

Dronacharya Group of Institutions, Gr. Noida

Department of Applied Sciences (First Year)

Even Semester (2020-2021)

Objective Question Bank

Subject Name & Code: ENGINEERING PHYSICS & KAS-201T

Unit No. 1st & Unit Name: Relativistic Mechanics

1. Which of the following was one of the conclusions of the Michaelson Morley experiment?
 - a) All laws of physics remain invariant in all inertial frames
 - b) Light propagates with different speeds in different directions
 - c) Ether has no observable properties
 - d) The velocity of light in free space is constant
2. The result of the Michaelson Morley experiment was as expected.
 - a) True
 - b) False
3. The device used in the Michaelson Morley experiment was _____
 - a) Telescope
 - b) Plain Grating
 - c) Interferometer
 - d) Prism
4. How much shift was expected in Michaelson-Morley experiment?
 - a) 0.01
 - b) 0.02
 - c) 0.03
 - d) 0.04
5. The fringes of equal inclination produced by using Michaelson Interferometer are called as ____
 - a) Equi-inclination Fringes
 - b) Michaelson's Fringes
 - c) Haidinger's Fringes
 - d) Morley's Fringes
6. When the movable mirror of a Michaelson Interferometer is shifted through 0.0589 mm, 200 fringes cross the field. What is the wavelength of the light?
 - a) 5890 Å
 - b) 5245 Å

- c) 4965 Å
- d) 6894 Å

7. When a thin plate of refractive index 1.5 is placed in the path of one of interfering beams of Michaelson Interferometer, a shift of 30 fringes is observed. If the thickness of plate is 0.018 mm, the wavelength of the used light is _____

- a) 4000 Å
- b) 5000 Å
- c) 6000 Å
- d) 7000 Å

8. In Michaelson interferometer, the position of mirror read 0.6025mm and 0.8970mm for a pair of consecutive bright. Mean wavelength of light is 5393 Å. The difference between the two wavelengths is _____

- a) 3 Å
- b) 4 Å
- c) 5 Å
- d) 6 Å

9. When a plate of thickness 0.05 mm is placed in the path of a Michaelson Interferometer, a shift of 100 fringes is observed for a light of wavelength 5000 Å. What is the refractive index of the plate?

- a) 1
- b) 1.5
- c) 2
- d) 2.5

10. As an object approaches the speed of light, it's mass becomes _____

- a) Zero
- b) Double
- c) Remains Same
- d) Infinite

11. If the sun radiates energy at the rate of $4 \times 10^{26} \text{ Js}^{-1}$, what is the rate at which its mass is decreasing?

- a) $5.54 \times 10^9 \text{ kgs}^{-1}$
- b) $4.44 \times 10^9 \text{ kgs}^{-1}$
- c) $3.44 \times 10^9 \text{ kgs}^{-1}$
- d) $2.44 \times 10^9 \text{ kgs}^{-1}$

12. The orbit of mercury is changing slightly due to the sun's gravity.

- a) True
- b) False

13. According to Einstein's Special Theory of Relativity, laws of physics can be formulated based on _____

- a) Inertial Frame of Reference
- b) Non-Inertial Frame of Reference
- c) Both Inertial and Non-Inertial Frame of Reference

d) Quantum State

14. For Einstein's relation, $E^2 - p^2c^2 =$ _____

- a) m_0c^2
- b) $m_0^2c^4$
- c) m_0c^4
- d) $m_0^2c^6$

15. A frame of reference has four coordinates, x, y, z, and t is referred to as the _____

- a) Inertial frame of reference
- b) Non-inertial frame of reference
- c) Space-time reference
- d) Four-dimensional plane

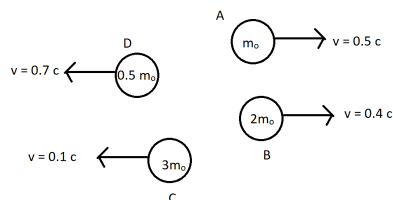
16. A man, who weighs 60 kg on earth, weighs 61 kg on a rocket, as measured by an observer on earth. What is the speed of the rocket?

- a) 2.5×10^8 m/s
- b) 2.5×10^7 m/s
- c) 5.5×10^7 m/s
- d) 5.5×10^8 m/s

17. The momentum of a photon having energy 1.00×10^{-17} J is _____

- a) 2.33×10^{-26} kg m/s
- b) 3.33×10^{-26} kg m/s
- c) 4.33×10^{-26} kg m/s
- d) 5.33×10^{-26} kg m/s

18. According to Einstein's special theory of relativity, which of these objects should be the heaviest?



- a) A
- b) B
- c) C
- d) D

19. The energy momentum relation in special theory of relativity is given by

- a) $E = \sqrt{(m_0^2c^4 + c^2 p^2)}$
- b) $E = \sqrt{(m_0^4c^4 + c^4 p^4)}$
- c) $E = \sqrt{(m_0^2c^4 - c^2 p^2)}$
- d) $E = \sqrt{(m_0c^2 + c^2 p^2)}$

20. A rod of length 5 m is moving at a speed of $0.6c$. To an observer sitting perpendicular to the direction of motion, the length appears to be _____

- a) 5 m

- b) 4 m
- c) 3 m
- d) 2 m

21. If an object reaches the speed of light, its length changes to _____

- a) Infinite
- b) Double of the value
- c) Half of the value
- d) Zero

22. A 20-year-old person goes at a high speed in a rocket on his birthday. When he comes back to earth after 1 earth year, he would be _____

- a) 1 year older
- b) 2 years older
- c) A few months older
- d) Same age

23. The length of a rod seems shorter to an observer when it moves in a specific direction. What change would he observe when the direction of rod changes by 180° ?

- a) The rod becomes even smaller
- b) The length of the rod increases
- c) The length of the rod remains the same
- d) The rod has the length equal to its proper length

24. An object of length 1 m is moving at speed $0.5c$. To an observer at rest relative to the object, the length of the object seems to be _____

- a) 0.86 m
- b) 0.5 m
- c) 1 m
- d) 0.14 m

25. How fast does a rocket have to move relative to an observer for its length to be contracted to 95% of its original length?

- a) $0.5c$
- b) $0.4c$
- c) $0.3c$
- d) $0.2c$

26. Which basic law is used for the derivation of mass variation with velocity?

- a) Law of conservation of Energy
- b) Law of conservation of Kinetic Energy
- c) Law of conservation of Momentum
- d) Law of conservation of mass

27. A rod of length 1m moves with a speed of $0.5c$. How much length contraction takes place?

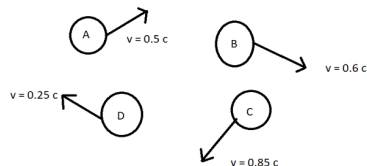
- a) 50 %
- b) 14 %
- c) 10 %

d) 35 %

28. A particle with a lifetime of 2×10^{-6} s moves through the laboratory with a speed of $0.9 c$. It's lifetime, as measured by an observer in the laboratory, is _____

- a) 2×10^{-6} s
- b) 3.2×10^{-6} s
- c) 4.6×10^{-6} s
- d) 5.4×10^{-6} s

29. All the given particles have a lifetime of 1 microsecond. Which of them will survive the longest?



- a) A
- b) B
- c) C
- d) D

30. Two particles approach each other with a speed $0.8 c$ with respect to the laboratory. Their relative speed is _____

- a) $0.912 c$
- b) $0.95 c$
- c) $0.975 c$
- d) $0.85 c$

31. What would be the mass of the body at rest, if it explodes into two objects of mass 2 kg each moving with a speed $0.8c$ relative to the original body?

- a) 4 Kg
- b) 5.4 Kg
- c) 6.2 Kg
- d) 6.7 Kg

32. In the case $v \ll c$, Lorentz transformation is the same as _____

- a) Einstein's transformation
- b) Galilean transformation
- c) Maxwell's transformation
- d) Planck's transformation

33. When a particle is moving with a velocity of light c relative to S , its velocity as observed by an observer in the frame S' is _____

- a) Zero
- b) $0.5 c$
- c) $0.75 c$
- d) c

34. Lorentz transformations are based on the principle of consistency of the velocity of light.

- a) True
- b) False

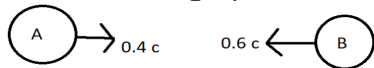
35. In Lorentzian relativity, if two events are simultaneous for one observer, they will be simultaneous for all other observers as well.

- a) True
- b) False

36. For $u' < c$ and $v < c$ the equation becomes _____

- a) $u = (u'+v)c^2/u'v$
- b) $u = (u'+v)/(1+u'v)$
- c) $u = 1+(u'v)/c^2$
- d) $u = u' + v$

37. From the graph, what should be the velocity as observed from frame S?



- a) 0.6 c
- b) 0.7 c
- c) 0.8 c
- d) 0.9 c

38. Two particles approach each other with a velocity of 0.9 c. What is their relative velocity as observed by A?

- a) 0.9 c
- b) 0
- c) 0.99 c
- d) 0.94 c

39. An atom A, moving relative to the observer, with velocity 2×10^8 m/s emits a particle B which moves with a velocity of 2.8×10^8 m/s with respect to the atom. The velocity of the emitter particle relative to the scientist is _____

- a) 0.8×10^8 m/s
- b) 2.4×10^8 m/s
- c) 3×10^8 m/s
- d) 2.95×10^8 m/s

40. The basic theorem/principle used to obtain mass-energy relation is _____

- a) Heisenberg's Uncertainty Principle
- b) Work-Energy Theorem
- c) Momentum Conservation Theorem
- d) Maxwell Theorem

41. Which of the following is Einstein's mass energy relation?

- a) $E_k = (m - m_0)c^2$
- b) $E = mc^2$
- c) $E^2 - p^2c^2 = m_0^2c^4$
- d) $E_k = mv^2/c^2$

42. For Pair Production phenomenon to occur to photon must have energy, greater than or equal to _____

- a) 0.51 MeV
- b) 1.02 MeV
- c) 0.32 MeV
- d) 0.85 MeV

43. Which of the following is the momentum-energy relation?

- a) $E^2 - p^2c^2 = m_0^2c^2$
- b) $E^2 - p^2c^2 = m_0^2c^4$
- c) $E^2 - p^2c^2 = m_0^2c^3$
- d) $E^2 - p^2c^2 = m_0c^2$

44. In Relativistic case, as the velocity of the particle approaches the speed of light, the Kinetic energy approaches _____

- a) Zero
- b) Kinetic Energy as in Non-Relativistic case
- c) Rest Energy
- d) Infinite

45. If a star radiates energy at the rate of $5 \times 10^{20} \text{ Js}^{-1}$, what is the rate at which its mass is decreasing?

- a) $5.54 \times 10^9 \text{ kgs}^{-1}$
- b) $4.44 \times 10^9 \text{ kgs}^{-1}$
- c) $3.44 \times 10^9 \text{ kgs}^{-1}$
- d) $2.44 \times 10^9 \text{ kgs}^{-1}$

46. What will be the rest energy of an electron?

- a) 0.41 MeV
- b) 0.51 MeV
- c) 0.61 MeV
- d) 0.71 MeV

47. The binding energy of an electron to a proton (i.e., hydrogen atom) is 13.6 eV. The loss of mass in the formation of one atom of hydrogen is _____

- a) $2.42 \times 10^{-35} \text{ Kg}$
- b) $3.34 \times 10^{-35} \text{ Kg}$
- c) $4.58 \times 10^{-35} \text{ Kg}$
- d) $5.19 \times 10^{-35} \text{ Kg}$

48. The momentum of a photon having energy 10^{-17} J is _____

- a) $1.11 \times 10^{-26} \text{ Kg m/s}$
- b) $2.22 \times 10^{-26} \text{ Kg m/s}$
- c) $3.33 \times 10^{-26} \text{ Kg m/s}$
- d) $4.44 \times 10^{-26} \text{ Kg m/s}$

49. The rest mass of a photon is equal to _____

- a) Gravitational mass
- b) Relativistic mass
- c) Inertial mass
- d) Zero

50. The lowest possible mass of a particle is its _____

- a) Relativistic mass
- b) Inertial mass

- c) Gravitational mass
- d) Rest mass

51. The frame of reference in which the law of inertia is satisfied is called _____ frame of reference.

- a) Einstein's
- b) Newton's
- c) non-inertial
- d) inertial

52. The frame of reference in which the law of inertia is not satisfied is called _____ frame of reference.

- a) Einstein's
- b) Newton's
- c) non-inertial
- d) inertial

53. At what speed the mass of an object would be double its value at rest?

- a) $\sqrt{2} c$
- b) $c/\sqrt{2}$
- c) $\sqrt{3}c/2$
- d) $2c/\sqrt{3}$

54. According to the special theory of relativity the speed of light is _____.

- a) zero
- b) constant
- c) infinite
- d) not predictable

55. The Michelson-Morley experiment was performed to verify the presence of _____ .

- a) matter
- b) ether
- c) aliens
- d) flying objects
