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HSSC-I NATIONAL BOOK FOUNDATION FBISE

PHYSICS TEST - CHAPTER 13: RELATIVITY

Name:		Roll No.		Section:

Total Time: 2:30 Hour
Time Allowed: 150 Minutes

Total Marks: 150

PAPER OBJECTIVE
SECTION-A (MARKS 150)

NOTE: Section-A is compulsory. All parts of this section are to be answered on these pages and handed over to the center superintendent. Deleting / overwriting is not allowed. Do not use lead pencil.

Q.1 Fill the relevant bubble for each part. All parts carry one mark.

Questions	A	B	C	D	A B C D
1. A frame of reference is a	coordinate system with clocks	kind of force	unit of speed	type of clock	●○○○
2. An inertial frame is one that	falls freely under gravity only	rotates	moves with constant velocity	accelerates	○○●○
3. Newton's first law holds in	accelerating frames only	no frames	inertial frames	all frames	○○●○
4. A frame accelerating with respect to an inertial frame is	non-inertial	inertial	stationary	absolute	●○○○
5. A rotating frame is	at rest	inertial	absolute	non-inertial	○○○●
6. Galilean relativity states that laws of mechanics are same in	accelerated frames only	rotating frames only	no frames	all inertial frames	○○○●
7. Galilean velocity addition gives velocity u′ =	u − v	uv	u + v	u/v	●○○○
8. A train moves at 20 m s^{-1} and a man walks forward at 2 m s^{-1} in it. Ground speed is	22 m s^{-1}	40 m s^{-1}	10 m s^{-1}	18 m s^{-1}	●○○○
9. Before Einstein, light was believed to need a medium called	ether	plasma	air	vacuum	●○○○
10. The Michelson–Morley experiment tried to detect	nuclear energy	motion through the ether	electrons	gravity waves	○●○○
11. The Michelson–Morley experiment gave a	positive result	negative charge	null result	fringe shift of one fringe	○○●○
12. The Michelson–Morley result showed that	light is a particle	ether is everywhere moving	light has no speed	ether does not exist	○○○●
13. Michelson–Morley used an	thermometer	oscilloscope	spectrometer	interferometer	○○○●
14. Special relativity was proposed by	Einstein	Maxwell	Newton	Galileo	●○○○

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Questions	A	B	C	D	A B C D
15. Special relativity was published in the year	1925	1915	1895	1905	○○○●
16. Special relativity deals with frames moving	in circles	with constant velocity	under gravity	with acceleration	○●○○
17. First postulate: laws of physics are the same in all	inertial frames	rotating frames	accelerated frames	non-inertial frames	●○○○
18. Second postulate: speed of light in vacuum is	infinite	constant for all observers	dependent on observer speed	dependent on source speed	○●○○
19. Speed of light in vacuum is about	340 m s^{-1}	3 × 10^6 m s^{-1}	3 × 10^8 m s^{-1}	3 × 10^{10} m s^{-1}	○○●○
20. Speed of light is	zero in vacuum	dependent on motion of source	independent of the motion of source	infinite	○○●○
21. No material object can reach	speed of sound	speed of light	340 m s^{-1}	100 m s^{-1}	○●○○
22. The Lorentz factor is γ =	$1 - v^2/c^2$	$\sqrt{(1 - v^2/c^2)}$	$1/(1 - v^2/c^2)$	$1/\sqrt{(1 - v^2/c^2)}$	○○○●
23. At v = 0, γ equals	infinity	1	2	0	○●○○
24. As v approaches c, γ approaches	zero	infinity	two	one	○●○○
25. γ is always	≤ 1	negative	zero	≥ 1	○○○●
26. γ at v = 0.6c is	1.67	0.8	1.25	2	○○●○
27. γ at v = 0.8c is	0.6	1.25	2.5	1.67	○○○●
28. γ at v = 0.866c is	3	2	1.5	1.25	○●○○
29. Simultaneity of events is	always true	independent of frame	relative	absolute	○○●○
30. Two events simultaneous in one frame are generally	the same event	simultaneous in all frames	not simultaneous in another moving frame	never happening	○○●○
31. Time dilation means moving clocks run	at same rate	slow	fast	backwards	○●○○

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Questions	A	B	C	D	A B C D
32. Time dilation formula is t =	$t_0 \gamma^2$	t_0/γ	$t_0 - \gamma$	γt_0	○○○●
33. Proper time is the time measured in the frame where the events occur	at light speed	at the same place	at rest to the observer far away	at different places	○●○○
34. Proper time is always	infinite	the longest time interval	the shortest time interval	zero	○○●○
35. A clock moving at 0.6c ticks 10 s in its rest frame. Observer measures	10 s	16.7 s	12.5 s	8 s	○○●○
36. A clock moving at 0.8c ticks 6 s in its rest frame. Observer measures	3.6 s	6 s	10 s	7.5 s	○○●○
37. A clock moving at 0.866c ticks 5 s in its rest frame. Observer measures	4.3 s	10 s	5 s	2.5 s	○●○○
38. Time dilation is negligible at	everyday speeds	0.9c	speeds near c	0.99c	●○○○
39. Evidence for time dilation is the	Brownian motion	extended lifetime of cosmic ray muons	speed of sound	photoelectric effect	○●○○
40. Muons reach the earth's surface because their lifetime is	zero	shortened	constant in all frames	dilated	○○○●
41. Atomic clocks flown in aircraft show	speed of light change	no change at all	time dilation	gravitational wave	○○●○
42. In the twin paradox, the travelling twin returns	twice as old	older	the same age	younger	○○○●
43. Length contraction occurs in the direction of	all directions	no direction	perpendicular to motion	motion	○○○●
44. Length contraction formula is L =	γL_0	L_0/γ	$L_0 + \gamma$	$L_0\gamma^2$	○●○○
45. Proper length is the length measured in the frame where the object is	moving	at rest	in vacuum	accelerating	○●○○
46. Proper length is always	the longest length	the shortest length	infinite	zero	●○○○
47. A rod 1 m long at rest moves at 0.6c. Its length is	0.8 m	0.6 m	1 m	1.25 m	●○○○
48. A rod 5 m long at rest moves at 0.8c. Its length is	4 m	3 m	8.3 m	5 m	○●○○

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Questions	A	B	C	D	A B C D
49. A spaceship of 100 m moves at 0.866c. Its length is	200 m	50 m	86.6 m	100 m	○●○○
50. Dimensions perpendicular to motion are	unchanged	contracted	expanded	zero	●○○○
51. Length contraction is negligible at	speeds near c	0.99c	low speeds	0.9c	○○●○
52. Relativistic momentum is p =	$m_0 v/\gamma$	$\gamma m_0 v$	$m_0 c$	$m_0 v$	○●○○
53. Relativistic mass is m =	$m_0 - \gamma$	γm_0	$m_0 \gamma^2$	m_0/γ	○●○○
54. Mass of a moving body	stays zero	increases with speed	is constant	decreases with speed	○●○○
55. Rest mass is the mass measured when the body is	in a gravitational field only	accelerating	moving at c	at rest	○○○●
56. A 1 kg object at 0.6c has relativistic mass	1.25 kg	0.8 kg	1.67 kg	1 kg	●○○○
57. A 2 kg object at 0.8c has relativistic mass	2 kg	5 kg	3.33 kg	1.2 kg	○○●○
58. Mass-energy equivalence is	$E = mc^2$	$E = m/c^2$	$E = m^2c$	$E = mc$	●○○○
59. Rest energy is	m_0c	$\frac{1}{2}m_0c^2$	m_0v^2	m_0c^2	○○○●
60. Total energy of a moving particle is	$\gamma m_0 c^2$	$m_0 v^2$	$\frac{1}{2} m_0 v^2$	$m_0 c^2$	●○○○
61. Kinetic energy relativistically is	$m_0 c^2$	$\gamma m_0 c^2$	$(\gamma - 1) m_0 c^2$	$\frac{1}{2} m_0 v^2$	○○●○
62. At low speeds relativistic KE reduces to	zero	$\frac{1}{2} m_0 v^2$	$m_0 c^2$	$m_0 v$	○●○○
63. Energy released when 1 kg of mass is converted is	3×10^8 J	9×10^{13} J	9×10^{16} J	3×10^{16} J	○○●○
64. Energy equivalent of 1 g of mass is	9×10^{13} J	3×10^8 J	9×10^{16} J	9×10^{10} J	●○○○
65. Energy equivalent of 1 u is about	931 MeV	93.1 MeV	1.6 MeV	931 eV	●○○○

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Questions	A	B	C	D	A B C D
66. Mass of 2×10^{-3} kg converts to energy	2×10^{-3} J	6×10^{5} J	1.8×10^{14} J	1.8×10^{11} J	○○●○
67. Rest energy of an electron is about	938 MeV	1 eV	931 MeV	0.511 MeV	○○○●
68. Rest energy of a proton is about	0.511 MeV	1 MeV	931 keV	938 MeV	○○○●
69. Sun gives energy by converting	charge into mass	mass into energy	energy into mass	mass into charge	○●○○
70. Mass of a nucleus is less than the sum of its nucleons by	spin defect	none	mass defect	charge defect	○○●○
71. Binding energy is obtained from	mass defect × c	mass defect	mass defect / c^2	mass defect × c^2	○○○●
72. Photon rest mass is	zero	very large	negative	1 u	●○○○
73. Particles with zero rest mass travel at	zero speed	any speed below c	speed of light	340 m s^{-1}	○○●○
74. Accelerating a particle to speed c would need	zero energy	infinite energy	1 eV	1 J	○●○○
75. Relativistic KE grows without limit as v approaches	0	c	0.5c	100 m s^{-1}	○●○○
76. Relativistic velocity addition gives speeds always	below c	above c	zero	equal to sum	●○○○
77. Two spaceships each at 0.9c toward each other: relative speed is	exactly c	below c	1.8c	above c	○●○○
78. Light beam from a ship moving at 0.5c has speed relative to ship	1.5c	0.5c − c	c	0.5c	○○●○
79. Light beam from a ship at 0.5c has speed relative to Earth	c	1.5c	2c	0.5c	●○○○
80. Spacetime combines	space and time	force and energy	heat and work	mass and charge	●○○○
81. Spacetime has	five dimensions	two dimensions	four dimensions	three dimensions	○○●○
82. An event in spacetime is specified by	mass and charge	t only	x, y, z and t	x and y only	○○●○

Questions	A	B	C	D	A B C D
83. Spacetime interval is	frame dependent	zero always	invariant	negative always	○○●○
84. Light cones show regions of	causal connection	colour	heat	mass	●○○○
85. General relativity was published by Einstein in	1925	1905	1895	1915	○○○●
86. General relativity describes	heat flow	gravity	magnetism	sound	○●○○
87. General relativity treats gravity as	a heat effect	a magnetic force	a chemical force	curvature of spacetime	○○○●
88. Equivalence principle says gravity is equivalent to	velocity	charge	magnetism	acceleration	○○○●
89. A person in a closed accelerating rocket cannot tell it from	a magnetic field	an inertial frame	a gravitational field	a vacuum	○○●○
90. Gravitational time dilation: clocks run slower in	weaker gravity	space only	stronger gravity	no gravity	○○●○
91. Clock at sea level compared with one on a mountain runs	faster	slower	same	backwards	○●○○
92. GPS satellites need relativistic correction because of	heat	speed and gravity	colour	magnetism	○●○○
93. Light passing near a massive object	stops	bends	goes straight	speeds up	○●○○
94. Bending of starlight near the Sun was observed during a	solar eclipse	storm	transit	lunar eclipse	●○○○
95. Gravitational lensing is caused by	massive objects bending light	magnets	clouds	lenses made of glass	●○○○
96. A black hole is a region from which	only heat escapes	all matter escapes	only sound escapes	even light cannot escape	○○○●
97. The boundary of a black hole is the	corona	magnetosphere	photosphere	event horizon	○○○●
98. Gravitational waves were predicted by	Newton	Galileo	Planck	Einstein	○○○●
99. Mercury's orbit precession is explained by	Ohm's law	general relativity	Coulomb's law	Newton's gravity alone	○●○○

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Questions	A	B	C	D	A B C D
100. Gravitational redshift means light climbing out of gravity	gains energy	loses energy	stays the same	turns blue	○●○○
101. Time at event horizon appears to stop to a	local observer	no observer	distant observer	falling observer	○○●○
102. Special relativity applies only for	accelerated frames	rotating frames	gravitational fields	inertial frames	○○○●
103. Einstein's explanation of relativity was based on	accelerators	thought experiments	lasers	microscopes	○●○○
104. Newtonian mechanics holds when speeds are	equal to c	near c	much less than c	greater than c	○○●○
105. A particle with speed 0.1c has γ approximately	0.9	1.005	1.5	2	○●○○
106. Faster speed of an object gives	less time dilation	no time dilation	greater time dilation	negative time	○○●○
107. Proper time between two events at the same place is measured by	one clock	light only	two synchronized clocks	no clock	●○○○
108. Observer moving with the object measures its length as	infinite	contracted length	zero	proper length	○○○●
109. An observer on Earth sees a fast spaceship's length	contracted	unchanged	doubled	expanded	●○○○
110. A fast spaceship's passenger sees Earth's clocks run	at same rate	backwards	slow	fast	○○●○
111. Relativistic effects are significant when speed is	zero	340 m s^{-1}	far less than c	comparable to c	○○○●
112. Time dilation factor for v = 0 is	1	2	0	infinity	●○○○
113. Mass and energy are	opposite	interconvertible	the same unit	unrelated	○●○○
114. Total energy E^2 =	$(pc)^2 + (m_0c^2)^2$	$pc + m_0c^2$	$(pc)^2 - (m_0c^2)^2$	$p^2c + m_0c$	●○○○
115. For a photon, E =	pc	pc^2	p/c	zero	●○○○
116. Nuclear reactors use	mass converted into energy	chemical burning only	electrostatic force only	energy into mass	●○○○

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Questions	A	B	C	D	A B C D
117. In pair production energy converts into	heat only	particle and antiparticle	sound	only photons	○●○○
118. Frame in which the object is at rest is the	lab frame always	zero frame	moving frame	rest frame	○○○●
119. The twin who experiences acceleration is the	neither	Earth twin	travelling twin	both	○○●○
120. Speed of light measured by moving observer relative to source is	$c - v$	$c + v$	zero	c	○○○●
121. Galilean transformations fail near	speed of light	walking speed	100 m s^{-1}	speed of sound	●○○○
122. Lorentz transformations replace	Newton's laws	Galilean transformations	Ohm's law	Maxwell's laws	○●○○
123. Maxwell's equations predict speed of light as	$\sqrt{(\mu_0\varepsilon_0)}$	$\mu_0\varepsilon_0$	$1/\sqrt{(\mu_0\varepsilon_0)}$	μ_0/ε_0	○○●○
124. Simultaneity relativity is shown by lightning at both ends of a	vacuum jar	stationary rod	at rest laboratory	moving train	○○○●
125. Which has zero rest mass?	Photon	Proton	Neutron	Electron	●○○○
126. Energy needed to create an electron–positron pair is at least	931 MeV	0.511 MeV	2 MeV	1.02 MeV	○○○●
127. A 0.5 kg mass converted fully gives	4.5×10^{16} J	9×10^{16} J	4.5×10^{13} J	1.5×10^{8} J	●○○○
128. Relativistic effects were first confirmed by	thermometers	water waves	muon decay observations	sound echoes	○○●○
129. Time dilation for v = 0.6c compared with rest time is	the same	2 times longer	0.8 times shorter	1.25 times longer	○○○●
130. Length contraction for v = 0.8c gives fraction	0.8 of proper length	0.36 of proper length	0.6 of proper length	1.67 of proper length	○○●○
131. Newton's laws are special cases of relativity when speed is	very small compared with c	above c	equal to c	infinite	●○○○
132. Light takes about how long to travel 3×10^8 m in vacuum?	1 min	1 ms	1 h	1 s	○○○●
133. A light-year is a unit of	speed	time	energy	distance	○○○●

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Questions	A	B	C	D	A B C D
134. Distance light travels in one year is about	9.5×10^{15} m	1.5×10^{11} m	9.5×10^{5} m	3×10^{8} m	●○○○
135. Speed of a particle with $\gamma = 2$ is	0.5c	0.99c	0.866c	0.6c	○○●○
136. Speed of a particle with $\gamma = 1.25$ is	0.5c	0.6c	0.9c	0.8c	○●○○
137. Total energy of a particle at rest is	$\frac{1}{2}m_0c^2$	zero	m_0c^2	infinite	○○●○
138. A particle's kinetic energy equals its rest energy when γ is	3	2	1	0.5	○●○○
139. Mass defect of 0.03 u gives energy about	28 MeV	0.03 MeV	2.8 MeV	931 MeV	●○○○
140. Energy released if 1 u of mass is converted fully is	9.31 MeV	931 MeV	1.6 MeV	93.1 MeV	○●○○
141. Muons formed in the upper atmosphere decay in about	2.2 μs at rest	2.2 ms	2.2 ns	2.2 s	●○○○
142. Moving clocks tick slower by factor	γ^2	γ	$1/\gamma$	$1/\gamma^2$	○○●○
143. Observers in relative motion disagree on	invariant interval	laws of physics	speed of light	time intervals and lengths	○○○●
144. Observers in different inertial frames agree on	the length of a rod	the time between events	simultaneity	the speed of light	○○○●
145. Time dilation depends on	relative speed	mass	colour	direction only	●○○○
146. Cosmic rays are mostly	visible light	sound	radio waves	high-energy charged particles	○○○●
147. At 0.99c, γ is about	1.5	100	2	7	○○○●
148. Relativistic mass diverges as $v \to$	c/2	0	c	2c	○○●○
149. Event horizon radius depends on the black hole's	colour	mass	temperature only	charge only	○●○○
150. In general relativity, free-fall is motion along	the straightest path in curved spacetime	a magnetic path	a curved force path	no path	●○○○

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