EDUCATIONAL ASSESSMENT AND EXAMINATIONS SERVICE (EAES)
ETHIOPIAN SECONDARY SCHOOL LEAVING CERTIFICATE EXAMINATION (ESSLCE)
Physics, Sene, 2017 E.C /June/July, 2025 G.C

NUMBER OF ITEMS: 60 **SUBJECT CODE: 04**
TIME ALLOWED: 2:30 HOURS **BOOKLET CODE: 326**

You may refer to the information given below when you need to work on some of the questions.

Name of constants	Symbol	Value
Acceleration due to gravity	g	$10\ m/s^2$
Mass of proton	m_p	1.67×10^{-27} kg
The charge of electron	e^-	-1.6×10^{-19} C
Mass of electron	m_e	9.11×10^{-31} kg
Universal gravitational constant	G	$6.67 \times 10^{-11}\ Nm^2/kg^2$
Mass of the Earth	M_E	6×10^{24} kg
Radius of the Earth	R_E	6.4×10^6 m
Density of water	ρ_w	$1000\ kg/m^3$
Specific heat capacity of water	c_w	4200 J/kg.K
Molar gas constant	R	8.314 J/mol.K
Permittivity of free space	ε_o	$8.85 \times 10^{-12}\ C^2/Nm^2$
Magnetic permeability of free space	μ_o	$4\pi \times 10^{-7}$ Tm/A
Coulomb's constant	k	$9 \times 10^9\ Nm^2/C^2$
Planck's constant	h	6.63×10^{-34} Js
Pi	π	3.14
$\sin 30^o = \cos 60^o = 0.5$		
$\sin 60^o = \cos 30^o = 0.87$		
$\sin 37^o = \cos 53^o = 0.6$		
$\sin 53^o = \cos 37^o = 0.8$		

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1. The magnetic field created by a long straight current carrying wire

   A. is inversely proportional to the current in the wire.
   B. is directly proportional to the distance from the wire.
   C. forms circular pattern around the wire.
   D. is directed in the same direction as the current.

2. We usually use plastic materials to cover metallic wires that carry electricity to protect living things from danger. Which of the following statement correctly describes the nature of the plastic to use for this purpose?

   A. Since it has no free electrons, it directs the electrons in the wire to flow in the same direction.
   B. Since it has free electrons, it facilitates the easy flow of electric current in the metallic wires.
   C. Since every electron in plastic is tightly bound to the parent atom, it becomes poor conductor.
   D. Since every electron in plastic is slightly bound to the parent atom, it becomes poor conductor.

3. What will happen on a pure semiconductor when it is doped by group III element?

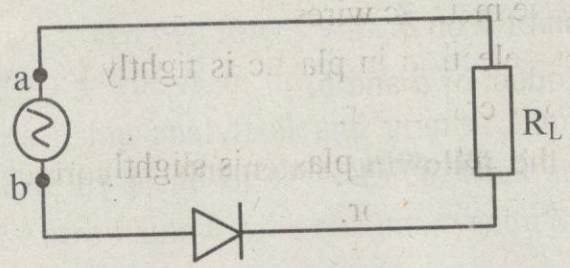
   A. It becomes P-type semiconductor.
   B. It becomes N-type semiconductor.
   C. It gets extra free electrons.
   D. It becomes intrinsic semiconductor.

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4. Which one of the following statements is correct about the current-voltage (I-V) characteristics of a typical semiconductor diode?

A. The current due to the majority charge carriers is represented in the reverse bias region of the I-V curve.
B. The current due to the minority charge carriers is represented in the forward bias region of the I-V curve.
C. The region of the I-V curve that increases very rapidly after the bias voltage exceeds the breakdown voltage is in the forward bias region.
D. The region of the I-V curve that rises very rapidly after the voltage exceeds the cut-in voltage is the forward bias region.

5. Consider a circuit containing diode and load resistor (R_L) are connected to an AC voltage source as shown in the figure below.



If initially, polarity of 'a' is positive while 'b' is negative,

A. During the second half-cycle, the diode is reverse biased and no current flow in the load resistor.
B. During the first half-cycle, the diode is forward biased and voltage is developed across the load resistor.
C. During the first half-cycle, the diode is reverse biased and voltage is developed across the load resistor.
D. During the second half-cycle, the diode is forward biased and current flows in the load resistor.

6. A circular coil is located in a uniform magnetic field of magnitude $0.50\,T$ directed perpendicular to the plane of the coil. If the area of the coil changes with uniform rate, in such a way that it increases by $4.0 \times 10^{-3}\,m^2$ in $2\,s$, what is the magnitude of the induced electromotive force (emf) in the coil?

A. $4.0 \times 10^{-3}\,V$
B. $1.0 \times 10^{-3}\,V$
C. $2.5 \times 10^{2}\,V$
D. $1.0 \times 10^{3}\,V$

7. If two vectors $\vec{a}$ and $\vec{b}$, with respective magnitudes of a and b, form an angle α between them when they are connected tail to tail, then the expression $ab\cos\alpha$ defines the value of

A. scalar product of $\vec{a}$ and $\vec{b}$.
B. resultant of $\vec{a}$ and $\vec{b}$.
C. projection of $\vec{a}$ on $\vec{b}$.
D. vector product of $\vec{a}$ and $\vec{b}$.

8. Which one of the following statements is correct about real and virtual images?

A. Real images can be magnified but virtual images cannot.
B. Virtual images can be magnified but real images cannot.
C. Virtual images can be displayed on a screen unlike the real ones.
D. Real images can be displayed on a screen unlike the virtual ones.

9. An object moving in one dimension with constant acceleration a travels through a displacement s in a time interval t. If its velocity at the initial time $t = 0$ is v_i and its velocity at a later time t is v_f, which of the following is a correct relation between the given quantities?

A. $s = \left(\frac{v_f - v_i}{2}\right)t$
B. $s = v_i t + \frac{1}{2}at$
C. $s = \frac{v_f^2 - v_i^2}{a}$
D. $s = v_f t - \frac{1}{2}at^2$

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10. If the critical angle for an optically denser medium to air boundary is 53°, what will be the refractive index of the medium? (Assume the index of refraction of air is 1.00, $\sin 53^{\circ} = \cos 37^{0} = 0.8$, $\cos 53^{\circ} = \sin 37^{0} = 0.6$)

A. 1.25
B. 1.00
C. 1.33
D. 1.67

11. Given the displacement vector $\vec{A} = (3\ \hat{\imath} - 4\ \hat{\jmath})\ m$, what is the unit vector in the direction of $\vec{A}$?

A. $0.6\ \hat{\imath} + 0.8\ \hat{\jmath}$
B. $0.8\ \hat{\imath} - 0.6\ \hat{\jmath}$
C. $0.6\ \hat{\imath} - 0.8\ \hat{\jmath}$
D. $-0.6\ \hat{\imath} + 0.8\ \hat{\jmath}$

12. Suppose that you are given two forces with $F_1 = 75\ N$ in the direction of 53° west of north and $F_2 = 100\ N$ in the direction of 37° east of north. If you add the two forces using analytical and graphical methods and represent using graphical scale of 1 cm for 10 N force, what are the possible length and direction of the arrow line for the resultant vector?

A. 1.73 cm to 45^{0} North of East
B. 1.25 cm to the North
C. 17.3 cm to 45^{0} North of East
D. 12.5 cm to the North

13. The amount of heat energy required to raise the temperature of a given substance by 1°C is

A. specific heat capacity.
B. quantity of heat.
C. heat capacity.
D. latent heat.

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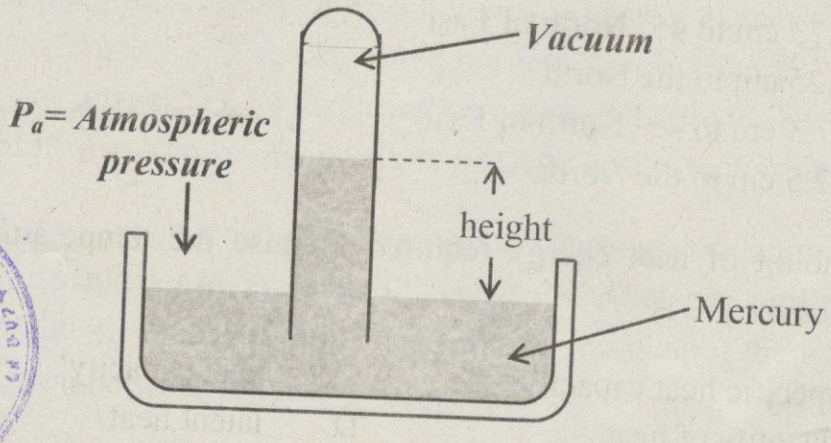
14. Which one of the following statements is correct about the properties of waves?

A. Diffraction of a wave through a narrow gap is more observable than through a wider gap.
B. When two waves interfere destructively, the amplitude of the resultant wave is greater than the amplitude of each wave.
C. When a wave is refracted, its speed and wavelength remain the same.
D. When a wave is reflected, its speed and wavelength are changed.

15. A square metal plate of coefficient of linear expansion α, has a surface area A_0 at a temperature T_0. If the temperature is raised by an amount ΔT, then the plate surface area is changed to A which is expressed as

A. $A = 2A_0(1 + \alpha\,\Delta T)$.
B. $A = A_0(1 + 2\,\alpha\,\Delta T)$.
C. $A = A_0(1 + 3\,\alpha\,\Delta T)$.
D. $A = A_0(1 + \alpha\,\Delta T)$.

16. The atmospheric pressure in a certain area is determined to be 103.36 kPa, using a mercury barometer shown in the figure below. *(*Acceleration due to gravity, $g = 10\ m/s^2$, and density of mercury, $\rho_m = 13.6 \times 10^3\ kg/m^3$*)*



The height to which the mercury column rises is about

A. 76 cm
B. 76 mm
C. 760 cm
D. 7.6 m

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17. An object dropped into a sea sinks to a depth of 100 m. Which of the following is correct about the pressure the object experiences? (Assume the density of seawater is 1030 kg/m^3 and the air above the see exerts a pressure of $P_{atmospheric} = 1.00 \times 10^5$ Pa, g = 10 m/s^2)

A. The absolute pressure exerted on it is $P_{absolute} = 9.30 \times 10^5$ Pa.
B. The gauge pressure exerted on it is $P_{gauge} = 1.01 \times 10^5$ Pa.
C. The gauge pressure exerted on it is $P_{gauge} = 1.03 \times 10^7$ Pa.
D. The absolute pressure exerted on it is $P_{absolute} = 1.13 \times 10^6$ Pa.

18. How much heat energy is required to change 5 kg of ice at -20 °C to water at 10 °C? (Specific heat capacities of water in liquid and solid phases are 4.2 kJ/kg°C and 2.1 kJ/kg°C, respectively, and latent heat of fusion of water, $L_f = 336000$ J/kg).

A. 1.68×10^6 J
B. 4.20×10^5 J
C. 1.89×10^6 J
D. 2.10×10^6 J

19. A force that is exerted on a simple machine in order to produce input work is called

A. effort.
B. normal.
C. friction.
D. load.

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20. Which one of the following statements is correct about transverse and longitudinal waves?

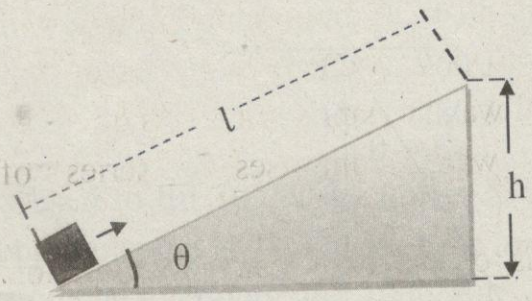
A. The directions of wave motion and vibration of particles are parallel for longitudinal waves but perpendicular for transverse waves.
B. A longitudinal wave comprises a series of crests and troughs, whereas a transverse wave comprises a series of compressions and rarefactions.
C. The directions of wave motion and vibration of the particles are parallel for transverse waves and perpendicular for longitudinal waves.
D. Waves on a string are longitudinal whereas sound waves are transverse.

21. An object that is partially or fully submerged in a fluid experiences an upward force from the fluid. The apparent weight of the object is the weight of the

A. object in air.
B. fluid it displaces minus the buoyant force.
C. fluid it displaces.
D. object in air minus the buoyant force.

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22. A force is used to push a box of mass, m along the slop of inclined plane with constant velocity as shown in the figure below.



If the coefficient of friction between the box and the inclined plane be μ, the actual mechanical advantage (AMA) of the inclined plane is

A. $(\sin\theta + \mu\cos\theta)$
B. $1/(\cos\theta + \mu\sin\theta)$
C. $(\cos\theta + \mu\sin\theta)$
D. $1/(\sin\theta + \mu\cos\theta)$

23. A wheel and axle of radii 40 cm and 8 cm, respectively, is used to lift a bucket of 6 kg of water from a well by applying an effort of 20 N on the wheel. The percentage efficiency of this simple machine is

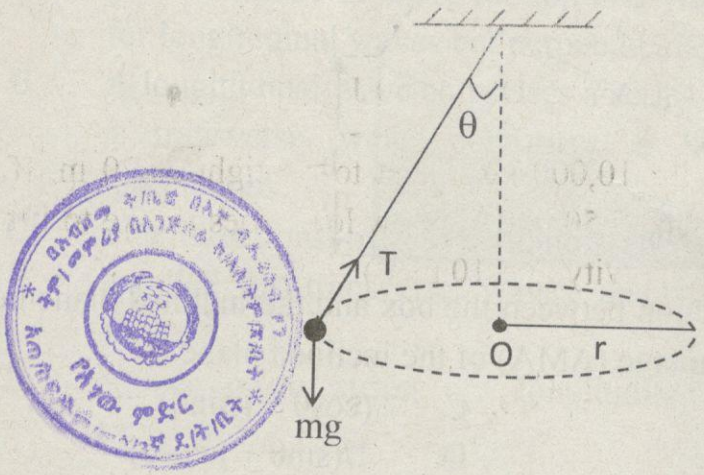
A. 30 %
B. 80 %
C. 60 %
D. 66.7 %

24. Block A of mass $m_1 = 8.0$ kg travelling initially at $u_1 = 6$ m/s in the positive x-direction collides with block B of mass $m_2 = 12$ kg moving in the same direction at $u_2 = 3$ m/s. If the velocity of block A, immediately after the collision, is $v_1 = 4$ m/s to the positive x-axis, what is the velocity of the block B, immediately after the collision?

A. 3.71 m/s to the positive x-axis
B. 4.33 m/s to the positive x-axis
C. 4.33 m/s to the negative x-axis
D. 3.71 m/s to the negative x-axis

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25. Suppose a particle of mass, m is tied to a string and then whirled around in a horizontal circle of radius r about the center O as shown in the figure below.



If the string makes an angle of θ to the vertical while rotating, the component of the force that is responsible for the circular motion of the mass by providing the centripetal force is

A. $mg\cos\theta$.
B. $mg\sin\theta$.
C. $T\cos\theta$.
D. $T\sin\theta$.

26. Which one of the following statements is correct about the fundamental forces in nature and their applications?

A. The electromagnetic force is the force that keeps protons and neutrons bound together in the nucleus of an atom.
B. The force that arises in most radioactive processes and in nuclear reactions that generate the Sun's energy is the strong nuclear force.
C. The gravitational force makes planets to revolve around the Sun and to follow their orbital path.
D. The force that keeps the nucleus of an atom from flying apart due to the repulsive force between protons is the weak nuclear force.

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27. A spring stores 120 J of elastic potential energy when it is stretched by 0.5 m. What is the potential energy stored by the spring when it is stretched by 1.5 m?

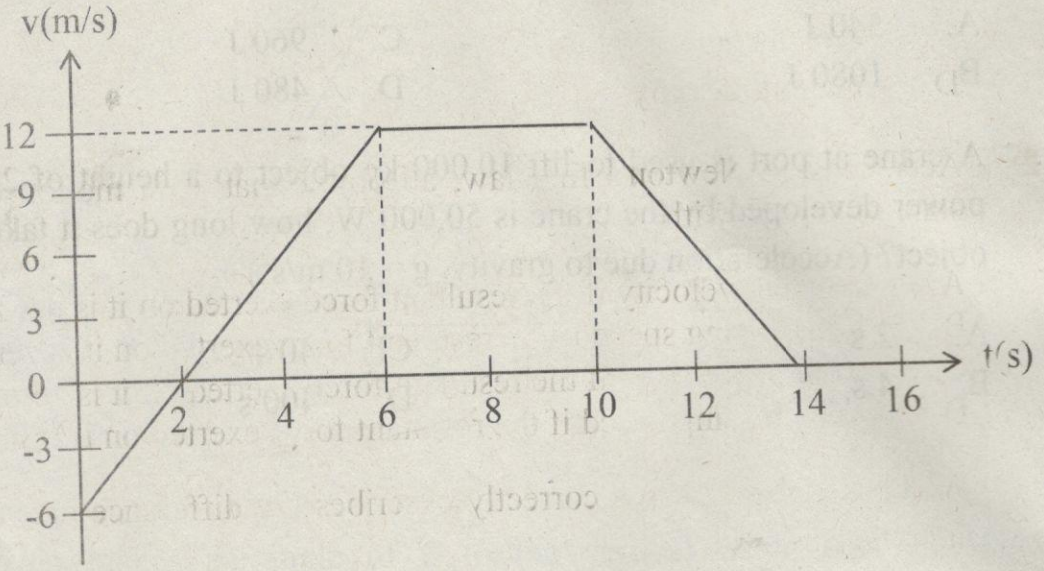
A. 540 J
B. 1080 J
C. 960 J
D. 480 J

28. A crane at port is used to lift 10,000 kg object to a height of 20 m. If the power developed by the crane is 50,000 W, how long does it take to lift the object? (Acceleration due to gravity, $g = 10\ m/s^2$)

A. 2 s
B. 4 s
C. 40 s
D. 400 s

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29. The velocity-time graph of an object moving in a straight line is shown in the figure below.



What is the magnitude of the total displacement covered by the object in the time interval of 14 seconds?

A. 42 m
B. 54 m
C. 90 m
D. 102 m

30. A system of four masses $m_1 = 4$ kg, $m_2 = 4$ kg, $m_3 = 5$ kg and $m_4 = 3$ kg are located in the xy-plane at the coordinates of (0, 0), (30 cm, 0), (-40 cm, 0) and (0, 20 cm), respectively. What is the coordinate of the center of mass of the system?

A. (-5 cm, 3.75 cm)
B. (-5 cm, 10 cm)
C. (-6.7 cm, 5 cm)
D. (20 cm, 3.75 cm)

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31. Vector quantities are represented by

A. direction only.
B. magnitude and direction.
C. dimensionless values.
D. magnitude only.

32. According to Newton's first law, an object that is in motion continues its state of motion with

A. constant velocity if the resultant force exerted on it is not zero.
B. a decreasing speed if the resultant force exerted on it is zero.
C. constant velocity if the resultant force exerted on it is zero.
D. an increasing speed if the resultant force exerted on it is not zero.

33. Which of the following correctly describes the difference between distance and displacement?

A. Distance depends on the initial and final points, while displacement depends on the path followed by a moving body.
B. Distance can be described both in magnitude and direction, while displacement is described only by magnitude.
C. Distance has either positive or negative values, while displacement has only positive value.
D. Distance is always greater than or equal to the magnitude of displacement, while the magnitude of the displacement is always less than or equal to distance.

34. Which of the following statements is correct about a uniformly accelerated motion?

A. The acceleration is constant.
B. The velocity is constant.
C. The displacement increases at a uniform rate.
D. The speed is constant but the direction is changing.

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35. Two displacement vectors have magnitudes 4 m and 3 m. Which one of the following is **NOT** the possible value of the magnitude of their resultant vector?

A. 7 m
B. 1 m
C. 12 m
D. 5 m

36. A train is moving along a straight line with a constant acceleration of 5 m/s^2 when it passes by a traffic light point. From there on, if the time taken by the train to reach a velocity of 30 m/s is 4 seconds, then what is the distance of the train from the traffic point after 8 seconds?

A. 160 m
B. 80 m
C. 320 m
D. 240 m

37. An electric field is defined as a region where

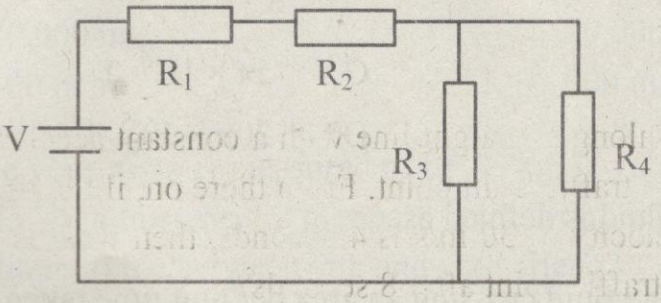
A a neutral particle experiences electric force when it is placed in that region.
B. a charged particle experiences an electric force if it is placed in that region.
C. a charged particle losses its charge when it is placed in that region.
D. a charged particle experiences no electric force when it is placed in that region.

38. Which one of the following statements is correct about the speed of sound in different medium? The speed of sound

A. increases as the temperature and density of a material increases.
B. in liquid is less than its speed in gas.
C. in a colder and less dense medium is faster than in hotter and denser material.
D. in solid is less than its speed in liquid.

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39. Four resistors are connected to a voltage source as shown in the figure below.



Which one of the following is correct about the circuit?

A. R_1 is connected in series with the effective combination of R_3 and R_4.
B. R_2 is connected in parallel with the effective combination of R_3 and R_4.
C. R_2 is connected in parallel with R_3.
D. R_1 is connected in parallel with R_2.

40. What is the magnitude of electric field strength at a distance of 2.0 m from a point charge, Q = 4.0 C?

A. 54.0×10^9 N/C
B. 18.0×10^9 N/C
C. 9.0×10^9 N/C
D. 72.0×10^9 N/C

41. A wire that has a resistance of 6 Ω is drawn out so as to make it into a new wire two times as long as the original and half cross-sectional area of the original. What will be the resistance of the new wire?

A. 3 Ω
B. 24 Ω
C. 12 Ω
D. 6 Ω

42. A long straight wire carries a current of 5.0 A. What is the magnetic field strength produced by the current at a distance of 2.0 cm from the wire? (Magnetic permeability free space $\mu_0 = 4\pi \times 10^{-7}\ \frac{Tm}{A}$)

A. 20×10^{-5} T
B. 5×10^{-5} T
C. $5\pi \times 10^{-5}$ T
D. $20\pi \times 10^{-5}$ T

43. The flow rate of a fluid is defined as

A. the mass of the fluid crossing an area per unit time taken.
B. the rate of change of the speed with which fluid flowing through a pipe.
C. the volume of the fluid crossing an area per unit time taken.
D. the speed with which the fluid flowing through a pipe.

44. At normal condition, solids are almost incompressible compared to liquids and gases. The reason is that

A. their atoms vibrate and free to move.
B. there is much space and little force between atoms.
C. their atoms are free to slide about and interact with neighbors.
D. their atoms are relatively fixed distance apart and held together.

45. Which of the following statements is correct about magnets?

A. Unlike permanent magnets, electromagnets are magnets without poles.
B. If you cut a bar magnet into two, each piece has both north and south poles.
C. The north pole of one magnet repels the south pole of another magnet.
D. Like electric charges, magnetic poles exist in a single isolated form.

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46. A wheel of radius, $r = 50\ cm$, rotates about a fixed perpendicular axis that passes through its center. If the angular speed is $\omega = 200\ \frac{rad}{s}$, how much is the tangential speed of a point on the rim of the wheel?

A. 80,000 m/s
B. 100 m/s
C. 10,000 m/s
D. 800 m/s

47. Suppose your mass is measured to be 50 kg. If your friend having a mass of 55 kg is at a distance 2 m apart from you, what is the magnitude of gravitational force between you and your friend?

A. 4.6×10^{-8} N
B. 4.6×10^{-11} N
C. 9.2×10^{-8} N
D. 9.2×10^{-11} N

48. A 10 N force is applied to the smaller circular piston of a hydraulic lift of radius 0.1 m to lift a 2500 N load placed on the larger piston. What is the area of the larger piston?

A. 3.14 m^2
B. 7.85 m^2
C. 2.50 m^2
D. 0.25 m^2

49. Which of the following concepts of physics are the primary focus points in mechanical engineering?

A. Dynamics, Thermodynamics, Force, and Stress
B. Geometric optics, Electrostatics, Thermodynamics, and Stress
C. Molecular physics, Dynamics, Nuclear physics, and Force
D. Nuclear physics, Geometric optics, Dynamics, and Force

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50. Which one of the following defense technologies is correctly matched with its working principle?

A. A radar is a rocket propelled weapon designed to deliver an explosive weapon with a great accuracy at high speed.
B. Missiles radiate electromagnetic signal and examine the echo received to identify the location of the target.
C. Drones radiate electromagnetic signal and examine the echo received to identify the location of the target.
D. Infrared device uses heat emission to identify objects that cannot be detected using available light sources.

51. Which one of the following phenomena occurs during change of phases of a matter? During a phase change from

A. solid to liquid, heat energy is released from a substance while its temperature remains constant.
B. gas to liquid, heat energy is absorbed by a substance while its temperature remains constant.
C. liquid to gas, heat energy is absorbed by a substance while its temperature remains constant.
D. liquid to solid, heat energy is released from a substance while its temperature changes uniformly.

52. Assume that a ball is thrown horizontally from a building of height h above the ground with initial speed v_o. Which one of the following statements is correct about the motion of the object?

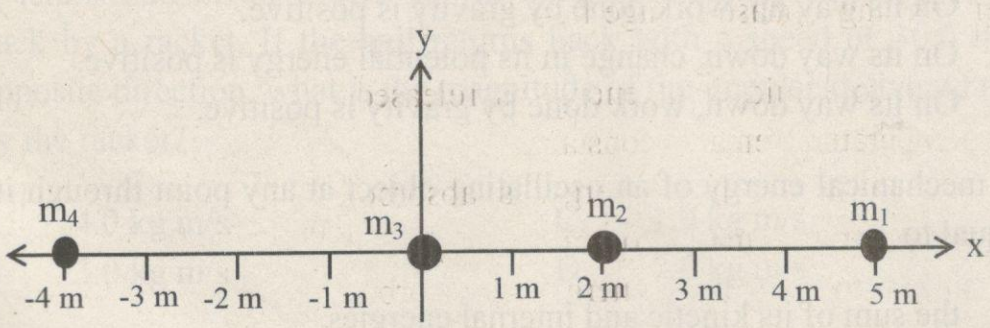
A. Its vertical component velocity remains constant.
B. Its horizontal component acceleration is zero.
C. Its horizontal component velocity uniformly increases.
D. Its vertical component acceleration is zero.

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53. A projectile is thrown from a level ground with an initial velocity $\vec{v}_0$ making an angle of θ above the horizontal. If the maximum height covered by the projectile is H, the what is the horizontal range of the projectile in terms of H and θ?

A. $\frac{H \tan\theta}{4}$
B. $\frac{H}{\tan\theta}$
C. $\frac{H}{4\tan\theta}$
D. $\frac{4H}{\tan\theta}$

54. Four point masses $m_1 = 4$ kg, $m_2 = 1$ kg, $m_3 = 3$ kg and $m_4 = 5$ kg are attached to a massless road which lays on the x-axis as shown in the figure below.



How much is the moment of inertia of the system about the y-axis?

A. 184 kgm^2
B. 187 kgm^2
C. 84 kgm^2
D. 190 kgm^2

55. Which one of the following statements is a necessary condition for an object to be in linear equilibrium?

A. The linear acceleration of the object is zero.
B. The net force acting on the object is non-zero constant.
C. The linear acceleration of the object is non-zero constant.
D. The linear speed of the object is constant.

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56. When an object tends to slide over the surface of another object, tiny bumps at the surface of the two objects knocking and locking together. This causes

A. electrostatic force.
B. gravitational force.
C. frictional force.
D. normal force.

57. Suppose a ball is thrown vertically upward and after reaching a maximum height, it returns back to its initial position. Which of the following statement is correct about energy changes and work done on the ball?

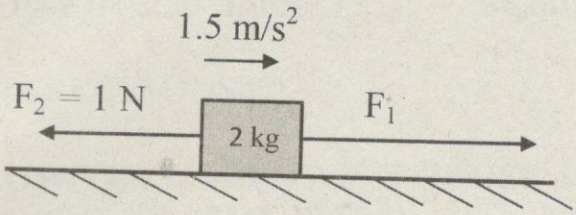
A. On its way up, change in its kinetic energy is positive.
B. On its way up, work done by gravity is positive.
C. On its way down, change in its potential energy is positive.
D. On its way down, work done by gravity is positive.

58. The mechanical energy of an oscillating object at any point through its path is equal to

A. the sum of its kinetic and internal energies.
B. the sum of its kinetic and potential energies.
C. the difference between its kinetic and potential energies.
D. the sum of its potential and internal energies.

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59. A 2 kg object accelerates with 1.5 m/s^2 to the right on a horizontal frictionless surface under the action of two horizontal forces, F_1 and F_2 as shown in the figure below.



What should be the magnitude of F_1?

A. 1 N
B. 2 N
C. 4 N
D. 3 N

60. A tennis ball of mass 0.10 kg traveling horizontally at 40.0 m/s is struck back by a racket. If the ball returns back with a speed of 30.0 m/s in the opposite direction, what is the magnitude of the impulse delivered to the ball by the racket?

A. 4.0 kg m/s
B. 3.0 kg m/s
C. 1.0 kg m/s
D. 7.0 kg m/s

The End.