EDUCATIONAL ASSESSMENT AND EXAMINATIONS SERVICE (EAES)

ETHIOPIAN SECONDARY SCHOOL LEAVING CERTIFICATE EXAMINATION (ESSLCE)

Hamlie, 2016 E.C /July, 2024 G.C

SUBJECT: PHYSICS **BOOKLET CODE: 175**

SUBJECT CODE: 04 **TIME ALLOWED: 2:30 HOURS**

GENERAL DIRECTIONS:

I. FOLLOW THE FOLLOWING RULES AND REGULATIONS IN DOING THE EXAMINATION:

- FEED THE SUBJECT NAME, SUBJECT CODE AND BOOKLET CODE GIVEN ABOVE ON THE SEPARATE ANSWER SHEET PROVIDED
- SELECT ONLY THE **CORRECT** ANSWER FOR EACH QUESTION
- USE ONLY **PENCIL** TO MARK YOUR ANSWERS
- **BLACKEN** ONLY THE LETTER OF YOUR CHOICE IN LINE WITH THE BOX ON THE SEPARATE ANSWER SHEET PROVIDED
- **ERASE** ALL UNNECESSARY MARKS COMPLETELY
- ANY FORM OF **CHEATING** IS **PROHIBITED**
- YOU MUST IMMEDIATELY **STOP WORKING** WHEN TIME IS OVER
- FOLLOW **FURTHER INSTRUCTIONS** ON THE BOOKLET FOR EACH QUESTION

II. ATTENTION!

MAKE SURE THAT YOU HAVE WRITTEN ALL THE REQUIRED INFORMATION ON THE SEPARATE ANSWER SHEET CORRECTLY BEFORE YOU RETURN IT.

DO NOT TURN THIS PAGE OVER UNTIL YOU ARE TOLD TO DO SO.

EAES WISH YOU ALL THE BEST!

EDUCATIONAL ASSESSMENT AND EXAMINATIONS SERVICE (EAES)

ETHIOPIAN SECONDARY SCHOOL LEAVING CERTIFICATE EXAMINATION (ESSLCE)

Hamlie, 2016 E.C /July, 2024 G.C

Subject Code: 04 **Booklet Code: 175**

Item Number: 60 **Time Allowed: 2:30 Hours**

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	6.67×10^{-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	1000 kg/m^3
Molar gas constant	R	8.314 J/mol.K
permittivity of vacuum	ε_o	8.85×10^{-12} F/m
Magnetic permeability of free space	μ_o	$4\pi \times 10^{-7}$ Tm/A
Coulomb's constant	K	9×10^{9} Nm^2/C^2
Planck's constant	h	6.63×10^{-34} Js
Specific latent heat of fusion for ice	L_f	3.3×10^{5} J/kg
Thermal conductivity of copper	K_{cu}	385 W/m.K
Thermal conductivity of brass	K_{Bu}	109 W/m.K
Pi	π	3.14
$\sin 30^o = \cos 60^o = 0.5$		
$\sin 60^o = \cos 30^o = 0.87$		
$\sin 37^o = \cos 53^o = 0.6$		
$\sin 53^o = \cos 37^o = 0.8$		

SUBJECT CODE: 04 BOOKLET CODE: 175

1. Lenz's law states that the direction of the induced current in a loop is in such a way that the current

A. is in opposite direction to that of the applied magnetic field that is causing it.
B. creates a magnetic field that reinforces the change in magnetic flux through the loop.
C. is in the same direction as that of the applied magnetic field that is causing it.
D. creates a magnetic field that opposes the change in magnetic flux through the loop.

2. Which one of the following statements is correct about the resistance of a conducting wire? The resistance of the wire is

A. directly proportional to the square of its length.
B. directly proportional to the square of its cross-sectional area.
C. inversely proportional to its cross-sectional area.
D. inversely proportional to its length.

3. Consider an ideal transformer having N_p and N_s turns, and voltages V_p and V_s in its primary and secondary coils, respectively. Which one of the following is the correct ideal transformer equation?

A. $V_p = \left(\frac{N_p}{N_s}\right)^2 V_s$

B. $\frac{V_s}{V_p} = \frac{N_p}{N_s}$

C. $\frac{N_s}{N_p} = \left(\frac{V_s}{V_p}\right)^2$

D. $\frac{V_s}{V_p} = \frac{N_s}{N_p}$

SUBJECT CODE: 04 BOOKLET CODE: 175

4. Which one of the following statements is correct about the electrical conductivity of materials? Materials in which all the

A. outer most shell electrons are free to move within the material are semiconductors.
B. outer most shell electrons are tightly bound to its parent atom are conductors.
C. inner and outer most shell electrons are tightly bound to its parent atom are insulators.
D. inner and outer most shell electrons are free to move within the material are conductors.

5. Which one of the following statements distinguishes precision from accuracy?

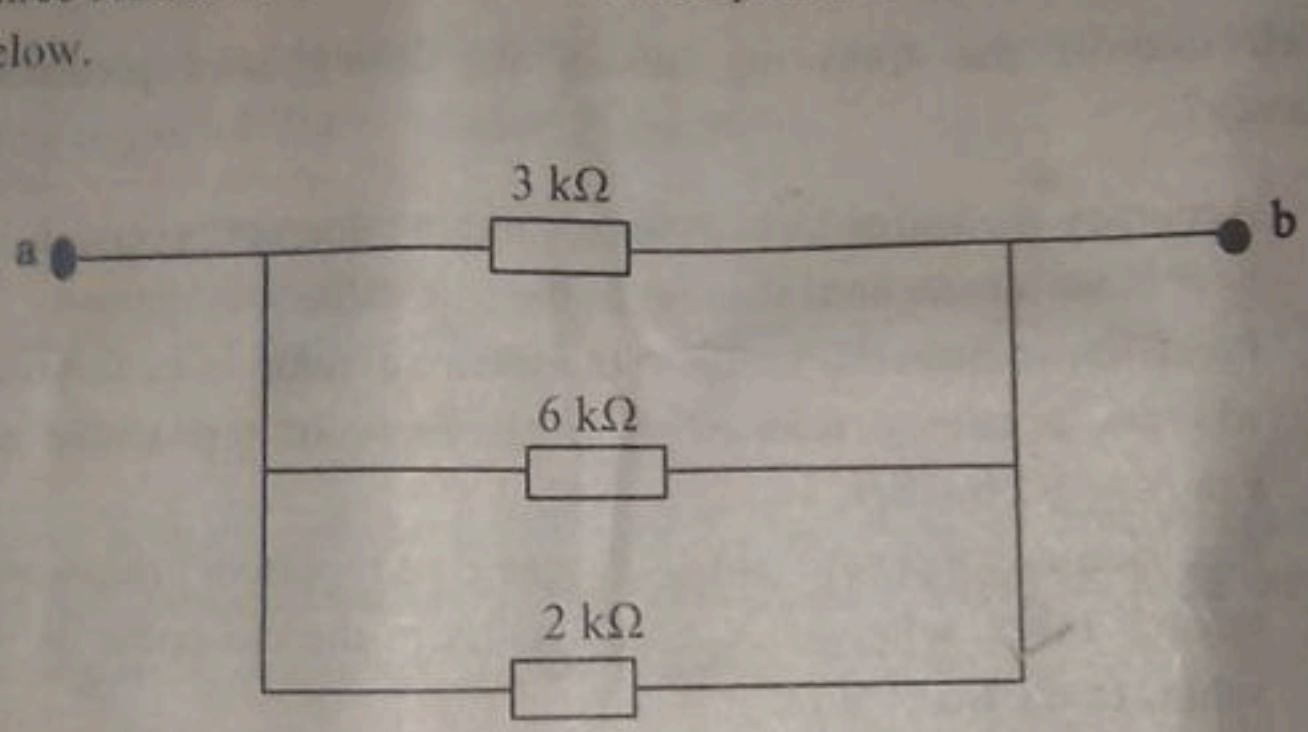
A. Accuracy measures how exact a value is whereas precision indicates how close a measured value is to the true value.
B. Precision indicates how close a measured value is to the true value, whereas accuracy refers to the closeness of repeatedly measured values to each other.
C. Precision is a measure of the closeness of repeatedly measured values to each other, whereas accuracy refers to the closeness of measured values to the true value.
D. Precision is a measure of the closeness of repeatedly measured values to each other, whereas accuracy is related to the number of significant figures.

SUBJECT CODE: 04 BOOKLET CODE: 175

6. Which of the following statements about the nature electromagnetic waves is correct? Electromagnetic waves are transverse waves produced when

A. charges are placed at rest in an electric and magnetic fields that are perpendicular to each other.
B. electric and magnetic fields are oscillating perpendicular to each other.
C. charges are placed at rest in an electric and magnetic fields that are parallel to each other.
D. electric and magnetic fields are oscillating parallel to each other.

7. Three resistors are connected between points a and b as shown in the figure below.



The effective resistance of the circuit is

A. 11.0 Ω.
B. 1.0 Ω.
C. 11.0 kΩ.
D. 1.0 kΩ.

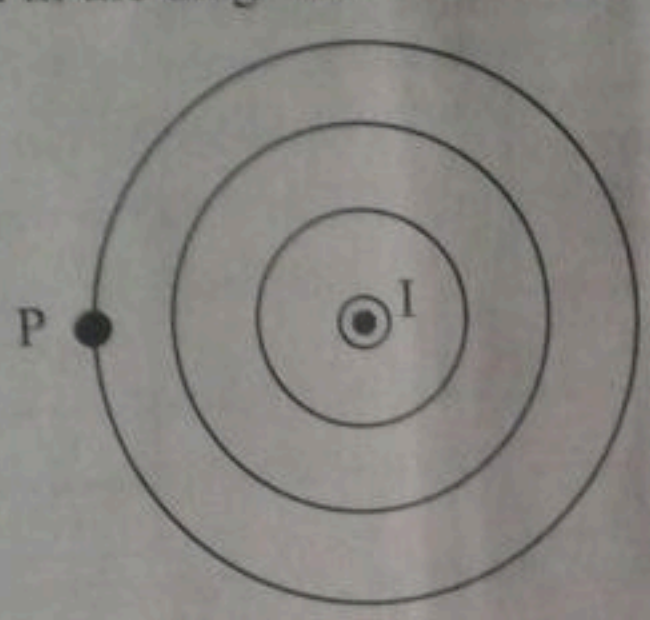
SUBJECT CODE: 04

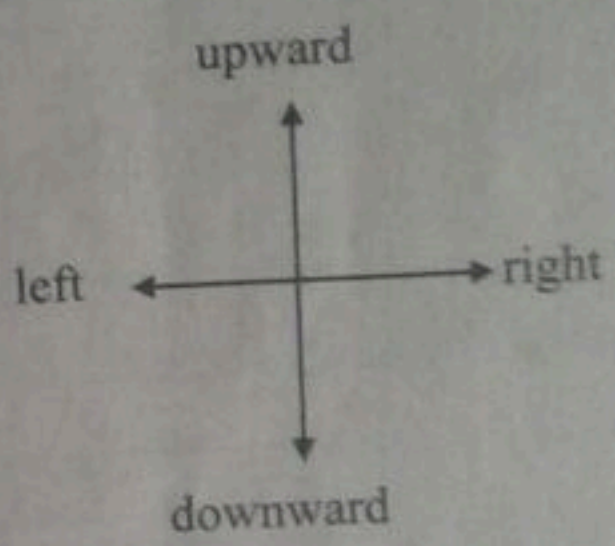
BOOKLET CODE: 175

8. A concave mirror has a radius of curvature of 30.0 cm. It is positioned so that the upright image of an object is 2.0 times the size of the object. How far is the object from the mirror?

A. 15.0 cm
B. 10.0 cm
C. 7.5 cm
D. 22.5 cm

9. In an experiment to determine the direction of the magnetic field around a long straight current-carrying wire, a student placed a small compass at point P, as shown in the diagram.



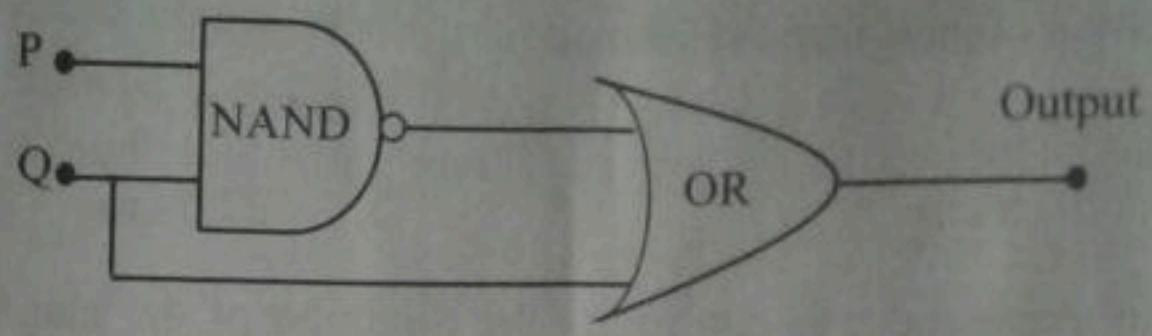


If the direction of the current in the wire is directed out-of the page, then the magnetic needle of the compass will point

A. downward.
B. to the right.
C. upward.
D. to the left.

SUBJECT CODE: 04 BOOKLET CODE: 175

10. A combination of logic gate is constructed from an NAND gate and an OR gate, as shown in the diagram below.



The truth table for the logic circuit shown above is

A.

P	Q	Output
0	0	0
0	1	0
1	0	0
1	1	0

C.

P	Q	Output
0	0	1
0	1	0
1	0	0
1	1	1

B.

P	Q	Output
0	0	0
0	1	1
1	0	1
1	1	0

D.

P	Q	Output
0	0	1
0	1	1
1	0	1
1	1	1

SUBJECT CODE: 04 BOOKLET CODE: 175

11. When a force F is applied to a wire of length L fixed at one end, the wire extends by x. The tensile strain of the wire is

A. the applied force F divided by the extension.
B. the product of the force F and the extension x.
C. the extension x divided by the length L.
D. the length L divided by the extension x.

12. Which one of the following factors does **NOT** affect the moment of inertia of an object?

A. The angular speed of the object
B. The mass of the object
C. The axis about which the object is rotating
D. The size of the object

13. Which of the following describes the difference between static and dynamic equilibrium? In static equilibrium,

A. acceleration is zero, whereas in dynamic equilibrium the acceleration increases uniformly.
B. an object moves with constant velocity, whereas in dynamic equilibrium, an object is at rest.
C. an object is at rest, whereas in dynamic equilibrium, the object moves with constant velocity.
D. an object moves with constant acceleration, whereas in dynamic equilibrium, the object is at rest.

SUBJECT CODE: 04 BOOKLET CODE: 175

14. About an axis of rotation perpendicular to a plane of a couple, the forces in a couple produce

A. torques in opposite direction.
B. torques in the same direction.
C. no torque.
D. non-zero resultant force.

15. Which one of the following statements describes the difference between heat and temperature?

A. Heat is a measure of the average kinetic energy, whereas temperature is a flow of energy from hotter to colder object.
B. Heat is an energy that flows spontaneously from colder to hotter object, whereas temperature is the degree of hotness and coldness.
C. Heat is a transfer of energy due to temperature difference, whereas temperature is a measure of the average kinetic energy.
D. Heat is measured with a thermometer in Kelvin, whereas temperature is measured with a Calorimeter in Joule.

16. Which one of the following statements does **NOT** describe the relationship of physics with biology?

A. Both physics and biology are mainly concerned in the interaction of large number of particles.
B. Newtonian mechanics and biology are used to explain why cheetah is fastest animal.
C. Physics and biology are interrelated to each other in the study of vision and color detection.
D. Physics and biology used to study how air vibrates in vocal cords.

SUBJECT CODE: 04 BOOKLET CODE: 175

17. Which one of the following is a correct relation of physics with medicine?

A. Physics is a branch of medicine that sets standards during medical diagnosis.
B. A discipline called medical physics deals with principles of physics in medical diagnosis.
C. Modern medical imaging instrument are developed with knowledge of medicine and later used by physics.
D. Medicine is a branch of physics dealing with nuclear reaction.

18. A ball is released from a height h. It then rises to a maximum height of $\frac{1}{2}$ h after collision with the ground. Neglecting air resistance, which one of the following statements is correct about the ball's mechanical energy?

A. Mechanical energy after collision is greater than mechanical energy before collision.
B. Mechanical energy before collision is equal to after collision.
C. Mechanical energy after collision is less than mechanical energy before collision.
D. Mechanical energy of the ball increases while moving downward, but decreases while moving upward.

19. A glass tube of radius 30 mm is inserted in a bowl which contains methyl iodide of density 2.28 kg/m^3. If the contact angle of the methyl iodide in the tube is 30^0 and the surface tension is 0.26 N/m, how much height does the methyl iodide rises through the tube?

A. 6.6 m
B. 0.066 m
C. 0.52 m
D. 0.66 m

SUBJECT CODE: 04 BOOKLET CODE: 175

20. Two rods, one made of brass and the other made of copper, are joined end to end. The length of the brass section is 0.2 m and the length of the copper section is 0.8 m. Each segment has cross-sectional area 0.005 m^2. The free end of the brass segment is kept at 100^0C and the free end of the copper segment is kept at 0^0C. If the rate of heat flow is the same through both rods, what is the temperature of a point where the two segments are joined? (k_{cu} = 385 W/m.K, k_{br} = 109 W/m.K)

A. 100^0C
B. 53^0C
C. 50^0C
D. 10.2^0C

21. A pressure applied to one point in an enclosed incompressible fluid is transmitted to all parts of the fluid without reducing in value. This is the principle of

A. Archimedes.
B. Pascal.
C. Continuity.
D. Bernoulli.

22. Which of the following statement describes uniform motion?

A. An object moving at 30 m/s toward East and then 30 m/s toward North
B. An object moving around a circular track with constant speed of 30 m/s
C. An object moving with constant speed of 30 m/s in a straight line
D. An object, starting from rest, moving on a straight line to attain a velocity of 30 m/s

23. Which of the following statement describes inertia of an object? It

A. increases with increasing mass of the object.
B. increases with an increasing velocity of the object.
C. makes to change state of rest of the object.
D. is a physical quantity which has a unit of mass.

SUBJECT CODE: 04 BOOKLET CODE: 175

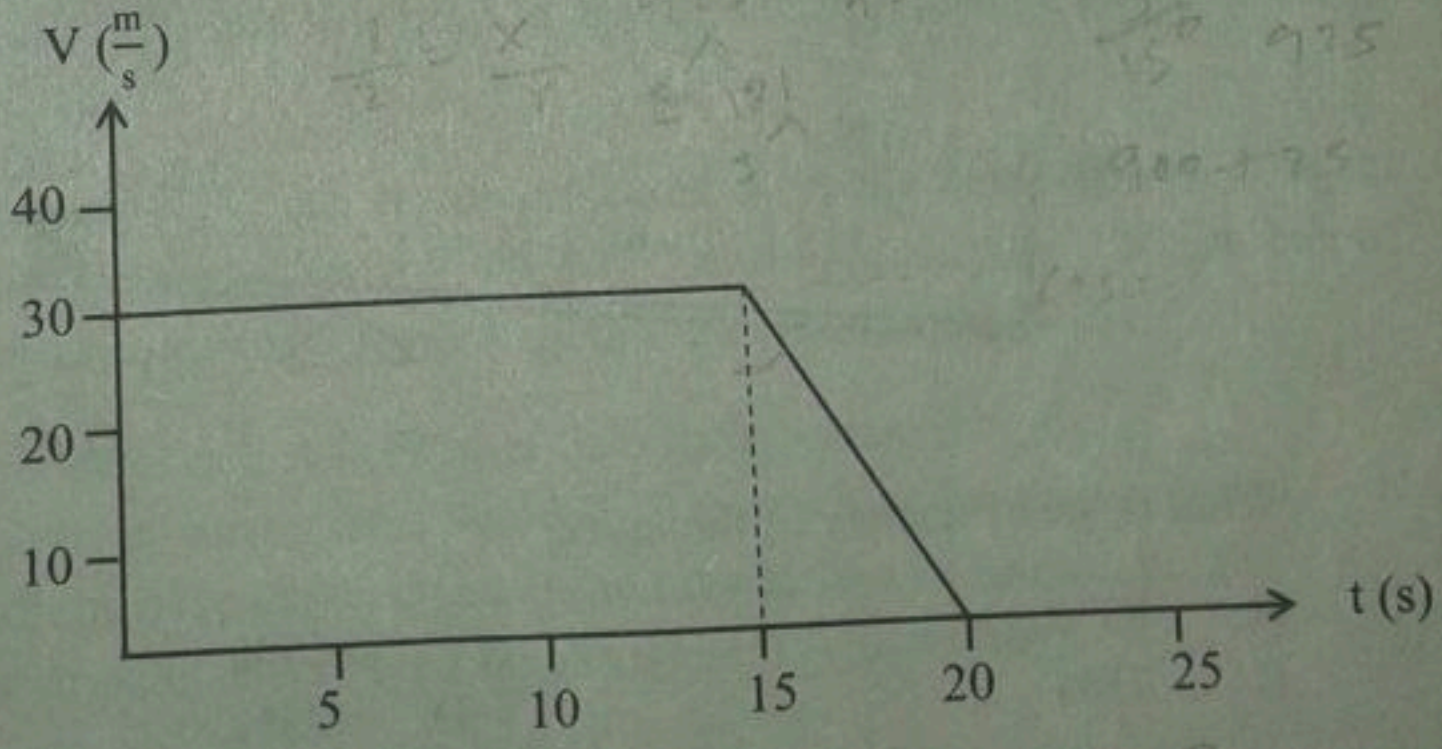
24. Two objects, object A of mass m and object B of mass $2m$ are placed at heights of h_1 and h_2, respectively, from the surface of the earth. Assuming that the gravitational field strength is constant, the potential energy of object A is twice of that of object B, if

A. $h_1 = \frac{1}{2}h_2$.
B. $h_1 = 2h_2$.
C. $h_1 = \frac{1}{4}h_2$.
D. $h_1 = 4h_2$.

25. A car travels 60 m north and then 80 m west. What is the magnitude of the resultant displacement of the car from its starting point?

A. 100 m
B. 140 m
C. 20 m
D. 4800 m

26. The velocity-time graph of an object moving along a straight line toward east is described by the figure shown below.



What is the total displacement moved by the object?

A. 450 m East
B. 375 m East
C. 525 m East
D. 600 m East

SUBJECT CODE: 04 BOOKLET CODE: 175

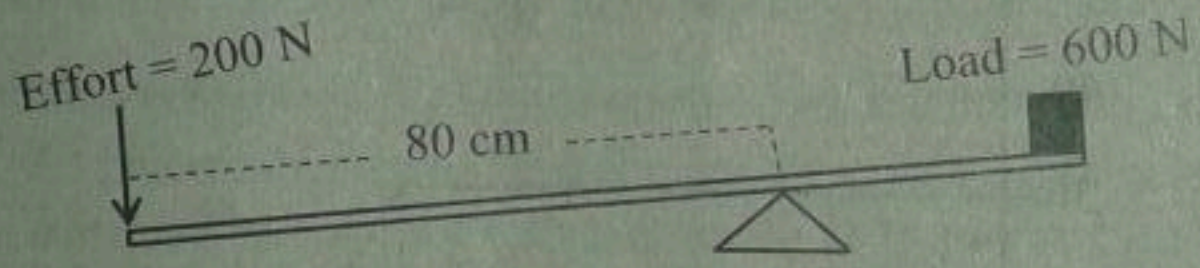
27. A person of mass 75 kg experiences a net force of 400 N when placed in an upward accelerating lift. What is its apparent weight?

A. 350 N
B. 1150 N
C. 400 N
D. 750 N

28. A block of mass 20 kg is pushed horizontally, at constant speed, along a rough horizontal floor over a distance of 5 m. If coefficient of kinetic friction between the block and the surface is 0.4, what is the amount of work done by friction?

A. - 1000 J
B. - 100 J
C. - 40 J
D. - 400 J

29. A 200N force is required to be applied at one end of a 1m long lever, 80cm from its fulcrum, in order to lift a load of 600N placed at the other end as shown the figure below.



What is the efficiency of the lever?

A. 83%
B. 75%
C. 17%
D. 25%

30. A substance with a mass of 2kg has a volume of 2.5×10^{-3} m^3. What is the relative density of the substance?

A. 1.25
B. 0.8
C. 8.0
D. 80

31. The gauge pressure at a point in a fluid at rest is defined as

A. the actual pressure at a given point relative to absolute vacuum.
B. the sum of absolute pressure and atmospheric pressure.
C. the pressure difference between the absolute pressure and the atmospheric pressure.
D. the atmospheric pressure difference between sea level and the local area at which the fluid exists.

32. How do we use manometer to measure pressure of a given gas? We use in such a way that

A. the principle of the hydrostatic equilibrium is considered to measure the pressure of unknown gas.
B. the pressure at the surface of open end manometer is the same as the gas pressure in closed tube.
C. the gauge pressure equals the atmospheric pressure.
D. the gauge pressure in a fluid in the open end equals the gas pressure in closed tube.

33. Consider two balls A and B are projected with the same velocity, v_0 at angles θ_1 and θ_2, respectively, $0 < \theta_1 < 45^o$ and $45^o < \theta_2 < 90^o$. Which one of the following statements is correct about the motion of the balls?

A. The range of ball A is smaller than its maximum height.
B. Ball A takes longer time than ball B to reach its maximum height.
C. Both balls have equal speed at their respective maximum height.
D. The two balls cover equal ranges when $\theta_1 + \theta_2 = 90^0$.

SUBJECT CODE: 04 BOOKLET CODE: 175

34. A car initially traveling at speed of 20 m/s undergoes a constant deceleration of magnitude 1.5 m/s^2. If the radius of each tire is 0.3 m, how many revolutions does each tire make, without slipping, before the car comes to rest?

A. 444.4 rev
B. 70.77 rev
C. 44.44 rev
D. 133.33 rev

35. A constant tangential force is applied on a rim of uniform solid disk of mass m = 50 kg and radius r = 0.5 m. If the angular speed of the disk changes by 1 rev/s within 2.0 s, what is the magnitude of the torque produced by the force? $\left(\text{moment of inertia of disk } I=\frac{mr^2}{2}\right)$

A. 19.6 Nm
B. 39.3 Nm
C. 3.125 Nm
D. 8.25 Nm

36. A loop of 0.1 m wide in diameter is placed in xy-plane in uniform magnetic field of 0.6 T that is perpendicular to the plane of the loop. What is the net magnetic flux through the coil?

A. 1.9×10^{-2} Wb
B. 5.6×10^{-2} Wb
C. 4.7×10^{-3} Wb
D. 9.4×10^{-3} Wb

37. A 12 V voltage source is connected across the primary coil of a transformer having 600 turns. If the secondary coil of a transformer has 1000 turns, what voltage appears across the secondary coil?

A. 72.0 V
B. 7.2 V
C. 12.0 V
D. 20.0 V

38. The following table shows the density of different objects at 20°C.

substance	Density in kg/m^3	substance	Density in kg/m^3
Water	1000	Gold	19300
Seawater	1025	Bone	1800
Blood	1060	Air	1.29
Gasoline	680	Copper	8920
Ice (0°C)	916	Iron	7860

Based on the information given in the table, if we identify substances that sink and float with respect to other substance,

A. bone, iron and seawater will sink in water.
B. water, gasoline and ice will sink into seawater.
C. gasoline, ice and blood floats on the surface of water.
D. gold, blood and copper floats in gasoline.

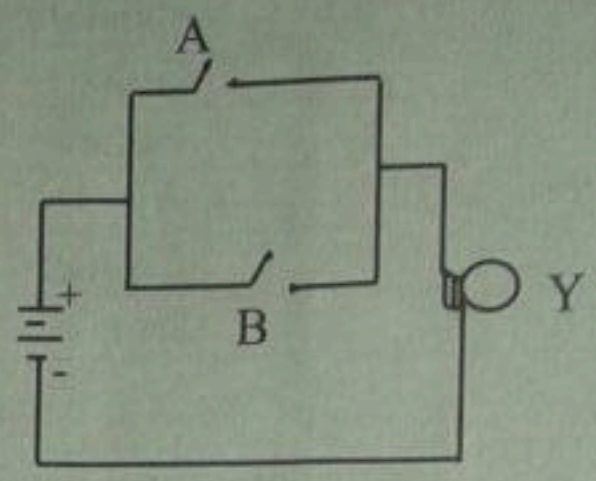
39. Which one of the following statements differentiates emitter, collector and base of a transistor?

A. The collector region is heavily doped as compared with emitter and base.
B. The emitter region is heavily doped as compared with base and collector.
C. The three parts; emitter, base and collector are equally doped.
D. The base region is heavily doped as compared with base and collector.

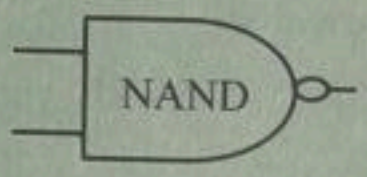
SUBJECT CODE: 04

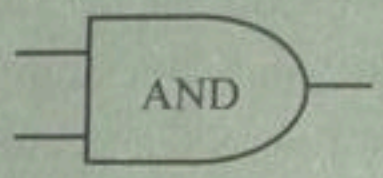
BOOKLET CODE: 175

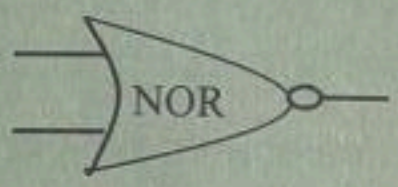
40. The following figure shows a switch of circuit consisting of a battery source, two switches represented by letters A and B, and a light bulb Y.

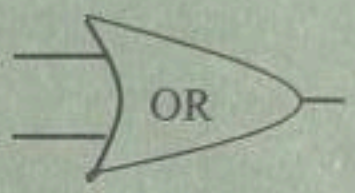


Which one of the following logic get can be represented by equivalent switch circuit?

A. 

C. 

B. 

D. 

41. The angular momentum of a rotating object is defined as the product of its

A. moment of inertia and the square of the angular velocity.
B. mass and the angular velocity.
C. mass and one-half of the square of the angular velocity.
D. moment of inertia and angular velocity.

SUBJECT CODE: 04 BOOKLET CODE: 175

42. What do you call the sound wave that is heard after reflection from a hard surface?

A. Echo
B. Loudness
C. Pitch
D. Timber

43. Which one of the following waves is identified as longitudinal wave?

A. Sound wave
B. Deep water wave
C. S-wave of Earthquake
D. Wave on a vibrating string

44. Which of the following statements is correct about the components of the velocity of a ball projected up at an angle of θ with the horizontal? Neglecting the air resistance,

A. the vertical component of velocity increases while the horizontal component of velocity decreases.
B. the vertical component of the velocity remains constant throughout its journey.
C. the horizontal velocity of the ball is equal to zero at the maximum height.
D. the horizontal component of the velocity remains constant throughout its journey.

45. Which one of the following statements is correct about the electric field due to a charged spherical solid conductor?

A. It is non-zero constant outside the sphere.
B. It is zero inside the sphere.
C. It is parallel to the surface of the sphere.
D. It is non-zero constant inside the sphere.

SUBJECT CODE: 04 BOOKLET CODE: 175

46. A metal wire made of coefficient of linear expansion α is heated so that its temperature is changed by ΔT. If the length of the wire before heating is L_o, which one of the following expressions is correct for the final length of the wire after heating?

A. $\frac{L_o}{1+\alpha\Delta T}$
B. $L_o\alpha\Delta T$
C. $\frac{L_o}{1-\alpha\Delta T}$
D. $L_o(1+\alpha\Delta T)$

47. What amount of heat energy is required to completely melt 200g of ice at 0 °C? (Take specific latent heat of melting for ice, $L_f = 3.3\times10^5$ J/kg)

A. 6.60×10^4 J
B. 1.65×10^7 J
C. 1.65×10^3 J
D. Zero

48. The orbital speed of a satellite at a height of 780 km from the surface of the earth is 7,465 m/s. what is the period of the satellite?

A. $6.04 \times 10^3\ s$
B. $6.04 \times 10^2\ s$
C. $6.60 \times 10^2\ s$
D. $6.60 \times 10^3\ s$

49. The charge of 20.0 μC is stored on the capacitor when a potential difference between its two parallel plates is 200.0 V. what is the capacitance of the capacitor?

A. 10.0 μF
B. 1.0 μF
C. 4.0 mF
D. 0.1 μF

SUBJECT CODE: 04

BOOKLET CODE: 175

50. An air filled parallel plate capacitor is connected to a potential difference v to store electric charge. If the area of the plates is A and the separation between the plates is d, then the electrical energy stored on the capacitor is

A. $\frac{\varepsilon_0 A V^2}{d}$.

B. $\frac{1}{2}\frac{\varepsilon_0 d V^2}{A}$.

C. $\frac{1}{2}\frac{\varepsilon_0 A V^2}{d}$.

D. $\frac{\varepsilon_0 d V^2}{A}$.

51. Which one of the following is correct about the four basic forces in nature?

A. Electromagnetic force is the weakest of all the forces in nature.
B. Gravitational force is attractive force that acts on the scale of the atomic nucleus.
C. Strong nuclear force is short-range force that holds protons and neutrons together inside a nucleus.
D. Weak nuclear force keeps the electrons in their orbit around a nucleus.

52. Which of the following is correct about impulse?

A. The direction of the impulse is in the same direction to change in the momentum of the object.
B. During momentum change final momentum of an object is along the impulse on the object.
C. Impulse due to a force exerted for a short time is equal to impulse due to the same force exerted for a long time.
D. The impulse is smaller than change of momentum which caused by the applied force.

Sin 53 Cos 37 = 0·8

Sin 37 Cos 53 = 0·6

SUBJECT CODE: 04 BOOKLET CODE: 175

53. A person walked 10 m in a direction 53^0 North of East, 10 m North, and finally 20 m in a direction 37^0 North of West. The magnitude of the person's displacement is

A. 30.0 m.
B. 31.6 m.
C. 40.0 m.
D. 20.0 m.

54. Which of the following pair of vectors is collinear?

A. $\vec{C} = \hat{i} + \hat{j}$ and $\vec{D} = \hat{i} - \hat{j}$
B. $\vec{A} = 2\hat{i} + 3\hat{j}$ and $\vec{B} = -4\hat{i} + 6\hat{j}$
C. $\vec{E} = -\hat{i} + \hat{j}$ and $\vec{F} = 3\hat{i} - 3\hat{j}$
D. $\vec{G} = 2\hat{i} + 3\hat{j}$ and $\vec{F} = 3\hat{i} + 2\hat{j}$

55. A ball is thrown vertically upward with 12 m/s from the ground. Its speed when the ball is 4.0 m above the ground is

A. 8 m/s.
B. 15 m/s.
C. 10 m/s.
D. 12 m/s.

56. An object is projected at angle θ from the horizontal with initial velocity v_0. Which one of the following expressions represents the relationship between maximum height, h_{max}, and range of the projectile, R?

A. $R = h_{max}\frac{tan\theta}{2}$
B. $R = 4\,h_{max}\,tan\theta$
C. $R = \frac{2\,h_{max}}{\tan\theta}$
D. $R = \frac{4\,h_{max}}{tan\,\theta}$

SUBJECT CODE: 04 BOOKLET CODE: 175

57. A 0.5 kg block moving with an initial speed of 5.0 m/s slides 2.5 m on a rough horizontal surface before coming to rest. The coefficient of kinetic friction is

A. 0.5.
B. 0.3.
C. 0.1.
D. 0.4.

58. A 0.2 kg ball is kicked from the ground at 16 m/s in a direction making an angle θ above the horizontal. Neglecting air resistance, the magnitude of velocity of the ball when it is 3.0 m from the ground is

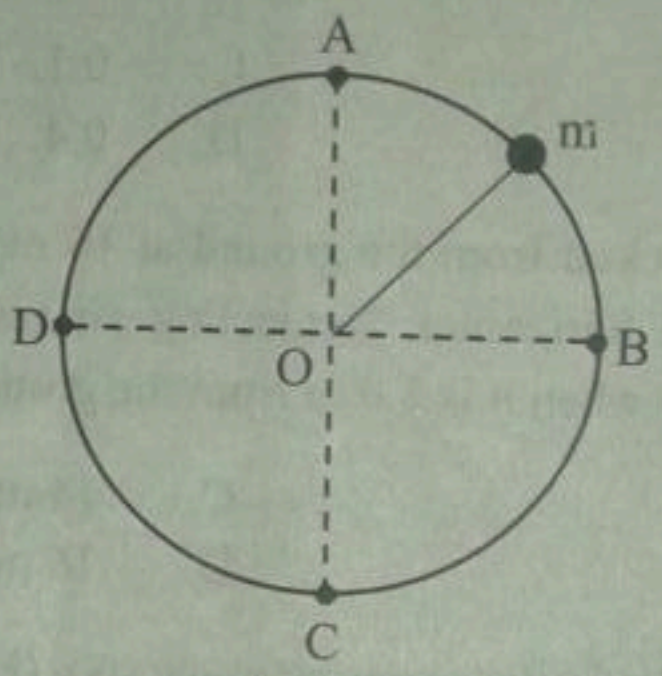
A. 7 m/s.
B. 2 m/s.
C. 14 m/s.
D. 16 m/s.

59. The angular speed of a disk rotating about its axis increases by 2000 rad/s in a time interval of 3.0 s. If the moment of inertia of the disk is 0.6 kg m^2, what is the average torque on the disk?

A. 670 Nm
B. 1200 Nm
C. 6000 Nm
D. 400 Nm

SUBJECT CODE: 04 BOOKLET CODE: 175

60. A small ball of mass m tied to a rope of length l is moving along a vertical circle about a point O as shown in the figure.



If A, B, C, and D are points on the path, then which one of the following is correct about the force exert on the ball at these points?

A. At point C, the radial force and the tension on the rope are in opposite direction.
B. At point D, the radial force is equal to the tension on the rope.
C. At point A, the radial force is in opposite direction to the gravitational force on a ball.
D. At point B, the radial force is equal to the gravitational force on the ball.

The End.