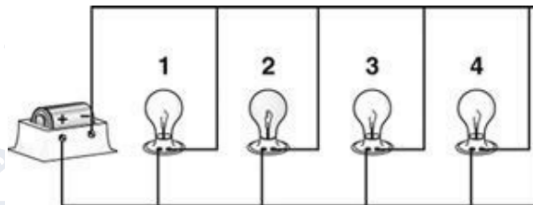


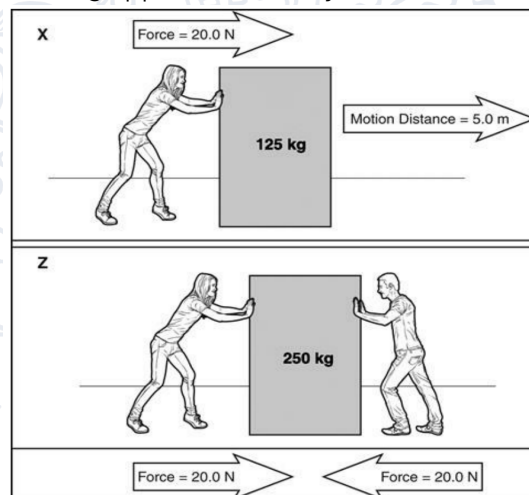
COPERNICUS OLYMPIAD
Physics and Astronomy Discipline
Category 2 - Sample Questions

- Adam had a string of lights. The whole string of lights stopped glowing when one of the lightbulbs burned out. What caused this to happen?
 - The burned-out lightbulb closed the circuit.
 - The burned-out lightbulb opened the circuit.
 - The burned-out lightbulb drained the power source.
 - The burned-out lightbulb caused a surge in the power source.
- Which statement best describes work being done on an object?
 - Two equal, but opposite, forces are applied to an object.
 - A force is applied to an object and the object remains stationary.
 - The frictional force on an object is greater than a pushing force applied to the object.
 - A force is applied to an object, and the object moves in the same direction as the force.
- Refer to the electric circuit to answer the question that follows.



Light bulb 2 burned out in this circuit. If voltage remains constant, what happens to the remaining light bulbs?

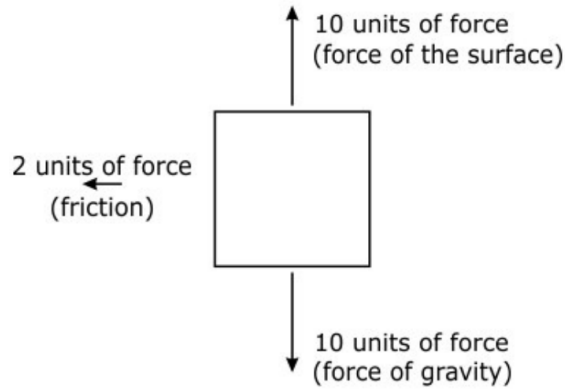
- They burn out.
 - They got dimmer.
 - They get brighter.
 - They remain the same.
4. The diagrams below show force being applied to two objects.



Which conditions indicate that work was NOT done?

- X because the box moved, unlike Z.
- X because the box had less mass and more force than Z.
- Z because the box had more mass and less force than X.
- Z because the box was pushed by two equal forces, unlike X.

5. A ball is rolling on a flat, frictionless surface. What will happen to the ball if no unbalanced force acts on the ball?
- The ball will roll faster and faster.
 - The ball will begin to roll in the opposite direction.
 - The ball will begin to roll faster for a time and then begin to roll slower.
 - The ball will continue to roll in the same direction and at the same speed.
6. This diagram shows the forces acting on an object as it moves to the right.



How will these forces affect the object's motion?

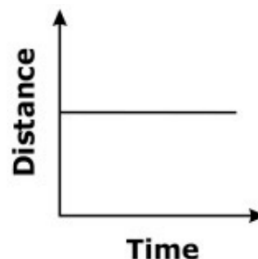
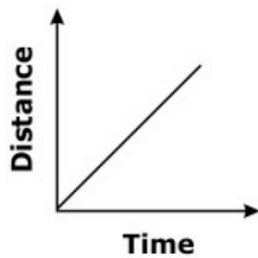
- The object will slow down because friction is an unbalanced force.
 - The object will slow down because gravity is an unbalanced force.
 - The object will move at a constant speed because friction is balanced by the other two forces.
 - The object will move at a constant speed because gravity is balanced by the other two forces.
7. What A stationary object experiences two forces, as shown in the diagram below.

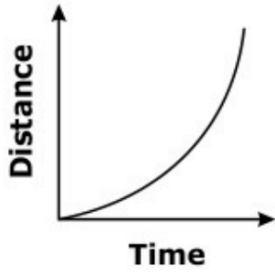


How will these forces affect the object?

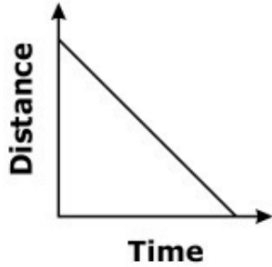
- The object will accelerate because the forces are balanced.
- The object will accelerate because the forces are unbalanced.
- The object will remain stationary because the forces are balanced.
- The object will remain stationary because the forces are unbalanced.

8. Which graph shows an increasing speed?



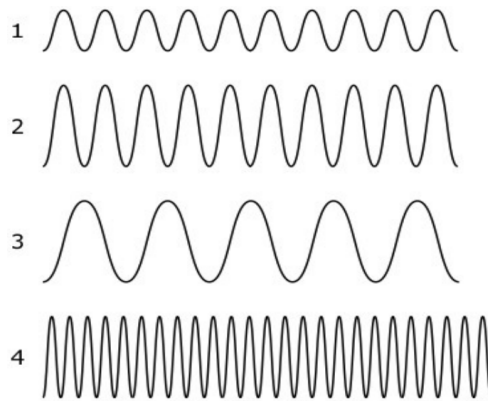


C.



D.

9. Each wave pictured shows a different property.



Which wave will produce the strongest earthquake and the highest pitched sound?

- A. Wave 1
- B. Wave 2
- C. Wave 3
- D. Wave 4

10. Which statement best describes visible light?

- A. The human eye can only detect visible light as white light.
- B. Visible light can only be seen with special equipment or technology.
- C. Visible light makes up a small part of the electromagnetic spectrum.
- D. The frequency of visible light is the same as the frequency of gamma rays.

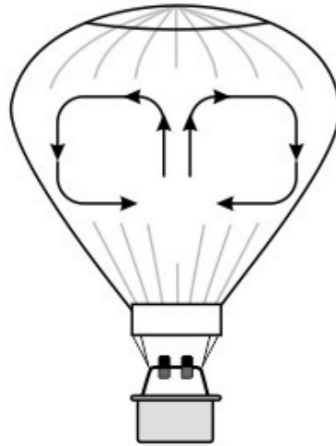
11. The diagram below shows a sound wave moving through air from a speaker to an ear.



What kind of wave is represented in the diagram?

- A. Electromagnetic
- B. Longitudinal
- C. Mechanical
- D. Transverse

12. The image below shows a hot air balloon.



What is the main kind of energy transfer within the balloon?

- A. Absorption
- B. Conduction
- C. Convection
- D. Radiation

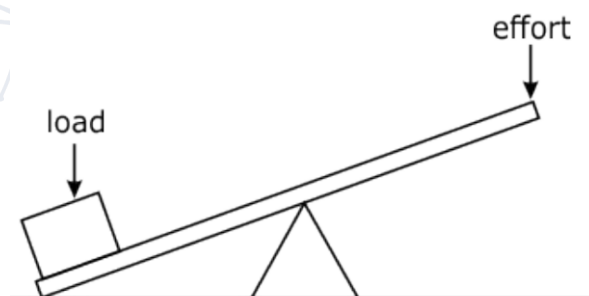
13. The picture below shows a pencil in water.



Which term best describes the wave behavior as light moves from air to water in this setup?

- A. Absorption
- B. Reflection
- C. Refraction
- D. Scattering

14. The diagram below shows a lever.



Which statement is true about the diagram?

- A. Energy transfer (effort) must equal the load.
- B. Energy transfer (effort) must be more than the load.

- C. Load must be larger than the energy transfer (effort).
- D. No relationship exists between the energy transfer (effort) and load.

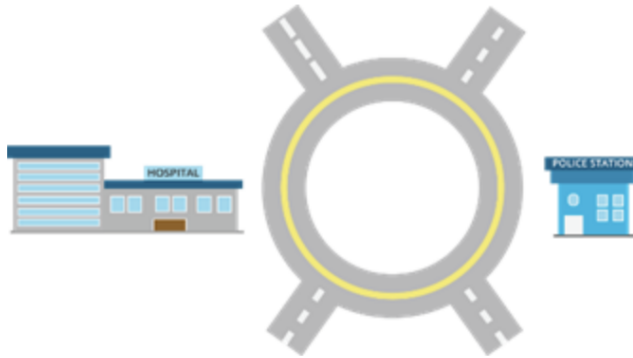
15. A light bulb with a resistance of $80\ \Omega$ is connected to a $120\ \text{V}$ source. What is the current flowing through the light bulb?

- A. $0.67\ \text{A}$
- B. $0.96\ \text{A}$
- C. $1.2\ \text{A}$
- D. $1.5\ \text{A}$

16. An electric iron is plugged in a wall outlet that supplies a voltage of $210\ \text{V}$. If the current is $1.05\ \text{A}$, find the resistance of the electric iron.

- A. $100\ \Omega$
- B. $125\ \Omega$
- C. $200\ \Omega$
- D. $225\ \Omega$

17. A car traverses half of a roundabout on its way from the police station to the hospital, which is situated on opposite sides.



If the car travels at $19.0\ \text{m/s}$ along the lane that is around $242.0\ \text{m}$ away from the center of the roundabout, how much time does it need to travel?

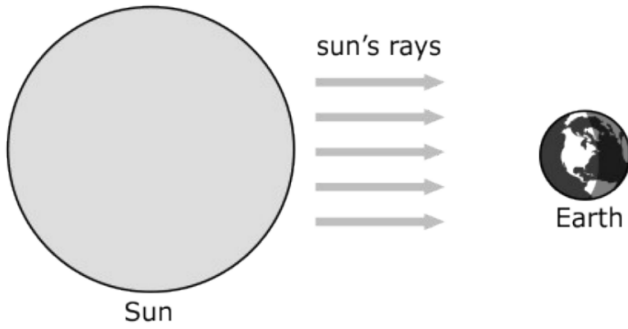
- A. $20.0\ \text{s}$
- B. $30.0\ \text{s}$
- C. $40.0\ \text{s}$
- D. $50.0\ \text{s}$

18. You joined a 100-m run and clocked a speed of $12\ \text{m/s}$. If you start from rest, how much work did you exert during the run? Assume that your mass is $60\ \text{kg}$.

- A. $360\ \text{J}$
- B. $720\ \text{J}$
- C. $4320\ \text{J}$
- D. $8640\ \text{J}$

19. If the sun is able to do $3.9 \times 10^7\ \text{J}$ of work in a distance of $1\ \text{m}$, how much power is used by the sun to do work on a distance same as the radius of Earth in a day? The radius of Earth is $6371\ \text{km}$.

20. The diagram below shows energy being transmitted from the Sun to Earth.

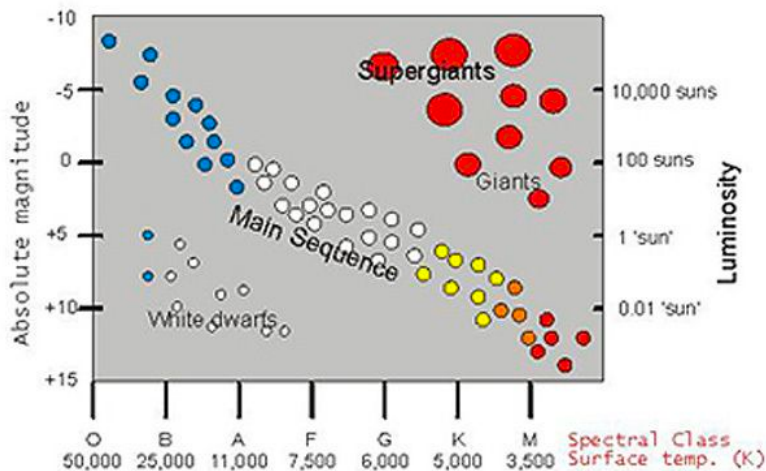


- What does the diagram imply?
- A. The energy is transferred as thermal radiation and light because no direct contact is needed between the sun and Earth.
 - B. The energy is transferred by conduction because no direct contact is needed between the sun and Earth.
 - C. The energy is transferred as thermal radiation because at times the sun and Earth are in direct contact.
 - D. The energy is transferred by conduction because the sun and Earth are always in direct contact.

21. Which of the following describes the big bang theory?
- A. A cosmological model explaining how the universe began.
 - B. A theory suggesting that the universe has always been present.
 - C. A hypothesis explaining that the universe has no beginning and no end.
 - D. A scientific model describing how the universe will end through a sudden collapse.

22. What does the cosmic microwave background radiation prove?
- A. The universe has no beginning or end.
 - B. The universe began from a hot and violent expansion.
 - C. The universe began from a cold and dense expansion.
 - D. The universe will end in an explosion called cosmic egg.

23. Analyze the given diagram below.



Based on this diagram which type of stars would belong to spectral class M and have the lowest luminosity?

- A. Giants
- B. Main sequence stars
- C. Super giants
- D. White dwarfs

24. What type of galaxy is shown in the image below?



- A. Elliptical
- B. Irregular
- C. Regular
- D. Spiral

25. The photo below shows two merging galaxies taken by the Hubble space telescope. What could possibly happen if these two galaxies collide?



- A. One galaxy will die.
- B. A spiral galaxy is formed.
- C. An irregular galaxy is formed.
- D. One galaxy will break up into two.

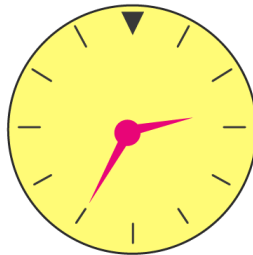
26. The freezing and boiling points of a substance 'P' are -220°C and -185°C respectively. At which of the following range of temperatures will 'P' exist as a liquid?

- A. Between -175°C and -210°C
- B. Between -190°C and -225°C
- C. Between -200°C and -160°C
- D. Between -195°C and -215°C

27. What happens to the inertia of an object when its velocity is doubled?

- A. The object's inertia becomes 2 times lesser
- B. The object's inertia becomes 2 times greater
- C. The object's inertia becomes 4 times greater
- D. The object's inertia remains the same

- 28.** The force experienced by a current-carrying conductor placed in a magnetic field is the largest when the angle between the conductor and the magnetic field is
- 45°
 - 60°
 - 90°
 - 180°
- 29.** The mass of a planet is 6×10^{24} kg and its diameter is 12.8×10^3 km. If the value of gravitational constant be 6.7×10^{-11} Nm²/kg², calculate the value of acceleration due to gravity on the surface of the planet. What planet could this be?
- Mars
 - Earth
 - Venus
 - None of these.
- 30.** The resistance of a wire of length 300 m and cross-section area 1.0 mm² made of material of resistivity 1.0×10^{-7} Ωm is
- 2 Ω
 - 3 Ω
 - 20 Ω
 - 30 Ω
- 31.** The figure given alongside shows the image of a clock as seen in a plane mirror. The correct time is



- 2.25
 - 2.35
 - 6.45
 - 9.25
- 32.** A metal sphere of mass 12 kg has the same diameter as another sphere of mass 4 kg. Both spheres are dropped simultaneously from a tower. When they are 8 m above the ground, they have the same what? Neglect air resistance.
- Kinetic energy
 - Potential energy
 - Momentum
 - Acceleration
- 33.** A body travels 2 m in the first two second and 2.20 m in the next 4 second with uniform deceleration. The velocity of the body at the end of 9 second is
- 10 m/s
 - 0.20 m/s
 - 0.40 m/s
 - 0.80 m/s

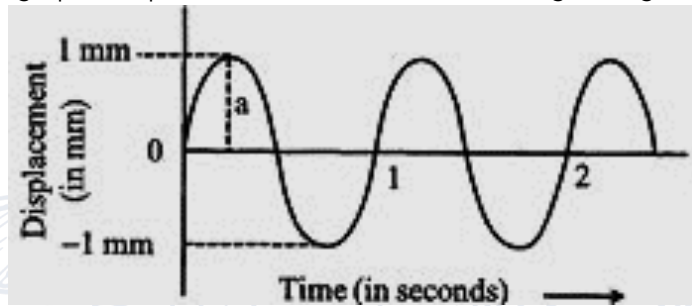
34. An electric dipole placed in a non-uniform electric field experience

- A. Both a torque and a net force
- B. Only a force but no torque
- C. Only a torque but no net force
- D. No torque and no net force

35. A hammer exerts a force of 1.5 N on each of the two nails A and B. The area of cross section of tip of nail A is 2 mm^2 while that of nail B is 6 mm^2 . Calculate pressure on each nail in pascal.

- A. $7.5 \times 10^5 \text{ Pa}$ and $2.5 \times 10^5 \text{ Pa}$
- B. $3.0 \times 10^5 \text{ Pa}$ and $2.5 \times 10^5 \text{ Pa}$
- C. $7.5 \times 10^6 \text{ Pa}$ and $2.5 \times 10^5 \text{ Pa}$
- D. $3.0 \times 10^5 \text{ Pa}$ and $2.5 \times 10^5 \text{ Pa}$

36. The position versus time graph of a particle in a wave is shown in the given figure.



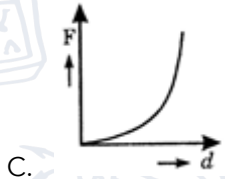
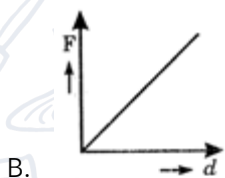
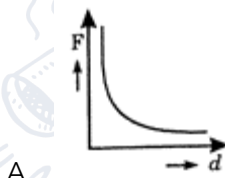
The parameter of the wave denoted by 'a' is known as its

- A. Wavelength
- B. Amplitude
- C. Frequency
- D. Origin

37. The work done in holding 15 kg suitcase while waiting for a bus for 15 minutes is

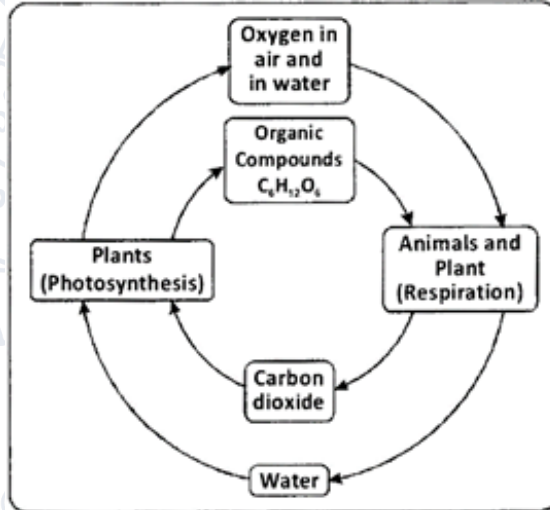
- A. 225 J
- B. 13500 J
- C. 1500 J
- D. Zero

38. In the given figure, distance [d] between conductors carrying currents I_1 and I_2 is varied. Which of the following graphs correctly represents the variation of force (F) between the conductors and distance [d]?



- D. None of these.

39. Identify the given biogeochemical cycle.



- A. Mineral cycle
- B. Nitrogen cycle
- C. Water cycle
- D. Oxygen cycle

40. Velocity time curve for a body projected vertically upwards is

- A. Parabola
- B. Ellipse
- C. Hyperbola
- D. Straight line

41. A car has travelled a distance s , from its starting point on a trip is shown in the table below as a function of time t , since the trip started.

Hour	0	1	2	3	4	5
Km	0	45	135	220	300	400

What is the average velocity between $t = 1$ h and $t = 3$ h.

- A. 110 km/h
- B. 95 km/h
- C. 87.5 km/h
- D. 85 km/h

42. Four optical media A, B, C and D have optical densities 1.35, 1.21, 1.58 and 1.002 respectively. In which optical medium will the light travel fastest?

- A. A
- B. B
- C. C
- D. D

43. Which of the following is an abiotic component of the environment?

- A. Plants
- B. Animals
- C. Microorganisms
- D. Water

44. If a force F is applied on a body and it moves with a velocity V , the power will be

- A. $F \times v$
- B. $\frac{F}{v}$

- C. $\frac{F}{v^2}$
 D. $\frac{F \times v}{2}$

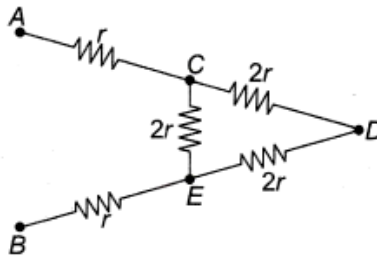
45. What kind of energy is present in a rotating wheel?

- A. Kinetic energy
 B. Electrical energy
 C. Potential energy
 D. Wind energy

46. An object is dropped from certain height. Which of the following statements is correct about the object when it is about to reach the ground?

- A. It has minimum kinetic energy.
 B. It has maximum kinetic energy.
 C. The kinetic energy is zero at this point.
 D. It has maximum potential energy.

47. What is the equivalent resistance between points A and B in the given circuit diagram?



- A. 43 r
 B. 103 r
 C. 53 r
 D. 10 r

48. An iron ball and a wooden ball of the same radius are released from a height H in vacuum. The times taken by both of them to reach the ground are

- A. Roughly equal
 B. Unequal
 C. Exactly equal
 D. In the inverse ratio of their diameters

49. If the kinetic energy of a body of mass 2 kg is 25 J. Its speed is

- A. 25 m/s
 B. 15 m/s
 C. 5 m/s
 D. 2.5 m/s

50. SI unit of specific energy is

- A. Jkg^{-1}
 B. K^{-1}
 C. $\text{Jkg}^{-1}\text{K}^{-1}$
 D. Pa

51. What is the name of the region beyond Neptune's orbit where icy bodies lie?



- A. The Kuiper Belt
- B. The Oort Cloud
- C. The Outer Asteroid Belt
- D. All of the above.

52. What were the first elements made after the Big Bang?

- A. Hydrogen and helium
- B. Hydrogen and lithium
- C. Helium and oxygen
- D. Helium and argon

53. A low mass star will end its life as which of the following?

- A. Red dwarf
- B. Red giant
- C. Black dwarf
- D. Brown dwarf

54. The time when day and night everywhere on earth are approximately equal length is known as what?

- A. Solstice
- B. Equinox
- C. Season
- D. Mare

55. How long ago did the Big Bang happen?

- A. 10,000 years ago
- B. 13.7 billion years ago
- C. 13.7 million years ago
- D. 13.7 trillion years ago

56. The table given below shows the resistivity of three Material X, Y and Z.

Samples	X	Y	Z
Resistivity	3×10^{-9}	11.1×10^{-6}	18×10^{-17}

Arrange the samples in increasing order of conductivity.

- A. $Y < X < Z$
- B. $Y < Z < X$
- C. $X < Y < Z$
- D. $X < Z < Y$

57. Stopping distance of vehicles: When brakes are applied to a moving vehicle, the distance it travels before stopping is called stopping distance. It is an important factor for road safety that depends on the initial velocity (v_0) and the braking capacity or deceleration. A car travelling at speed 72km/hr suddenly applies the brake with a deceleration of 5 m/s^2 . Find the stopping distance of the car.

- A. 20 m
- B. 25 m
- C. 50 m
- D. 40 m

58. In a free fall, the velocity of a stone is increasing on equal intervals of time under the effect of gravitational force of the Earth. What can you say about the motion of this stone?

- A. Uniform acceleration
- B. Non-uniform acceleration
- C. Retardation
- D. Constant speed

59. If an object moves 3.14 km in a circular path of radius 1000 m, then the value of displacement is

- A. 4 km
- B. 8 km
- C. 2 km
- D. 0 km

60. The Upthrust on a body depends on which of the following factors?

- (1) The volume of the body submerged in the liquid.
- (2) Density of liquid in which the body is submerged.

- A. Both 1 and 2
- B. Only 1
- C. Only 2
- D. None of these.

61. Pressure of a point in a liquid at a given depth is _____ to its density.

- A. Equal
- B. Directly proportional
- C. Indirectly proportional
- D. None of these.

62. Read the given statements and choose the correct option.

- (1) The acceleration's direction depends directly upon the net force.
- (2) The acceleration depends inversely upon the object's mass.

- A. 1 is correct.
- B. 2 is correct.
- C. Both 1 and 2 are correct.
- D. None of these.

63. Mark the statement as true or false.

- (1) A piece of wood if left underwater comes to the surface of the water because the upthrust on the body due to its submerged part is equal to its own weight.
- (2) A body shall weigh less in a vacuum.

- A. 1 is true and 2 is false.
- B. 1 is false and 2 is true.

- C. Both are true.
- D. Both are false.

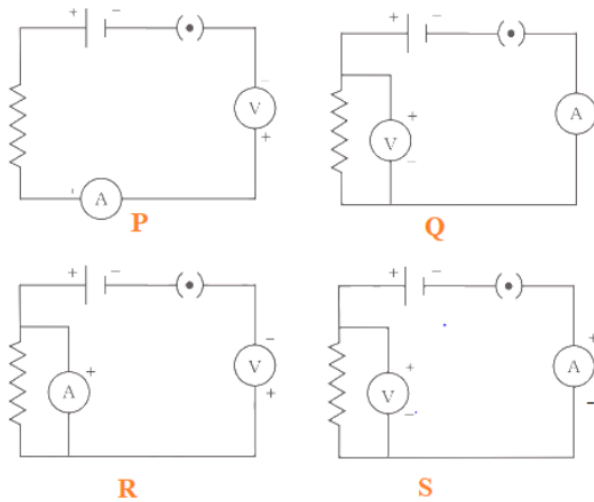
64. A body of volume V and density ρ is kept completely immersed in a liquid of density q . If g is acceleration due to gravity, the upthrust on the body is

- A. $V \rho g$
- B. $V q g$
- C. $V (\rho - q) g$
- D. None of these.

65. Suppose a boy is enjoying a ride on a merry-go-round which is moving with a constant speed of 10 m/s. It implies that the boy is

- A. At rest
- B. Moving with no acceleration
- C. In accelerated motion
- D. Moving with uniform velocity

66. Which one of the below circuits is properly connected with the electrical components?

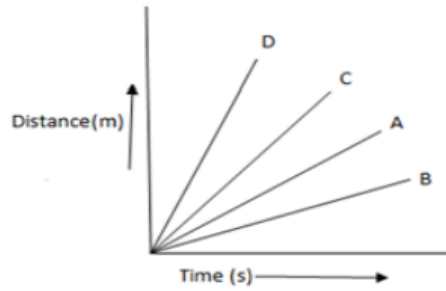


- A. P
- B. Q
- C. R
- D. S

67. Arhan leaves his house at 8:30 AM for his school. The school is 2 km away and classes start at 9:00 AM. If he walks at a speed of 3 km/hr for the first kilometer, at what speed should he walk the second kilometer to reach just in time?

- A. 3 km/hr
- B. 4 km/hr
- C. 6 km/hr
- D. 18 km/hr

68. Four cars A, B, C and D are moving on a levelled, straight road. Their distance time graphs are shown in the figure below. Which of the following is the correct statement regarding the motion of these cars?



- A. Car A is faster than car D
- B. Car B is the slowest
- C. Car D is faster than car C
- D. Car C is the slowest

69. The gravitational force between two bodies is decreased by 36% when the distance between them is increased by 3 m. The initial distance between them is

- A. 6 m
- B. 9 m
- C. 12 m
- D. 15 m

70. What kind of energy is present in a rotating wheel?

- A. Kinetic energy
- B. Electrical energy
- C. Potential energy
- D. Wind energy

71. Hydropower plants are located in

- A. Desert area
- B. Plane area
- C. Hilly terrains
- D. None of the above.

72. What is the minimum resistance which can be made using five resistors each of 1/2 ohm?

- A. 1/10 ohm
- B. 1/25 ohm
- C. 10 ohms
- D. 2 ohms

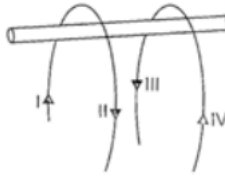
73. Four optical media A, B, C and D have optical densities of 1.35, 1.21, 1.58 and 1.002, respectively. In which optical medium will the light travel fastest?

- A. A
- B. B
- C. C
- D. D

74. A 5 cm tall object is placed perpendicular to the principal axis of a convex lens of focal length 20 cm. The distance of the object from the lens is 30 cm. Find the position of the image.

- A. 60 cm
- B. -60 cm
- C. 90 cm
- D. -90 cm

75. Two current-conducting wires are hung on a plastic rod. A large current is passed through the two wires in the direction shown. Which of the following statements is correct regarding this?



- (1) I and III parts of wire repel each other.
- (2) II and IV parts of wire repel each other.
- (3) I and IV parts of wire repel each other.
- (4) II and III parts of wire repel each other.

- A. Only 1 and 2
- B. Only 1 and 3
- C. Only 3 and 4
- D. Only 1 and 4

76. A small conducting rod of length l moves with a uniform velocity v in uniform magnetic field B as shown in figure. Which of the following options is correct?



- A. The end X of the rod becomes positively charged.
- B. The end Y of the rod becomes positively charged.
- C. The entire rod is unerringly charged.
- D. The rod becomes hot due to joule heating.

77. For hearing a distinct sound, the time interval between the original sound and the reflected one must be at least

- A. 1 s
- B. 0.1 s
- C. 2 s
- D. 0 s

78. 1 Kilo calorie = _____ Joule

- A. 42 joules
- B. 4184 joules
- C. 4000 joules
- D. 40 joules

79. A battery of 10V carries 20,000 C of charge through a resistance of 20Ω . The work done in 10 seconds is

- A. 10×10^3 joules
- B. 2×10^5 joules
- C. 2×10^4 joules
- D. 2×10^2 joules

80. A car starts from rest and acquires a velocity of 54 km/h in 2s. Find the following.

- (1) Acceleration
- (2) Distance travelled by car assuming motion of car is uniform
- (3) If the mass of the car is 1000 kg, what is the force acting on it?
- (4) Convert the force obtained in kilogram force.
- (5) The seat belts are provided in the cars so that if the car stops suddenly due to an emergency braking, the persons sitting on the front seats are not thrown forward violently and saved from getting injured. Can you guess the law due to which a person falls in forward direction on the sudden stopping of the car? Also give the statement of the law.

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Physics and Astronomy Discipline
Category 2 - ANSWER KEYS

No	Answer	No	Answer	No	Answer	No	Answer
1	B	21	A	41	C	61	B
2	D	22	B	42	D	62	C
3	D	23	B	43	D	63	A
4	D	24	A	44	A	64	B
5	D	25	C	45	A	65	C
6	A	26	D	46	B	66	B
7	B	27	D	47	B	67	C
8	C	28	C	48	C	68	B
9	D	29	B	49	C	69	C
10	C	30	D	50	C	70	A
11	B	31	D	51	A	71	C
12	C	32	D	52	A	72	A
13	C	33	B	53	C	73	D
14	B	34	A	54	B	74	A
15	D	35	A	55	B	75	A
16	C	36	B	56	A	76	B
17	C	37	D	57	A	77	B
18	C	38	A	58	A	78	B
19	Zero	39	D	59	C	79	B
20	A	40	D	60	A	80	
						80.1	7.5 m/s ²
						80.2	
						80.3	7500 N
						80.4	764.78715973 kg force
						80.5	Newton's first law of motion which states that an object at rest stays at rest and an object in motion stays in motion with the same speed and in the same direction unless acted upon by an unbalanced force.