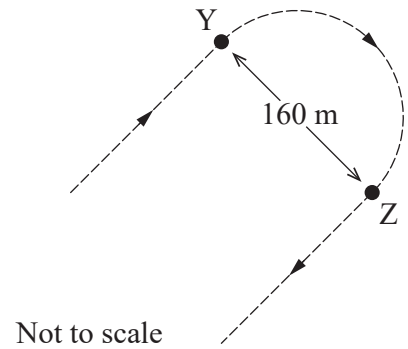
(B) shares characteristics with mechanical waves.

(C) is a longitudinal wave.

(D) acts like a particle.

QUESTION 6

An object of mass 6.0×10^2 kg travels along a path as shown. The object takes 25 seconds to complete the semicircular section of the path.



Calculate the centripetal force experienced by the object as it moves from Y to Z.

(A) 3.0×10^3 N

(B) 7.6×10^2 N

(C) 3.8×10^2 N

(D) 7.6×10^1 N

QUESTION 7

An electron and positron can annihilate into a photon, producing another electron and positron pair in the process. An outcome of this interaction is that

(A) total mass decreases.

(B) fewer baryons will be produced.

(C) the lepton number does not change.

(D) the number of particles will decrease.

QUESTION 8

Incident light with a frequency of 1.70×10^{15} Hz is shone onto a metal surface with a work function of 1.00×10^{-18} J.

Determine the kinetic energy of a photoelectron ejected from the metal surface.

(A) 7.9×10^{-1} eV

(B) 1.7×10^{-15} eV

(C) 1.3×10^{-19} eV

(D) 2.0×10^{-38} eV

QUESTION 9

A magnet is passed through a solenoid comprising five turns and a cross-sectional area of 0.60 m^2 to produce an EMF of 0.75 V.

Calculate the EMF if the same magnet passes through another solenoid with three times as many turns and half the cross-sectional area at the same rate.

(A) 0.89 V

(B) 1.1 V

(C) 4.0 V

(D) 4.5 V

QUESTION 10

A black body at a temperature of 6040 K produces photons across a range of frequencies.

Calculate the frequency at which the maximum number of photons is produced.

(A) 6.3×10^{14} Hz

(B) 2.1×10^{6} Hz

(C) 4.8×10^{-7} Hz

(D) 1.6×10^{-15} Hz

QUESTION 11

Coulomb's law describes the observation that

(A) an electromotive force in a circuit may be induced through changes in the magnetic flux.

(B) charged particles moving across magnetic field lines experience a force.

(C) a change in the electromotive force is opposed.

(D) like electric charges repel one another.

QUESTION 12

What is a consequence of symmetry in particle interactions?

(A) The law of conservation of momentum is obeyed.

(B) Charges on particles will always be different.

(C) Antiparticles travel backwards through time.

(D) Total mass of the particles will decrease.

QUESTION 13

A magnet moving through a coil of wire will induce a current with a magnetic field

(A) parallel to the electric field.

(B) opposite in direction to the change in flux.

(C) inversely proportional to the electromotive force.

(D) that will continue to fluctuate once the magnet is removed.

QUESTION 14

An electron is best described as a

(A) lepton with a larger mass than a positron.

(B) baryon with a smaller mass than a proton.

(C) meson that experiences the strong nuclear force.

(D) particle whose interactions can be mediated by photons.

QUESTION 15

Two objects experience a gravitational force, F, between them.

Calculate the magnitude of the force acting between the two objects if the distance between them was doubled and the mass of one object was doubled.

(A) $\frac{1}{4}F$

(B) $\frac{1}{2}F$

(C) $1\,F$

(D) $2\,F$

QUESTION 16

A train is travelling at relativistic speed and is about to move through a tunnel. An observer on the train measures the train and tunnel to each be 95 m long.

A second observer is stationary relative to the tunnel. They would observe the train to

(A) simultaneously enter and exit the tunnel.

(B) decrease its mass while in the tunnel.

(C) move faster while in the tunnel.

(D) be shorter than the tunnel.

QUESTION 17

The half-life of an unstable subatomic particle is measured by a stationary detector to be longer when its velocity approaches the speed of light. This is because the particle

(A) is moving relative to its frame of reference.

(B) is in the same frame of reference as the detector.

(C) experiences time differently relative to the detector.

(D) cannot be accurately observed at relativistic speeds.

QUESTION 18

A 20 kg object is placed on an inclined plane with a slope of 35°. If the object experiences a frictional force of 40 N and no additional applied force, calculate its acceleration down the inclined plane.

(A) $3.6\ \text{m s}^{-2}$

(B) $5.6\ \text{m s}^{-2}$

(C) $6.0\ \text{m s}^{-2}$

(D) $7.6\ \text{m s}^{-2}$

QUESTION 19

Calculate the electric field strength experienced at a distance of 2.8×10^{-11} m from the centre of a helium nucleus.

(A) $1.0\times10^{2}\ \text{N C}^{-1}$

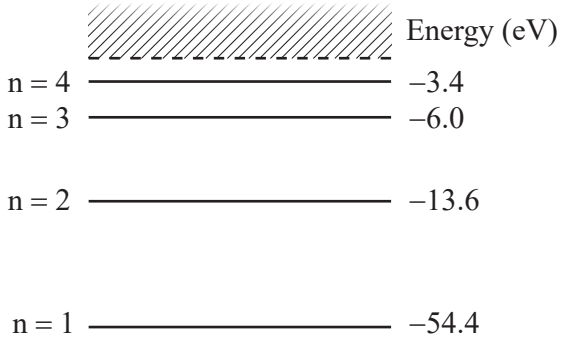
(B) $2.0\times10^{2}\ \text{N C}^{-1}$

(C) $3.7\times10^{12}\ \text{N C}^{-1}$

(D) $7.3\times10^{12}\ \text{N C}^{-1}$

QUESTION 20

The energy level diagram for a simple atom is shown.



Not to scale

What transition is allowed for an electron that absorbs a photon with a frequency of 6.3×10^{14} Hz?

(A) n = 1 to n = 3

(B) n = 1 to n = 4

(C) n = 2 to n = 3

(D) n = 3 to n = 4

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