

External assessment 2023

Multiple choice question book

Physics Alternative Sequence

Paper 1

General instruction

- Work in this book will not be marked.

Section 1

Instruction

- Respond to these questions in the question and response book.
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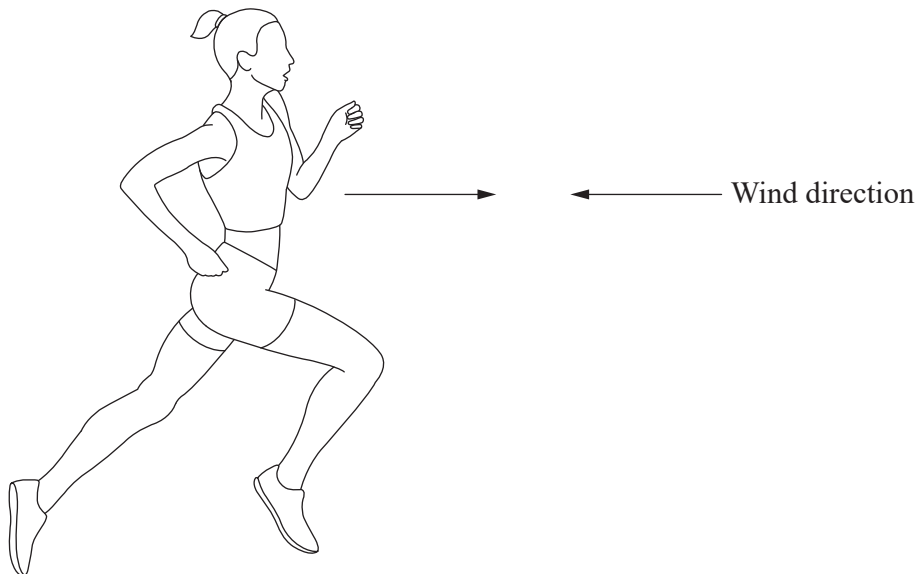
QUESTION 1

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

A runner moving at a constant velocity encounters a gust of wind opposite to their direction of travel.



For the runner to maintain their initial velocity, they need to

- (A) maintain a constant non-zero acceleration.
- (B) apply an equal and opposite force.
- (C) decrease the work acting on them.
- (D) reduce their momentum.

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QUESTION 3

The radioactive decay of 16 g of sodium-24 was recorded over time.

Predict how many half-lives it would take before only 1 g of sodium-24 remained.

- (A) 4
- (B) 5
- (C) 6
- (D) 8

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.

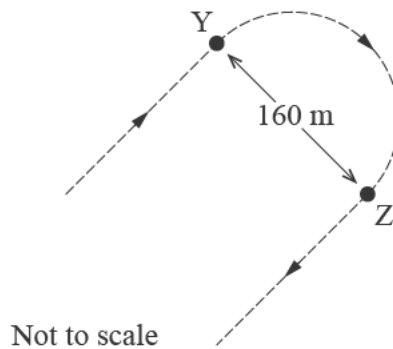
QUESTION 5

Fission chain reactions occur in collisions between atomic nuclei when

- (A) smaller nuclei combine to produce one large nucleus and an additional neutron.
- (B) the electron released from one collision causes successive collisions to occur.
- (C) neutrons are released, causing additional reactions to occur.
- (D) unstable atoms split and release excess protons.

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.

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QUESTION 8

Two objects of equal mass, X and Y, move forward in the same direction. Object X starts behind object Y and moves 40 m s^{-1} faster. The two objects eventually collide, resulting in a combined object Z that continues to move forward at three times the original velocity of object Y.

Determine the final velocity of object Z.

- (A) 20 m s^{-1}
- (B) 30 m s^{-1}
- (C) 40 m s^{-1}
- (D) 50 m s^{-1}

QUESTION 9

The displacement, s (in metres), of an object undergoing deceleration was recorded over time, t (in seconds). An equation describing the trend was developed.

$$s = (-1.3 \pm 0.2)t^2 + (203 \pm 2)$$

Given the uncertainties in the equation, what is a valid displacement of the object after seven seconds?

- (A) 267 m
- (B) 215 m
- (C) 194 m
- (D) 146 m

QUESTION 10

Subject matter that formed the basis for this question was identified as outside the scope of AS Unit 1 and AS Unit 2 during the 2023 EA marking operation.
Please continue to the next question.

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QUESTION 11

The strong nuclear force

- (A) holds atoms together.
- (B) is constant for all nuclei.
- (C) acts over small distances.
- (D) keeps electrons orbiting the nucleus.

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

Which changes in mass could occur in a nuclear fusion reaction?

	Total mass of reactant nuclei (amu)	Mass of product nucleus (amu)
(A)	5.03	4.98
(B)	10.05	10.08
(C)	234.97	233.96
(D)	235.87	236.05

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 are mediated by photons.

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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.

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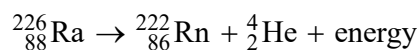
QUESTION 18

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 m s^{-2}
- (B) 5.6 m s^{-2}
- (C) 6.0 m s^{-2}
- (D) 7.6 m s^{-2}

QUESTION 19

Radium-226 experiences radioactive decay to produce radon-222 and an alpha particle. A mass difference of 0.0052 amu is measured between the reactants and products.

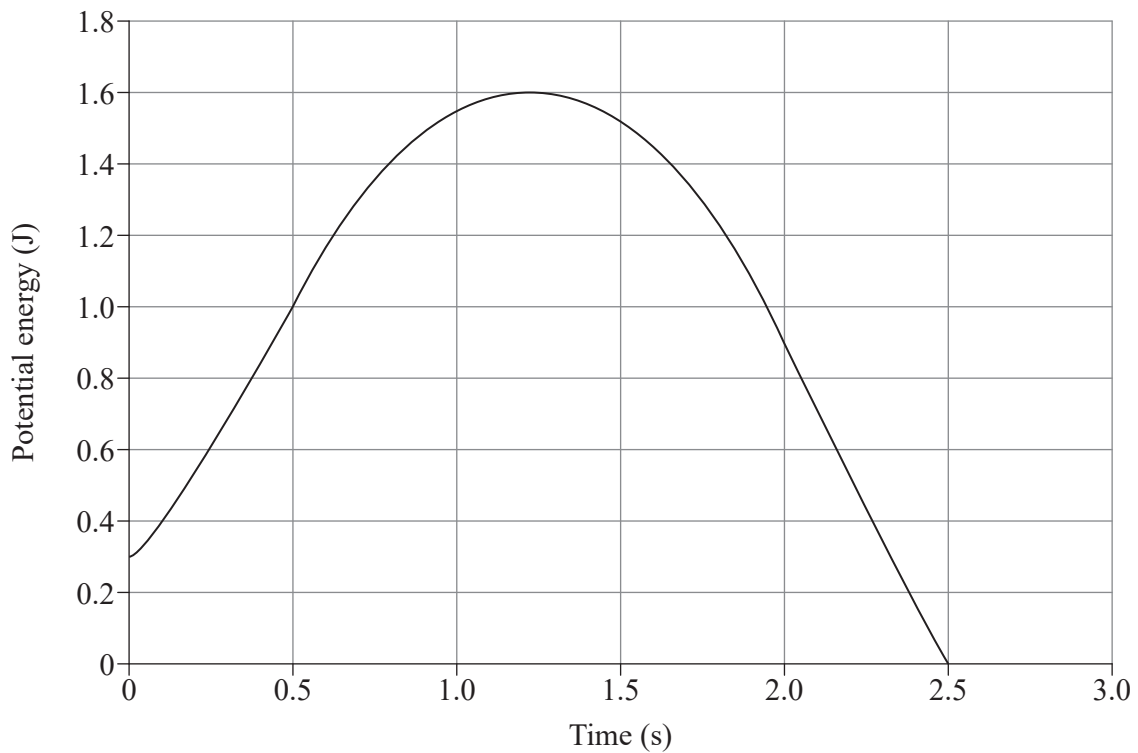


Calculate the energy released.

- (A) $4.7 \times 10^{14} \text{ J}$
- (B) $7.8 \times 10^{-13} \text{ J}$
- (C) $2.6 \times 10^{-21} \text{ J}$
- (D) $8.6 \times 10^{-30} \text{ J}$

QUESTION 20

An object of mass 0.6 kg is thrown vertically, then allowed to bounce elastically on the ground. A graph of the object's potential energy over time is shown.



Determine the velocity of the object immediately after it bounces off the ground.

- (A) 1.2 m s^{-1}
- (B) 1.6 m s^{-1}
- (C) 2.3 m s^{-1}
- (D) 5.3 m s^{-1}

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