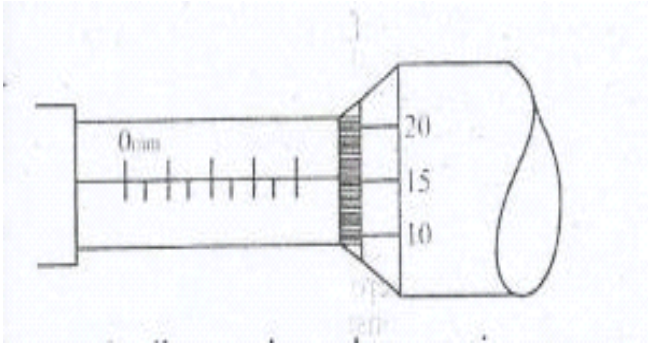
Contents

CHAPTER ONE

Measurement & Unit

Length area and volume: Meter rule, Vernier calipers Micrometer Screw-gauge

1. From the diagram below, the measuring accuracy of the micrometer screw gauge is



A. 4.78mm
B. 4.16mm
C. 4.66mm
D. 4.70mm
UTME, 2016

2.The inner diameter of a small test tube can be measured accurately using a

A. Micrometers screw gauge
B. Pair of dividers
C. Meter rule
D. Pair of vernier caliper
UTME, 2021

Fundamental physical quantities

3. At what respective value of a, b, and c would the unit of work, the joule, be dimensionally similar to $M^aL^b T^c$?

A. 1, – 2, 1
B. 1, 2, – 2
C. 1, 1, –2
D. 2, 2, 1
UTME, 2015

Derived physical quantities and their units

Combinations of fundamental quantities and determination of their units

4. The product PV where P is pressure and V is volume has the same unit as

A. impulse
B. power
C. force
D. work
UTME, 2020

5. Which of the units of the following physical quantities are derived?

I. Area
II. Thrust
III. Pressure
IV. Mass
A. I, II, III and IV
B. I, II, and III only
C. I, II, and IV only
D. I and IV only
UTME, 2021

ANSWERS AND EXPLANATIONS

1. Answer: **Option B**

Explanation: The main scale reading is 4mm and circular scale reading is 16.
Hence the total reading = M.S.R + C.S.R × LC = 4 +16 × 0.01
=4.16mm

2. Answer: **Option D**

Explanation: Vernier calipers are used to measure the inner and outer breadth of rods and domains and thickness of any sort of object accurately. The Vernier calipers can also be utilized to measure deepness of holes and objects which can be too hard to do with any other scale

3. Answer: **Option B**

Explanation: Work (w) = force (f) x distance (d)
Note: f= mass (m) x acceleration (a)
$W = kg \times ms^{-2} \times m$
$W = kgm^2s^{-2}$
(NB: kg = M, M = L &S = T)
$Work = ML^2T^{-2} = M^aL^bT^c$
Therefore a=1, b=2 and c=-2

4. Answer: **Option D**

Explanation: $PV = \frac{N}{m^2} \times m^3$
= Nm
Since the unit of force is newton and the unit for distance is meters
= Force x distance = work done

5. Answer: **Option B**

Explanation: Only 'mass' is a fundamental quantity

CHAPTER TWO

Scalars and Vectors

definition of scalar and vector quantities

6. The pair of physical quantities that are scalar only are?
A. volume and area
B. moment and momentum
C. length and displacement
D. Impulse and time
UTME,2013

7. A vector quantity can only be completely described when ..... and .....are mentioned.
A. Magnitude and motion
B. Magnitude and direction
C. Distance and specified displacement
D. Moment and momentum
UTME, 2015

examples of scalar and vector quantities

8. Which of the following is not a vector quantity?
A. momentum
B. force
C. temperature
D. displacement
UTME, 2021

relative velocity

9. A car accelerates uniformly from rest at $3ms^{-2}$. its velocity after traveling a distance of 24m is

A. $12ms^{-1}$

B. $144ms^{-1}$

C. $72ms^{-1}$

D. $36ms^{-1}$

UTME, 2014

ANSWERS AND EXPLANATIONS

6. **Option A** (Volume and Area have only magnitudes but no direction)

7. **Option B** (A vector quantity has both magnitude and direction)

8. **Option C**

Explanation: displacement, velocity, and acceleration, linear momentum, force are vector quantities, while speed (the magnitude of velocity), time, and mass are scalars. To qualify as a vector, a quantity having magnitude and direction must also obey certain rules of combination.

9. **Option A**

Explanation: $V^2 = U^2 + 2as$
$V^2 = 0 + 2(3)(24)$
$V^2 = 144$
$V = \sqrt{144} = 12ms^{-1}$

CHAPTER THREE

Motion

Types of motion: translational, oscillatory, rotational, spin and random

10. Which type of motion do the wheels of a moving car undergo?
A. Vibratory and translational motion
B. Random and translational motion
C. Rotational and oscillatory motion
D. Translational and rotational motion
UTME, 2014

11. If a body moves with a constant speed and at the same time undergoes an acceleration, its motion is said to be
A. oscillation
B. circular
C. rotational
D. rectilinear
UTME, 2019

linear motion
speed, velocity and acceleration

12. A train has an initial velocity of 44m/s and an acceleration of -4m/s^2. Calculate its velocity after 10 seconds
A. 10m/s
B. 6m/s
C. 8m/s
D. 4m/s
UTME, 2019

equations of uniformly accelerated motion

13. Which is the incorrect formula for a body accelerating uniformly?

A. $a = v^2 - u^2/2$

B. $v^2 = u^2 + 2as$

C. $s = Ut + \frac{1}{2}at^2$

D. $v^2 - u^2 = 2as$

UTME, 2017

motion under gravity

14. A structural engineer stood on top of a building releasing a light and heavy object to the ground. Which of the following statements is true? (Neglect Air Resistance)

A. Both light and heavy subject reach the ground at the same time

B. the light object gets to the ground first before the heavy object

C. he heavy object to the ground first before the light object

D. None get to the ground first

UTME, 2015

15. Calculate the time taken for a mango fruit that fall from the tree 20 m to the ground [g = 10 ms^{-2}]

A. 10s

B. 5s

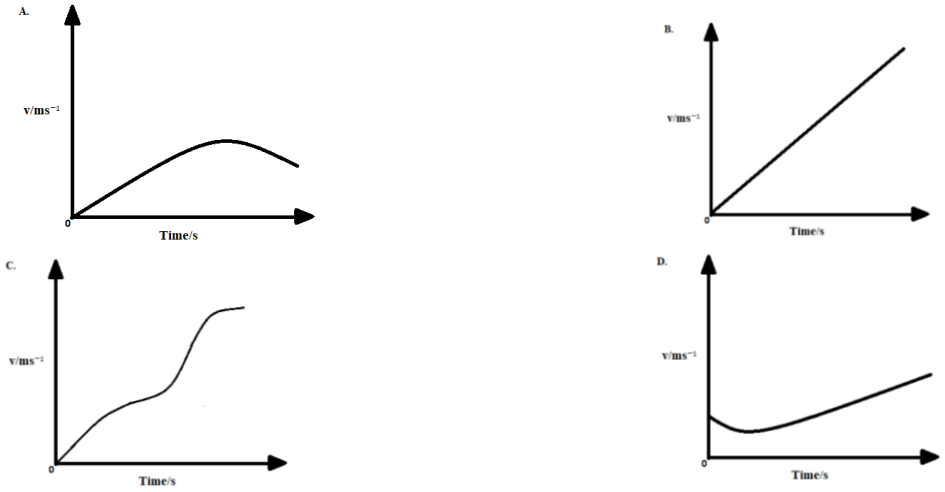
C. 4s

D. 2s

UTME, 2017

distance-time graph and velocity time graph

16. In the diagram below, which of the following velocity-time graphs shows uniform acceleration of a body from rest?



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

UTME, 2016

Projectiles:
calculation of range, maximum height and time of fight

17. If a projectile has maximum range of 36m, find the speed of projection (Take g = 9.8m/s²)

A. 19m/s
B. 2m/s
C. 4m/s
D. 7m/s

UTME, 2015

18. A projectile is fired from the ground level with a velocity of $300ms^{-1}$ at an angle of a 30^0 to the horizontal.
Calculate the time taken to reach the maximum height?
[$g = 10ms^{-2}$]
A. 30s
B. 20s
C. 25s
D. 15s
UTME, 2016
applications of projectile motion

19. A long jumper leaves the ground at an angle of 20 degrees above the horizontal and at a speed of 11m/s. How far does it jump in the horizontal direction?
A. 0.38m
B. 7.93m
C. 8.45m
D. 0m
UTME, 2020

Newton's laws of motion: inertia, mass and force

20. The impulse of a force is deduced from Newton's second law as
A. F = ma
B. F = m(v-u)/t
C. F = mg
D. F = mv – mu
UTME, 2016

21. The tendency of a body to remain at rest when a force is applied to it is called.

A. Impulse

B. Momentum

C. Inertia

D. Friction

UTME, 2018

22. Two bodies have masses in the ratio3:1. They experience forces which impart to them, acceleration in the ratio 2:9 respectively. Find the ratio of forces the masses experienced

A. 1:4

B. 2:1

C. 2:3

D. 2:5

UTME, 2021

impulse and momentum

23. A constant force of 5N acts for 5 seconds on a mass of 5kg initially at rest. Calculate the final momentum

A. $125kgms^{-1}$

B. $25kgms^{-1}$

C. $15kgms^{-1}$

D. $0kgms^{-1}$

UTME, 2017

24. A ball of mass 800g moving horizontally with a speed of 5m/s hits a vertical wall and rebounds with the same speed. The impulse experienced by the ball is?

A. 0kgm

B. 2kgm/s

C. 4kgm/s

D. 8kgm/s

UTME, 2018

conservation of linear momentum

25. In an elastic collision
I. Energy is conversed
II. Energy is decreased
III. Energy is increased
IV. Linear momentum conversed
A. I only
B. II and IV only
C. II only
D. III only
UTME, 2015

26. A body of mass 100g moving with a velocity if $10ms^{-1}$ collides with a wall. If after collision it moves with a velocity of $2.0ms^{-1}$ in the opposite direction, calculate the change in momentum.
A. 0.8Ns
B. 1.2Ns
C. 12.0Ns
D. 80.0Ns
UTME, 2018

27. A ball of mass 0.5kg moving at $10ms^{-1}$ collides with another ball of equal mass at rest. If the two balls move off together after the impact, calculate their common velocity.
A. $0.2ms^{-1}$
B. $0.5ms^{-1}$
C. $5.0ms^{-1}$
D. $5.5ms^{-1}$
UTME, 2021

Motion in a circle: angular velocity and angular acceleration

28. If an object which mass is 3kg moves in a circular path of a radius 0.7m, record a speed at 2m/s what is the result of the angular velocity?

A. 4 $rads^{-1}$

B. 1$rads^{-1}$

C. 3$rads^{-1}$

D. 4$rads^{-1}$

UTME, 2015

centripetal and centrifugal forces.

29. A satellite revolving around the earth is kept on its orbit by

A. Centripetal forces only

B. Centripetal and frictional forces

C. Centrifugal forces only

D. Centripetal and centrifugal forces

UTME, 2016

30. Particles of mass 10^{-2} kg is fixed to the tip of a fan blade which rotates with angular velocity of 100rad^{-1}. If the radius of the blade is 0.2m, the centripetal force is?

A. 2N

B. 20N

C. 200N

D. 400N

UTME, 2021

Simple Harmonic Motion (S.H.M):

definition and explanation of simple harmonic motion

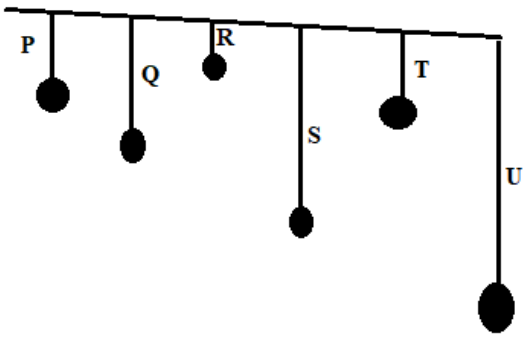
31. The motion of a body is simple harmonic if the?
A. acceleration is always directed towards a fixed point
B. path of motion is a straight line
C. acceleration is proportional to the square of the distance from a fixed point
D. acceleration is constant and directed towards a fixed point
UTME, 2021

examples of systems that execute S.H.M

32. Why do soldiers march disorderly while crossing a bridge?
A. To prevent resonance on the bridge
B. To set the bridge into resonance
C. To make the bridge collapse
D. To spread their weight evenly on the bridge
UTME, 2017

period frequency and amplitude of S.H.M

33. In the diagram shown, which of the simple pendulum will resonate with P when set into oscillation?



A. U
B. T
C. R and T
D. Q and R
UTME, 2018

34. An object of mass 50g is suspended from the end of a spiral spring of force constant 0.5N/m, the body is set into simple harmonic motion with 0.3m displacement. The period of the motion is

A. 1.00s
B. 1.99s
C.3.00s
D. 2.5s
UTME, 2020

energy change in S.H.M

35. A boy of mass m, suspended from a spring, is put into simple harmonic motion. If the motion has amplitude A and the spring constant k, the maximum potential energy of the mass is

A. KA
B. 0.5 kA^2
C. MkA
D. kA^2/m
UTME, 2020

ANSWERS AND EXPLANATIONS

10. Answer: **Option D**
Explanation: The tires of a car rotate and translates in a straight line alongside. If the wheels are turning it continues to translate through the rotational motion of the tires.

11. Answer: **Option B**
Explanation: this is because circular motion, a body may be moving with constant speed, but the velocity will never be constant. This is because velocity is a vector that depends on both magnitude and direction. As the direction of the object moving in a circle change, the velocity also changes even though the speed is constant. The body will also be accelerating because the velocity is changing. Remember, acceleration = change in velocity/change in time. So, a circular motion will automatically turn a constant speed into changing velocity (because of changing direction) and by extension acceleration.

12. Answer: **Option D**
Explanation:
V = u + at, at u = 44m/s
V= 44 + [-4]10
V= 44 - 40
V= 4m/s

13. Answer: **Option A**
The student should look through the equations of motion

14. Answer: **Option A**
Explanation: If we Neglect air resistance both objects will reach the ground at the same time This is because they only have one force acting on them: gravity.

15. Answer: **Option D**

Explanation: u =?, H = 20, g = 10
From equation of motion under gravity
$H = ut \pm 0.5gt^2$, it is falling so g is +ve
$H = 0 + 0.5gt^2$
$H = 0.5gt^2$
$2H = gt^2$
$\frac{2H}{g} = t^2$
$t = \sqrt{\frac{2H}{g}}$
$= \sqrt{\frac{2\times20}{10}}$
$= \sqrt{4}$
= 2s

16. Answer: **Option C**
Explanation: uniform acceleration is when the change in velocity is equal to the change in time taken and it's depicted in the diagram B.

17. Answer: **Option A**
Explanation: $R_{Max} = \frac{U^2}{g}$
$36 = \frac{U^2}{9.8}$
$U = \sqrt{36 \times 9.8}$
U= 19 m/s

18. Answer: **Option D**
Explanation:
The total time of flight is given as
$T = \frac{2Usin\theta}{g}$
Hence, time to maximum height is half of the total time of flight,
$t = \frac{Usin\theta}{g}$
$= \frac{300sin30}{10} = 15s$

19. Answer: **Option B**
Explanation:
Range= $\frac{U^2 \sin 2\theta}{g}$
Range= $\frac{11^2 \sin (2\times 20)}{9.81}$
Range=7.9283=7.93

20. Answer: **Option B**
Explanation: The impulse-momentum theorem states that the rate of change of momentum of an object is equal to the impulse applied to it. This is logically equal to Newton's second law of motion.

21. Answer: **Option C**
Explanation: Inertia, property of a body by virtue of which it opposes any agency that attempts to put it in motion or, if it is moving, to change the magnitude or direction of its velocity. Inertia is a passive property and does not enable a body to do anything except oppose such active agents as forces and torques. A moving body keeps moving not because of its inertia but only because of the absence of a force to slow it down, change its course, or speed it up.

22. Answer: **Option C**
Explanation
Given $\frac{m_1}{m_2} = \frac{3}{1} \Rightarrow m_1 = 3m_2$
$\frac{a_1}{a_2} = \frac{2}{9} = a_1 = \frac{2a_2}{9}$
F_1/F_2 =?
Since F = ma
$\Rightarrow \frac{F1}{F2} = \frac{m_1 a_1}{m_2 a_2} = \frac{(3m_2)(2a_2)}{9m_2 a_2}$
$\frac{F1}{F2} = \frac{2}{3} \Rightarrow 2:3$

23. Answer: **Option B**

Explanation: Impulse = momentum
Impulse = Force (f) × time (t)
Momentum = mass (m) × velocity (v)
∴ Ft = Final momentum - initial momentum
FT = mv - mu
Since it is initially at rest u = 0
∴ 5 × 5 = mv - m (0)
25 = mv
∴ Final momentum = 25kgms^{-1}

24. Answer: **Option D**
Explanation:
Initial momentum = 0.8 × 5 = 4.0kgms^{-1}
Final momentum = 0.8 × (– 5)
= – 4.0kgms^{-1}
Impulse on ball = Change in momentum
= 4.0 – (– 4.0)
= 8.0 kgms^{-1}

25. Answer: **Option B**
Explanation: In an inelastic collision, linear momentum is conserved and energy is decreased. Momentum and kinetic energy are conserved in elastic collision

26. Answer: **Option B**
Explanation:
Momentum = Mass x Velocity
Change in Momentum = Mass x (change in velocity)
Change in Momentum = Mass x (v - u)
Mass = 100g = 0.1kg
U = 2ms^{-1}
V = 10ms^{-1}
Change in momentum = m (v - u)

= 0.1 (2 -(- 10))
= 0.1 (12)
= 1.2Ns

27. Answer: **Option C**
Explanation:
Using; $m_1u_1 + m_2u_2 = (m_1 + m_2)\ v$
Since, $m_1 = 0.5kg$, $u_1 = 10ms^{-1}$, $m_2 = 0.5kg$ and $u_2 = 0$
$\therefore (0.5kg \times 10) + (0.5 \times 0) = (0.5 + 0.5)\ v$
$v = 5ms^{-1}$

28. Answer: **Option C**
Explanation:
M= 3kg, r = 0.7m, v = 2m/s
v = wr
w = angular velocity
r = radius in a tangential circular
v = speed of an object
$W = \frac{V}{\delta} = \frac{2}{0.7} = 2.85$
$W = 2.853rads^{-1}$
approx. Angular velocity (w) = $3rads^{-1}$

29. Answer: **Option D**
Explanation: Since centripetal force is the inward force required to keep an object moving with a constant speed in circular path and centrifugal force is the apparent force that pulls an object from its centre or axis of rotation. so, a satellite revolving around the earth kept on its orbit is both centripetal and centrifugal.

30. Answer: **Option B**
Explanation:
Given

m = 10^{-2}
w = 100rads^{-1}
F = mw^2r
r = 0.2m
F =?
= 10^{-2} x $(100)^2$ x 0.2
= 20N

31. Answer: **Option A**
Explanation: In simple harmonic motion, the acceleration of the particle is directed towards its mean position and directly proportional to its displacement

32. Answer: **Option A**
Explanation: Soldiers march disorderly while crossing a bridge to prevent resonance because when soldiers march in orderly manner across a bridge, they generate a rhythmic oscillation of wave on the bridge and at a certain point, would start oscillation to the same rhythm as that of the marching steps. This oscillation would reach a maximum peak when the bridge can no longer sustain its own strength and hence collapses. So, for these reasons, soldiers are ordered to march disorderly while crossing a bridge.

33. Answer: **Option A**
Explanation: The pendulum that will resonate with P is T. being of the same length and therefore of the same frequency.

34. Answer: **Option B**
see solution to the question below
$T=2\pi\sqrt{\frac{m}{k}}$
T=?
m=50g=0.05kg

k=0.5N/m

$T=2\times3.142\sqrt{\frac{0.05}{0.5}}$

$T=6.284\sqrt{0.1}$

$T=6.284\times0.316$

T=1.987s

35. Answer: **Option B**

Maximum PE = $\frac{1}{2}KA^2$

CHAPTER FOUR

Gravitational field

Newton's law of universal gravitation

36. The earth's gravitational field intensity at its surface is about ($G = 6.7 \times 10^{-11} Nm^2/kg^2$, mass of the earth is $6 \times 10^{24k} g$, radius of the earth is $6.4 \times 10^6 m$, g on the earth = $9.8 m/s^2$)

A. 6.7N/kg
B. 7.9N/kg
C. 8.0N/kg
D. 9.8N/kg

UTME, 2019

acceleration due to gravity [g=GM / R]

37. Calculate the apparent weight loss of a man weighing 70kg in an elevator moving downwards with an acceleration of $1.5ms^{-2}$
[g = $10ms^{-2}$]

A. 686N
B. 595N
C. 581N
D. 105N

UTME, 2013

38. What force has to be exerted on a mass 60kg to give it an acceleration of 10ms-2 vertically upwards?
[g = 10ms-2

A. 300N
B. 600N
C. 1200N
D. 400N

UTME, 2016

distinction between mass and weight

39. When a brick is taken from the earth's surface to the moon, its mass

A. remains constant

B. reduces

C. increases

D. becomes zero

UTME,2013

escape velocity

40. Calculate the escape velocity of a satellite launched from the earth's surface if the radius of the earth is $6.4x10^6$ m

A. $25.3kms^{-1}$

B. $4.2kms^{-1}$

C. $4.0kms^{-1}$

D. $11.3kms^{-1}$

UTME, 2014

parking orbit and weightlessness

41. A member of the crew of a SPACESHIP experiences weightlessness in a space when they

A. Fall freely from the earth's gravitational field

B. Is walking on the planet

C. In between the sun and the earth

D. Holding anything in space is negative

UTME, 2015

ANSWERS AND EXPLANATIONS

36. Answer: **Option A**

Explanation:

$F = \frac{Gm_1m_2}{r^2}$

M1 = 10^{24} Kg, M2 = 10^{27} Kg, r = 10^2

(Note: the gravitational constant of G = 6.67×10^7 ndash;11 Nm^2/Kg^2

$F = \frac{6.67 \times 10^{-11+24+27}}{10^{40}}$

$F = 6.67 \times \frac{10^{40}}{10^{40}}$

F= 6.67N

37. Answer: **Option D**

Explanation: Wt loss = mg - m (g - a)

= 70 x 10 - 70 (10 - 1.5) = 105N

38. Answer: **Option C**

Explanation:

F = Ma + mg = 60 x 10 x 60 x 10 = 1200N

39. Answer: **Option A**

Explanation: mass is the quantity of matter of an object it does not change

40. Answer: **Option D**

Explanation: Explanation

$V_{escape} = \sqrt{2gR}$

$V_{escape} = \sqrt{(2 \times 10 \times 6.4 \times 10^6)}$

$V_{escape} = \sqrt{128000000}$

$V_{escape} = 11313.7085 ms^{-1}$

$V_{escape} = 11.313 kms^{-1}$

41. Answer: **Option A**

Explanation: Weightlessness: The state of being free from the effects of gravity. (Zero gravity)

CHAPTER FIVE

Equilibrium of Forces

equilibrium of a particles: equilibrium of coplanar forces

42. A nail is pulled from a wall with a string tied to the nail. If the string is inclined at an angle of 30 degrees to the wall and the tension in the string is 50N, the effective force used in pulling the nail is:

A. 25N

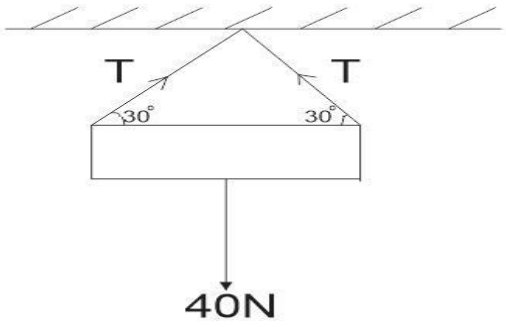
B. $25\sqrt{3}$

C. 50 N

D. $50\sqrt{3}$

UTME, 2020

Triangles and polygon of forces



43.The value of T in the figure above is

A. 30N

B. 10.0N

C. 20N

D. 40N

UTME, 2019

Principles of moments
simple treatment and moment of a couple (torgue)

44. The resultant force of a couple is .....?
A. Infinity
B. Zero
C. One
D. Half
UTME, 2015

Applications

45. What is the magnitude of the couple which acts on a rotating circular disc of radius 2m, if a constant tangential force of 2N is responsible for the rotation.
A. 15Nm
B. 25Nm
C. 3Nm
D. 4Nm
UTME, 2015

Conditions for equilibrium of rigid bodies under the action of parallel and non-parallel forces:
resolution and composition of forces in two perpendicular directions

46. A meter rule is pivoted at its mid-point with a vertical force of 10N hanging from the distance 30cm from the mid-point. At what distance must a 15N force hang to balance the ruler horizontally?
A. 30cm
B. 10cm
C. 20cm
D. 25m
UTME, 2016

47. A man on a bench will exert the greatest pressure on the bench when he
A. lies flat on his back
B. lies flat on his belly
C. stands on both feet
D. stands on the toes of one foot
UTME, 2021

Resultant and equilibrant

48. One of the conditions necessary for an object to be in equilibrium when acted upon by a number of parallel forces is that the vector sum of the forces is
A. Average
B. Zero
C. Negative
D. Positive
UTME, 2014

Centre of gravity and stability
stable, unstable and neutral equilibrium

49. Two masses 50g and 70g are suspended from the respective ends of a light metre rule, the centre of gravity of the system is
A. 58.3cm
B. 50.0cm
C. 70.2cm
D. 80.4cm
UTME, 2020

ANSWERS AND EXPLANATIONS

42. Answer: **Option A**

Explanation: The effective force required to remove the nail is horizontal component of the tension (T_x)

T_x = Tsin30

T_x= 50sin30

T_x=50 × 0.5 = 25N

43. Answer: **Option D**

Explanation:

Tsin30 + Tsin30 =40

2Tsin30 = 40

Tsin30 = 40/2 = 20

T (1/2) = 20

T = 20 x 2 = 40N

44. Answer: **Option B**

Explanation: moment of a couple = force × length

The tangential force is acting in an opposite direction alongside its length

i.e., $F_1L_1 = F_2L_2$

$F_2L_2 - F_1L_1 = 0$ (i.e., Zero)

45. Answer: **Option D**

Explanation: Magnitude =One of the forces x radius between them

Therefore, 2N x 2m =4Nm

46. Answer: **Option C**

Explanation: Explanation

Clockwise moment = Anti-clockwise moment

10 × 30 = 15 × d

d = $\frac{300}{15}$

d = 20cm

47. Answer: **Option D** (Pressure decreases with increase in area)

48. Answer: **Option B**

Explanation: If the net force is equal to zero, the object is said to be in equilibrium. Because there is no net force acting on an object in equilibrium, then from Newton's first law of motion, the object continues to move at a constant speed.

49. Answer: **Option A**

Explanation: Taking moment at the fulcrum.

Clockwise moment = 70 (100 - x)

Anticlockwise moment = 50x

By the principle of moment

70(100 - x) = 50x

7000 - 70x = 50x

Collecting like terms

7000 = 50x + 70x

7000 = 120x

Divide both sides by 120

x = $\frac{7000}{120}$ = 58.33cm

The centre of gravity of the system is 58.33cm from the 50g but 41.67cm from the 70g mass.

CHAPTER SIX

Work Energy and Power

definition of work, energy and power

50. A gas at a pressure of 10^5 Nm^{-2} expands from $0.6m^{-3}$ to $1.2m^3$ at constant temperature, the work done is

A. 7.0×10^6 J

B. 6.0×10^6 J

C. 6.0×10^5 J

D. 6.0×10^4 J

UTME, 2013

51. A car of mass 800kg attains a speed of 25m/s in 20 secs. The power developed in the engine is

A. 2.5×10^4 W

B. 50×10^4 W

C. 25×10^6 W

D. 50×10^6 W

UTME, 2021

forms of energy

52. If an object is placed at a height of tem above the ground at a stationary point. It possesses what types of energy?

A. Mechanical energy

B. Stationary energy

C. Potential energy

D. Vibrational energy

UTME, 2015

53. A lead bullet of mass 0.05 kg is fired with a velocity of 200 m/s into a lead block of mass 0.95 kg. Given that the lead block can move freely, the final kinetic energy after impact is

A. 100J

A. 150J

C. 50J

D. 200J

UTME, 2021

54. A ball of mass 0.1kg is thrown vertically upwards with a speed of $10ms^{-1}$ from the top of a tower 10m high. Neglecting air resistance, its total energy just before hitting the ground is? (Take g = $10ms^{-2}$)

A. 5J

B. 10J

C. 15J

D. 20J

UTME, 2021

conservation of energy

55. Which of the following best describes the energy changes which take place when a steam engine drives a generator which lights a lamp?

A. heat ----> Light----> Sound ----> Kinetic

B. Kinetic ----> Light ----> Heat ----> Electricity

C. heat ----> Kinetic ----> Electricity ----> Heat and Light

D. electricity ----> Kinetic ----> Heat ----> Light

UTME,2018

ANSWERS AND EXPLANATIONS

50. Answers: **Option D**
Explanation: $W = \frac{W1V1}{V2}$
$W = \frac{10 \times 0.6}{1.2}$
$W = 6.0 \times 10^4 J$

51. Answers: **Option A**
Explanation:
Power = Force x distance/time = $\frac{m(v-u)}{t} \times v$
$= \frac{800(25-0)}{20} \times 25$
$= 2.5 \times 10^4$ watts

52. Answers: **Option C**
Explanation: Energy due to position T is potential energy (P.E) while energy due to motion is kinetic energy (K.E)

53. Answers: **Option C**
Explanation: From principle of conservation of linear momentum,
(0.05 x 200) + (0.95 x 0) = (0.05 + 0.95) x V (since collision is inelastic).
10 + 0 = V
Thus V = 10m/s.
Recall Kinetic Energy = $\frac{1}{2}mv^2$
therefore K.E = $\frac{1}{2}$ (0.05 + 0.95) x 10^2
K.E = $\frac{1}{2}$(1 x 100) = 50J

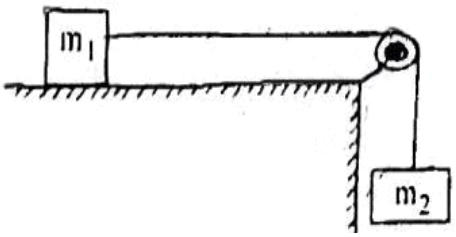
54. Answers: **Option C**
Explanation:
Given;
m = 0.1kg
u = $10ms^{-1}$

h = 10m
g = $10ms^{-2}$
At h_{max}; v = 0
Using;
V = u= gt
0 = w - 10t
$V^2 = u^2 - 2gh$
$0^2 = 10^2 - 2 \times 10h$
20h = 100
h = 5m
Total height = 10 + 5
= 15m
Total energy = mgh_r = 0.1 x 10 x1 5
= 15J

55. Answers: **Option C**
Explanation: the steam engine generates heat energy in form of steam which is used to drive stream turbine generator thereby creating kinetic energy. these turbine generators generate electricity which is now step down for office and household use as water heaters, lamps and bulbs (heat and light energy).

CHAPTER SEVEN

Friction
coefficient of limiting friction and its determination.



56. In the diagram given the hanging mass m2 is adjusted until m1 is on the verge of sliding. The coefficient of static friction between mass m1 and the table is

A. m_1/m_2
B. m_1g/m_2
C. $m_2/m1$
D. m_2g/m_2

UTME, 2018

57. The limiting frictional force between two surface depends on
I. the normal reaction between the surfaces
II. the area of surface in contact
III. the relative velocity between the surfaces
IV. the nature of the surface

A. I only
B. I & IV only
C. II only
D. III only

UTME, 2019

advantages and disadvantages of friction

58. When the brakes in a car are applied, the frictional force on the tyres
A. is a disadvantage because it is in the direction of the motion of the car
B. is a disadvantage because it is in the opposite direction of the motion of the car
C. is an advantage because it is in the direction of the motion of the car
D. is an advantage because it is in the opposite direction of the motion of the car
UTME, 2021

ANSWERS AND EXPLANATIONS

56. Answers: **Option C**
Explanation: Tension=weight on the hanging mass
tension = m_2g
normal reaction for $m_1=m_1g$
m_2g = coefficient of friction x m_1g
coefficient of static friction = $\frac{m_2g}{m_1g}$
= $\frac{m2}{m1}$

57. Answers: **Option B**
Explanation: Limiting friction also depends on the weight of the top contact object, the higher the weight, the higher the frictional force experienced. The limiting frictional force between two surfaces does not depend on the surface area in contact, neither does it depend on their relative velocities.

58. Answers: **Option D**
Explanation: frictional force helps to oppose the motion of the car. Friction depends on the nature of the surfaces in contact. Solid friction is independent of the area of the surfaces in contact and the relative velocity between the surfaces.

CHAPTER EIGHT

Simple Machines
mechanical advantage, velocity ratio and efficiency of machines

59. The velocity ratio of an inclined plane where angle of inclination in θ is

A. $\sin\theta$

B. $\cos\theta$

C. $\tan\theta$

D. $1/\sin\theta$

UTME, 2017

60. What effort will a machine of efficiency 90% apply to a load of 180N if its efforts arm is twice as long as its load arm?

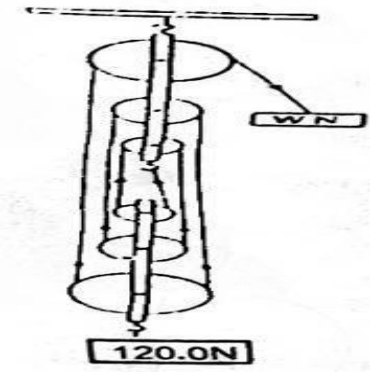
A. 100N

B. 90N

C. 80N

D. 120N

UTME, 2018



61. The diagram shown represents a block-and-tackle pulley system on which an effort of W Newtons supports a load of 120.0N. If the efficiency of the machine is 40, then the value of W is?

A. 28.0

B. 48.0N

C. 233.0N

D. 50.0N

UTME, 2018

62. The pitch of a screw jack is 0.45cm and the arm is 60cm long. If the efficiency of the Jack is 75/π %, calculate the mechanical advantage.

A. 400

B. 300

C. 200

D. 150

UTME, 2019

ANSWERS AND EXPLANATIONS

59. Answers: **Option D**

Explanation:

Consider an inclined plane shown below, as the effort moves along OB, the load moves is lifted up through a vertical height AB

V.R = $\frac{\text{distance moved by effort}}{\text{distance moved by load}} = \frac{OB}{AB}$

But Sin θ = $\frac{opp}{hyp} = \frac{AB}{OB}$

therefore; = $\frac{OB}{AB} = \frac{1}{\sin\theta}$

60. Answers: **Option A**

Explanation: M.A. = $\frac{\text{Efficiency} \times \text{Velocity ratio}}{100}$

M.A. = $\frac{90 \times 2}{100}$

M.A. = 1.8

E = $\frac{L}{M.A}$

E = $\frac{180}{1.8}$

E = 100N

61. Answers: **Option D**

Explanation:

Given Data:

Efficiency = 40% Load = 120N, V.R = 6 (Number of Pulleys)

Efficiency = $\frac{M.A}{V.R}$ x 100

40 = $\frac{M.A}{6}$ x 100

6 × 40 = 100 M.A

M.A = $\frac{240}{100}$ = 2.4

Where M.A = $\frac{Load}{Effort}$

2.4 = $\frac{120}{Effort}$

: Effort = $\frac{120}{2.4}$ = 50N

62. Answers: **Option C**

Explanation: P=0.45cm, L=60cm and Eff= 75/π

VR (screw system) = $\frac{2\pi r}{P} = \frac{2\pi L}{P}$

M.A = $\frac{Eff\% \times VR}{100}$

$= \frac{75}{\pi} \times \frac{1}{100} \times \frac{2\pi \times 60}{0.45}$

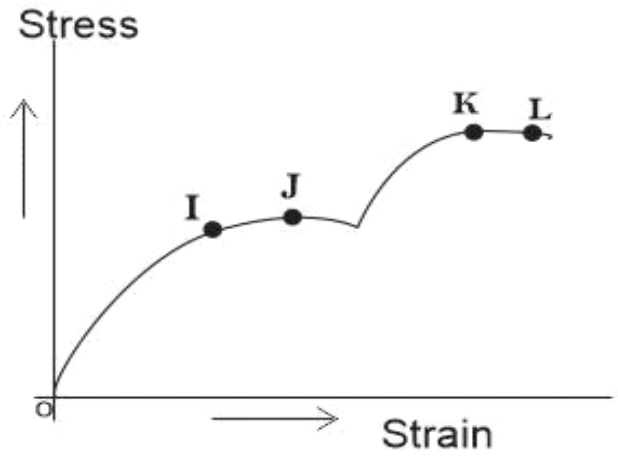
$= \frac{75 \times 800}{300}$

= 200

CHAPTER NINE

Elasticity

elastic limit, yield point, breaking point, Hooke's law and Young's modulus



63. The diagram above represents the stress-strain graph of a loaded wire. Which of these statements is correct?

A. At J, the wire becomes plastic

B. J is the yield point

C. L is the elastic limit

D. At K, the wire breaks

UTME, 2019

64. If the stress on a wire is 10^7 NM^{-2} and the wire is stretched from its original length of 10.00 cm to 10.05 cm. The young's modulus of the wire is

A. 5.0×10^4 Nm^{-2}

B. 5.0×10^5 Nm^{-2}

C. 2.0×10^8 Nm^{-2}

D. 2.0×10^9 Nm^{-2}

UTME, 2021

The spring balance as a device for measuring force

65. A string of length 5cm is extended by 0.04m when a load of 0.8kg is suspended at the end. How far will it extend if a force of 16N is applied? [g = 10ms^{-2}]

A. 0.04m

B. 0.12m

C. 0.01m

D. 0.08m

UTME, 2020

ANSWERS AND EXPLANATIONS

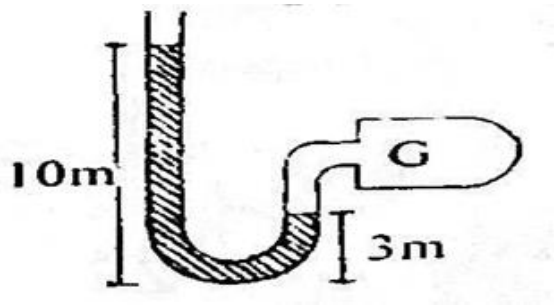
63. Answer: **Option B**
Explanation:
- I is the elastic limit
- the end of the constant part J is the yield point
- L is the break point.

64. Answer: **Option D**
Explanation:
Y = $\frac{\text{Stress}}{\text{Strain}}$, but stress = 10^7 Nm^{-2} (given).
Strain = $\frac{e}{10}$ = $\frac{10.05-10.00}{10.00}$ = 0.005
Thus Y = $\frac{10^7}{0.005}$ = 2.0 x 10^9 Nm^{-2}

65. Answer: **Option D**
Explanation:
From Hoke's Law, F = ke, K = Constant of Force
For the first case, Force = mg,
= 0.8 × 10 = 8N
∴ 8 = k × 0.04
k = $\frac{8}{0.04}$
= 200N/m
Since K is constant
For the second case, F = ke
F = 200 × e
∴ e = $\frac{F}{200}$
= $\frac{16}{200}$
= 0.08m

CHAPTER TEN

Pressure
Atmospheric Pressure:
measurement of pressure



66. In the diagram given if the atmospheric pressure is 760mm, the pressure in the chamber G Is

A. 660mm
B. 830mm
C. 690mm
D. 860mm

UTME, 2018

simple mercury barometer, aneroid barometer and manometer.

67. A manometer is an instrument used for measuring

A. Relative density of liquid
B. Pressure in liquids and gases
C. Humidity
D. Atmospheric pressure

UTME, 2016

Pressure in liquids:
the relationship between pressure, depth and density ($P = \rho gh$)

68. At what depth below the sea-level would one experience a change of pressure equal to one atmosphere? Density of sea water = 10^{13} kg^{-3}, one atmosphere = 0.01×10^5 Nm^{-2}, g = $10ms^{-2}$

A. 0.1m

B. 1.0m

C. 10.0m

D. 100.0m

UTME, 2013

69. The thrust due to hydrostatic pressure alone on the bottom of a fish tank which is 60cm x 40cm when the depth of water is 30cm is?

A. 8N

B. 12N

C. 720N

D. 24N

UTME, 2020

ANSWERS AND EXPLANATIONS

66. Answers: **Option B**
Explanation: the pressure in the chamber G= 10 - 3 = 7 cm
convert 7cm to mm gives you 70mm
since the gas pressure is greater than atmospheric pressure, which is (760+70) mm= 830mm

67. Answers: **Option B**
Explanation: a manometer is used to measure pressure in liquids and gases. Manometer gauges measure the pressure of gases and vapors from atmospheric to about 1 Pa by balancing the force exerted by the gas or vapor against the weight of a column of liquid, usually mercury, water, or oil.

68. Answers: **Option C**
Explanation
$H = \frac{P}{\rho g}$
$H = \frac{1.01\times10^5}{10^{13}\times10}$
H = 9.97

69. Answers: **Option C**
Explanation: L = 60cm = 0.6m
b = 40cm = 0.4m
h = 30cm = 0.3m
P = ρgh
ρ = 1000kg/m^3
P = 1000 × 10 × 0.3
= 3000Pa
P = F/A
A = 0.6 × 0.4 = 0.24m^2
F = PA = 3000 × 0.24
= 720N

CHAPTER ELEVEN

Liquids at Rest

definition of relative density

70. If 21g of alcohol of density 0.7gcm^{-3} is mixed with 10g of water, what would be the density of the resulting mixture?

A. 780gcm^{-3}

B. 0.78gcm^{-3}

C. 30gcm^{-3}

D. 10gcm^{-3}

UTME, 2020

71. A solid weigh 10.00N in air, 6 N when fully immersed in water and 7.0 N when fully immersed in a liquid X. Calculate the relative density of the liquid, X.

A. 5/3

B. 4/3

3. 3/4

D. 7/10

UTME, 2021

upthrust on a body immersed in a liquid

72. Calculate the upthrust on an object of volume 50cm^3 which is immersed in liquid of density 10^{3}kgm^{-3} [g = 10ms^{-2}]

A. 0.8N

B. 2.5N

C. 0.5N

D. 1.0N

UTME, 2020

Archimedes' principle and law of flotation and applications, e.g., ships and hydrometers.

73. A piece of cork floats in a liquid. What fraction of its volume will be immersed in the liquid? [Density of the cork = 0.25 x 10^3 kgm^{-3}, Density of the liquid = 1.25 x 10^3 kgm^{-3}]

A. 0.8

B. 0.5

C. 0.2

D. 0.1

UTME, 2013

ANSWERS AND EXPLANATIONS

70. Answer: **Option B**
Explanation: density = $\frac{\text{mass}}{\text{volume}}$
mass of resulting mixture = 21+10 = 31g
volume of water = 10/1 = 10g
volume of alcohol = 21/0.7 = 30g
volume of resulting mixture = 30+10 =40
density = 31/40 = 0.78gcm^{-3}

71. Answer: **Option C**
Explanation:
R.D = loss in weight in liquid X loss in weight in water.
R.D = $\frac{10-7}{10-6} = \frac{3}{4}$

72. Answer: **Option C**
Explanation: Upthrust = change in weight
density = $\frac{\text{mass}}{\text{volume}}$
Mass of liquid displaced = Density of Liquid × Volume;
= 10^3 × 50 × 10^{-6}m^3
= 0.05kg
(Note that the volume of 50cm^3 was converted to m^3 by multiplying by 10^6)
i.e 50cm^3 = 50 × 10^{-6} m^3
Since mass displaced = 0.05kg
Upthrust = mg = 0.05 × 10
= 0.5N

73. Answer: **Option C**
Explanation:
= $\frac{0.25 \times 10^3}{1.25 \times 10^3}$ = 0.2

CHAPTER TWELVE

Temperature and Its Measurement

thermometric properties

74. Quantities of heat Q can be measured using a container called

A. Thermometer

B. Measuring cylinder

C. Calorimeter

D. Meter rule

UTME, 2015

calibration of thermometers

75. The ice and steam points of a thermometer are 20mm and 100mm respectively. A temperature of 75 degree Celsius corresponds to Y mm on the thermometer. What is Y?

A. 100 mm

B. 70 mm

C. 80 mm

D. 60 mm

UTME, 2020

Types of thermometers

76. For a best result using temperature to achieve an accurate measurement, it is best to use

A. Mercury thermometer

B. gas thermometer

C. clinical thermometer

D. alcohol thermometer

UTME, 2015

Conversion from one scale of temperature to another

77. A platinum resistance thermometer wire has a resistance of 7ohms at 0°Cand 7.5 ohms at 100°C. Calculate the temperature of the wire when the resistance is 7.2 Ohms

A. 15°C

B. 40°C

C. 20°C

D. 10°C

UTME, 2015

ANSWERS AND EXPLANATION

74. Answer: **Option C** (Calorimeter is an apparatus used for measuring the heat (Q) generated or absorbed by change of phase (state) or other physical change)

75. Answer: **Option C**

Explanation:

$\frac{75-0}{100-0} = \frac{x-20}{100-20}$

$x - 20 = \frac{75\times80}{100}$

X= 60 + 20 = 80

76. Answer: **Option B**

Explanation: A gas thermometers are more besting use to achieve an accurate temperature than others, such as liquid in glass thermometers such as mercury, clinical and alcohol thermometer.

77. Answer: **Option B**

Explanation: R0 = 7Ω, R1 = 7.2 Ω, R2 = 7.5 Ω, Tx =?

$\frac{X-T0^0C}{R1-R0} = \frac{T100^0C-T0^0C}{R2-R0}$

$\frac{Tx-0}{7.2-7} = \frac{100-0}{7.5-7}$

$\frac{Tx}{0.2} = \frac{100}{0.5}$

$Tx = \frac{100\times0.2}{0.5}$

$= \frac{20}{0.5}$

= 40°C

CHAPTER THIRTEEN

Thermal Expansion

Solids: definition and determination of linear, volume and area expansivities

78. The linear expansivity of brass is $2 \times 10^{-5}\ C^{-1}$. If the volume of a piece of brass is 15.00cm at 0°C, what is the volume at 100°C

A. $16.03cm^3$

B. $15.09cm^3$

C. $16.00cm^3$

D. $15.03cm^3$

UTME, 2018

79. A metal rod has a length of 100cm at 200°C. At what temperature will its length be 99.4cm. If the linear expansivity of the material of the rod is $2 \times 10^{-5}C^{-1}$

A. 200°C

B. 300°C

C. 100°C

D. -100°C

UTME, 2019

effects and applications, e.g., expansion in building strips and railway lines

80. The thermal expansion of a solid is an advantage in

A. Balance wheel of a watch

B. Construction of steel rail lines

C. Construction of large steel bridges

D. Fitting of tyres on wheels

UTME, 2017

ANSWERS AND EXPLANATIONS

78. Answer: **Option B**
Explanation:
Volume Expansivity $\gamma = 3\alpha$
$\gamma=3\ (2\times10^{-5})$
$\gamma=6\times10^{-5}C^{-1}$
$V_2=V_1(1+\gamma\theta)$
$V_2=15(1+(6\times10^{-5}\times\ (100-0)))$
$V2=15(1.006)$
$= 15.09cm^3$

79. Answer: **Option D**
Explanation:
L1 = 100cm, T1 = 200°C
L2 = 99.4cm, T2 =?
$\alpha = 2 \times 10^{-5}\ C^{-1}$
$\alpha = \frac{L2-L1}{L1(T2-T1)}$
$2 \times 10^{-5} = \frac{110-99.4}{100(200-T2)}$
$2 \times 10^{-5} = \frac{0.6}{100(200-T2)}$
$2 \times 10^{-5} \times 100(200-T2) = 0.6$
$200 - T2 = 0.6/0.002 = 300°C$
$T2 = 200 - 300 = -100°C$

80. Answer: **Option A**
Explanation: Thermal expansion of a solid is majorly advantageous in the use of bimetallic strip in the balance of a watch so as not to lose time

CHAPTER FOURTEEN

Gas Laws

Boyle's law (PV = constant)

81. A gas at a volume of V_o in a container at pressure P_o is compressed to one-fifth of its volume. What will be its pressure if the magnitude of its original temperature T is constant?

A. $P_o/5$
B. $4P_o/5$
C. P_o
D. $5P_o$

UTME, 2021

Charles' law (V/P = constant)

82. The equation $P^aV^bT^c$ = constant reduces to Charles Law if

A. a=1, b=1and c=0
B. a=1, b=0 and c=-1
C. a=0, b=1 and c=1
D. a=0, b=1 and c=-1

UTME, 2014

Pressure law (P/T = constant)

83. What will happen to the pressure of a gas if its temperature is reduced to -273°C?

A. It will decrease
B. it will drop to zero
C. It will increase
D. It will remain constant

UTME, 2016

general gas equation (PV/T = constant)

84. A given mass of gas has a pressure of 80 Nm^{-2} at a temperature of 47°C. If the temperature is reduced to 27°C with volume remaining constant, the new pressure is?

A. 46.0 Nm^{-2}

B. 75.0 Nm^{-2}

C. 80.0 Nm^{-2}

D. 85.3 Nm^{-2}

UTME, 2021

ideal gas equation (Pv = nRT)

85. Calculate the temperature of 6 moles of an ideal gas at a pressure of 7.6 x $10^6 Nm^{-2}$ with a volume of 10^{-3} m^3.

[R = 8.3$jmol^{-1}K^{-1}$]

A. 201 ^0C

B. 126 ^0C

C. 153 ^0C

D. 185 ^0C

UTME, 2016

ANSWERS AND EXPLANATIONS

81. Answer: **Option D**
Explanation: At constant T, $P_1V_1 = P_2V_2$.
Let $P_1 = P_0$ and $V_1 = V_0$
Using Boyle's law.
$P_0V_0 = P_2 \times \frac{1}{5}V_0$
$P_0V_0 = P_2 \times \frac{V_0}{5}$
$P_0V_0 = \frac{P_2V_0}{5}$
Cross multiply
$5P_0V_0 = P_2V_0$
Divide both sides by V_0
$5P_0 = P2$ i.e., $P2=5P_0$

82. Answer: **Option D**
Explanation: if a=0, b=1 and c=-1 then
$P^0V^1T^{-1} = V/T$ (Charles Law)

83. Answer: **Option B**
Explanation: Gay Loussac's Law - states that the pressure of a given amount of gas held at constant volume is directly proportional to the Kelvin temperature. If you heat a gas, you give the molecules more energy so they move faster. Conversely if you cool the molecules down, they will slow and the pressure will be decreased

84. Answer: **Option B**
Explanation:
Using P1/T1=P2/T2
P1 = 80Nm2
T1 = 47 + 273 = 320k
T2 = 27 + 273 = 300k

P2?

$\therefore = P2 = \frac{P1T2}{T1}$

$= \frac{80 \times 300}{320} = 75Nm^2$

85. Answer: **Option C**

Explanation:

$T = \frac{PV}{nR} = \frac{7.6 \times 10^6 \times 10^{-3}}{6 \times 8.3}$

$= 153^oC$

CHAPTER FIFTEEN

Quantity of Heat

definition of heat capacity and specific heat capacity of solids and liquids

86. The quantity of heat needed to raise the temperature of a body by 1K is the body's

A. Heat capacity
B. Internal energy
C. Specific heat capacity
D. Latent heat of fusion

UTME, 2016

determination of heat capacity and specific heat capacity of substances by simple methods e.g. method of mixtures and electrical method

87. When two objects P and Q are supplied with the same quantity of heat, the temperature change in P is observed to be twice that of Q. The mass of P is half that of Q. The ratio of the specific heat capacity pf P to Q is

A. 1:4
B. 4:1
C. 1:1
D. 2:1

UTME, 2020

88. A piece of substance of specific heat capacity 450Jkg^{-1} k falls through a vertical distance of 20m from rest. Calculate the rise in temperature of the substance on hitting the ground when all its energies are converted into heat. [g = 10ms^{-2}]

A. 2/9 ^{0}C
B. 4/9 ^{0}C
C. 9/2 ^{0}C
D. 9/4 ^{0}C

UTME, 2021

ANSWERS AND EXPLANATIONS

86. Answer: **Option A** (The heat capacity of a defined system is the amount of heat (usually expressed in calories, kilocalories, or joules) needed to raise the system's temperature by one degree (usually expressed in Celsius or Kelvin).

87. Answer: **Option C**
Explanation:
$H = mc\theta$
$H_P = H_Q$, $\theta_P = 2\theta$,
$m_P = \frac{1}{2}m_Q$
$\therefore H_P = m_Q C_P \theta_P$, also $H_Q = m_Q C_Q \theta_Q$
Since $H_P = H_Q$
$\therefore m_P c_P \theta_P = m_Q c_P \theta_q$
Putting in the conditions
$\frac{1}{2}m_Q \times c_P \times 2\theta_Q = m_Q \times \theta_Q \times c_Q$
$\therefore C_P = C_Q$
$\frac{C_P}{C_Q} = \frac{1}{1}$
= 1:1

88. Answer: **Option B**
Explanation:
Using the law of conservation of energy
$mc\triangle\theta = mgh$
$\triangle\theta = \frac{gh}{c}$
$= \frac{10 \times 20}{450}$
$= \frac{4}{9}\ ^0C$

CHAPTER SIXTEEN

Change of State

specific latent heats of fusion and vaporization;

89. Calculate the heat energy required to vaporize 50g of water initially at 80°C if the specific heat capacity of water is 4.23jg^{-1}k^{-1} (specific latent heat of vaporization of water is 2260jg^{-1}

A. 530000J

B. 23200J

C. 17200J

D. 130000J

UTME, 2021

90. Calculate the mass of ice that would melt when 2kg of copper is quickly transferred from boiling water to a block of ice without heat loss (specific heat capacity of copper = 400Jkgk^{-1}, latent heat of fusion of ice = 3.3 x 10^{5} Jkg^{-1})

A. 8/33kg

B. 3.3/80kg

C. 80/33kg

D. 3.3/8kg

UTME, 2021

melting, evaporation and boiling

91. The following statements were made by some students describing what happened during the determination of the melting point of solids

1. The temperature of the solid was constant until melting started

2. The temperature of the solid rose until melting started

3. During melting, the temperature was rising

4. During melting, the temperature was constant

5. The temperature continued to rise after all the solid had melted.

6. The temperature stopped rising after all the solid had melted. Which of the following gives correct statements in the right order?

A. 2, 4 and 5
B. 2, 3 and 6
C. 1, 3 and 6
D. 1, 3 and 5
UTME, 2020

92. I. A liquid boil when its saturated vapor pressure is equal to the external pressure
II. Dissolved substances in pure water leads to an increase in the boiling point.
III. When the external pressure is increased, the boiling point increases.
IV. Dissolved substances in pure water decreases the boiling point
Which of the above combinations are peculiarities of the boiling point of a liquid?
A. I, II and III only
B. I, II, III, and IV
C. I, II, and IV
D. II, III, and IV
UTME, 2021

the influence of pressure and of dissolved substances on boiling and melting points.

93. What will happen to the boiling point of pure water when it is heated in a place 30m below sea level?
A. It will be more than 100^0C
B. It will be last than 100^0C
C. It will still be at 100^0C
D. It will be fluctuating
UTME, 2013

application in appliances

94. Which of the following will increase the boiling point of water?
I. Taking it to a high altitude
II. Dissolving a salt into it
III. Heating it in a sealed flask
IV. Increasing the rate of heat supply
A. I only
B. III & IV only
C. II & III only
D. II only
UTME, 2015

ANSWERS AND EXPLANATIONS

89. Answer: **Option D**
Explanation:
H = mc△θ + mL
H =?
m = 50g, c = 4.23J/gk,L = 2260, △θ = 80°C
H = 50 [4.23 x 80 + 2260]
= 129920 ≈ 130,000J
90. Option A
Explanation
mcΔθ = mλf
2 x 400 (100 - 0) = m (3.3×10^5)
m = $\frac{2\times400\times100}{3.3\times10^5}$
= $\frac{8}{33}$kg

91. Answer: **Option A**
Explanation: for a solid to change to a liquid, it undergoes fusion. and they following are what happens during the melting. when the solid is heated the temperature increases so as to disassociate the bonds but once it starts melting the temperature doesn't rise again but it is constant. so, after the solid have melted the temperature rises again to allow the melted solid reach it boiling point.

92. Answer: **Option A**
Explanation: The boiling point of a liquid depends on temperature, atmospheric pressure, and the vapor pressure of the liquid. When the atmospheric pressure is equal to the vapor pressure of the liquid, boiling will begin.

93. Answer: **Option A** (the pressure in a liquid increase with depth since it's below the sea level there is an increase in depth which will cause an increase in the boiling point of the pure water).

94. Answer: **Option C**

Explanation: The simplest way to change the boiling point of a liquid is to change the surrounding pressure.

(a) Using a closed system to artificially increase that pressure will raise the boiling point of a liquid.

(b) Boiling point is dependent upon the strength of the bonds between its molecules. For this reason, adding a solute to the liquid will create stronger bonds between molecules, raising the solution's boiling point without increasing pressure.

CHAPTER SEVENTEEN

Vapours

relationship between saturated vapour pressure (S.V.P) and boiling

95. Vapour is said to be saturated on top of an enclosed liquid if _____

A. The rate of condensation is greater than that of vapourization
B. The rate of condensation is equal to that of vapourization
C. There is neither condensation nor vaporization of the liquid
D. The rate of condensation is less than that of vaporization

UTME, 2016

formation of dew, mist, fog, and rain

96. The small droplets of water that form on the grass in the early hours of the morning is

A. Fog
B. Haul
C. Mist
D. Dew

UTME, 2014

study of dew point, humidity and relative humidity

97. The temperature at which the water vapour present in the air is just sufficient to saturate air is

A. Boiling point
B. Ice point
C. Saturation point
D. Dew point

UTME, 2014

ANSWERS AND EXPLANATIONS

95. Answer: **Option B** (In an enclosed system vapour is said to be saturated when the rate at which liquids turns into gas is the same at which the gas collides with the water and turns back into liquid)

96. Answer: **Option D** (The dew point is the temperature to which air must be cooled to become saturated with water vapor)

97. Answer: **Option D** (The dew point is the temperature to which air must be cooled to become saturated with water vapor, assuming constant air pressure and water content).

CHAPTER EIGHTEEN

Structure of Matter and Kinetic Theory

Molecular nature of matter

98. The differences observed in solids, liquids and gases may be accounted for by

A. their relative masses
B. their melting points
C. the spacing and forces acting between the molecules
D. the different molecules in each of them

UTME, 2018

99. Which of the following is not correct about the molecules of a substance in a gaseous state. They?

A. are in a constant state of motion
B. have different speeds
C. have a temperature which is measured by the average kinetic energy
D. The collision between the gases is perfectly inelastic

UTME, 2021

molecular theory: explanation of Brownian motion, diffusion, surface tension, capillarity, adhesion, cohesion and angles of contact

100. Which of the following statements is NOT correct?

A. Brownian motion is evidence of the particle nature of matter
B. Atoms combine to form molecules
C. The molecules of matter are in constant motion
D. matter is made up of molecules

UTME, 2016

101. When the temperature of a liquid is increased, its surface tension

A. increases
B. decreases
C. remains constant
D. increases then decreases

UTME, 2021

Examples and applications.

102. The action of blotting paper on ink is due to

A. diffusion
B. osmosis
C. capillarity
D. surface tension

UTME, 2017

Kinetic Theory

using the theory to explain the pressure exerted by gas, Boyle's law, Charles' law, melting, boiling, vaporization, change in temperature evaporation, etc.

103. According to kinetic molecular model, in gases

A. The particles vibrate about fixed positions and are held together by the strong intermolecular bond between them
B. The particles occur in clusters with molecules slightly farther apart
C. The molecules are very fast apart & occupy all the space made available
D. The particles are closely packed together, they occupy minimum space & are usually arranged in a regular pattern

UTME, 2019

ANSWERS AND EXPLANATION

98. Answer: **Option C**
Explanation: A solid has a definite shape and volume the molecules are closely packed and the forces between the molecules are held strongly together. A liquid has a definite volume but no definite shape their molecules are held together but not closely packed like solids they are allowed to move and assume the shape of the container. A gas has no definite shape or volume the force between the molecules is low.

99. Answer: **Option D**
Explanation: The collision between the gases is perfectly elastic

100. Answer: **Option A**
Explanation: Surface tension is the ability of a liquid to act as a stretched elastic skin which is formed by the bonds between and among the molecules of the liquid. When the temp. of the liquid is increased, these bonds gradually break up and the stretched elastic skin becomes weaker, hence, the surface tension is reduced. That is why boiling or heating is one of the ways of reducing surface tension in liquids.

101. Answer: **Option C** (statement C contradict Brownian motion which states that the particle of matter is in constant random motion)

102. Answer: **Option C** (the absorption of ink by blotting paper involves a capillary action phenomenon because the blotting paper is a thin and smooth paper that allows a little thicker liquids like ink to absorb).

103. Answer: **Option C** (In kinetic molecular model, gases are energized and thus moves freely, fast as they occupy specific space)

CHAPTER NINETEEN

Heat Transfer

convection and radiation as modes of heat transfer

104. When an athlete perspires after running, he loses heat through

A. Evaporation

B. Conduction

C. Radiation

D. Convection

UTME, 2016

105. The time rate of loss of heat by a body is proportional to the

A. temperature of its surroundings

B. temperature of the body

C. difference in temperature between the body and its surroundings

D. ratio of the temperature of the body to that of its surroundings

UTME, 2018.

temperature gradient, thermal conductivity and heat flux

106. The temperature gradient across a copper rod of thickness 0.02m, maintained at two temperature junctions of 20° and 80°C respectively is?

A. $3.0 \times 10^{2}\ km^{-1}$

B. $3.0 \times 10^{3}\ km^{-1}$

C. $5.0 \times 10^{3}\ km^{-1}$

D. $3.0 \times 10^{4}\ km^{-1}$

UTME, 2021

effect of the nature of the surface on the energy radiated and absorbed by it.

107. Which of the following surfaces will absorbs radiant heat energy heat?

A. white

B. red

C. black

D. blue

UTME, 2017

the conductivities of common materials.

108. A silver spoon and a wooden spoon are both at room temperature. The silver spoon is cooler to touch because silver

A. has a greater density

B. can be polished

C. is a less absorbent material than wood

D. is a better conductor of heat

UTME, 2020

ANSWERS AND EXPLANATIONS

104. Answer: **Option A** (Perspiration cools the body as sweat evaporates from the skin surface. So, he cools by evaporation).

105. Answer: **Option C** (from newton's law of cooling)

106. Answer: **Option B**
Explanation:
$\Delta = \triangle\theta/\delta = \frac{80-20}{0.02}$
$= 3.0 \times 10^{3}\ km^{-1}$

107. Answer: **Option C** (black solution is a better radiator of heat and allow a better absorber of heat).

108. Answer: **Option D** (At room temperature a silver spoon will be cooler to the touch than the wooden spoon because silver is a better conductor of heat than wood).

CHAPTER TWENTY

Waves

Production and Propagation: wave motion

109. What is the velocity of sound at 100°C if the velocity of sound at 0°C is 340ms^{-1}?

A. 497ms^{-1}

B. 440ms^{-1}

C. 397ms^{-1}

D. 240ms^{-1}

UTME, 2013

vibrating systems as source of waves

110. The frequency of beats produced when two tunning forks of frequencies 258Hz and 270Hz are sounded close to each other

A. 6Hz

B. 264Hz

C. 528Hz

D. 12Hz

UTME, 2016

waves as mode of energy transfer

111. If the frequency of an emitted x-ray is 1.6 x 10^{16} Hz, the accelerating potential is? [e = 1.6 x 10^{-19} J, h = 6.63 x 10^{-34} Js]

A. 6630 .0V

B. 663.0V

C. 66.3V

D. 6.6V

UTME, 2021

Relationship between frequency, wavelength and wave velocity (V=f λ)

112. A source of sound produces waves in air of wavelength 1.65m. If the speed of sound in air is 330ms^{-1}, the period of vibration in air is?

A. 200
B. 0.005
C. 0.5
D. 0.02

UTME, 2021

progressive wave equation

113. The equation of a wave traveling along the positive x-direction is given by; y = 0.25 x 10^{-3} sin (500t - 0.025x). Determine the angular velocity of the wave motion.

A. 0.25 x 10^{-3} rads^{-1}
B. 0.25 x 10^{-1} rads^{-1}
C. 5.00 x 10^{2} rads^{-1}
D. 2.50 x 10^{3} rads^{-1}

UTME, 2021

Classification: types of waves; mechanical and electromagnetic waves

114. Which of the following is not a mechanical wave?

A. wave in closed pipe
B. radio waves
C. water waves
D. sound waves

UTME, 2017

115. The electromagnetic waves that are sensitive to temperature changes are

A. Ultra-violet rays
B. Gamma-rays
C. Infra-red rays
D. X-rays

UTME, 2020

longitudinal and transverse waves

116. A transverse wave and a longitudinal wave travelling in the same direction in a medium differ essentially in their

A. frequency
B. amplitude
C. direction of vibration of the particles of the medium
D. period of vibration of the particles of the medium

UTME, 2013

stationary and progressive waves

117. A stroboscope can be used to make the wave appear .....

A. Stationary
B. In motion
C. Dipper
D. Ripple

UTME, 2015

Characteristics / Properties:
reflection, refraction, diffraction and plane Polarization

118. I. Refraction II. Interference III. Diffraction Which of the above properties are common to all waves?

A. II and III only
B. I, II and III
C. I and II only
D. I and III only

UTME, 2020

ANSWERS AND EXPLANATIONS

109. Answer: **Option C**
Explanation:
$V \propto \sqrt{T}$
$\Rightarrow \frac{V1}{\sqrt{T1}} = \frac{V2}{\sqrt{T2}}$
$\frac{V2}{\sqrt{373}} = \frac{340}{\sqrt{273}}$
V2 = 397.42
$V2 \approx 397 ms^{-1}$

110. Answer: **Option D**
Explanation: Beat = f2 - f1 = 270 - 258 = 12Hz
111. Answer: **Option C**
Explanation:
Given f = 1.6×10^{16}HZ, h = 6.63×10^{-34}Js
e = 1.6×10^{-19}C, V =?
$V = \frac{w}{e} = \frac{hf}{e} = \frac{1.6\times10^{16}\times6.63\times10^{-34}}{1.6\times10^{-19}}$
= 66.3V

112. Answer: **Option B**
Explanation:
$V = \lambda/T$
: $v = 330 ms^{-1}$
$\lambda = 1.65m$
T =?
$330 = \frac{1.65}{T}$
$T = \frac{1.65}{330} = 0.005s$

113. Answer: **Option C**
Explanation:
Using y = A sin (wt + 0)

Given y = 0.25 x 10^{-3}sin (500t - 0.025x)
By comparing, w = 5.00 x 10^{2}rads^{-1}

114. Answer: **Option B** (Mechanical waves require material medium for their propagation only radio waves among the options docs require a material medium)

115. Answer: **Option C** (infra-red rays are as a result of the heat content of a system. so, they are sensitive to temperature change)

116. Answer: **Option C**
Explanation: Transverse waves are always characterized by particle motion being perpendicular to wave motion. A longitudinal wave is a wave in which particles of the medium move in a direction parallel to the direction that the wave moves.

117. Answer: **Option A** (Stroboscope is a scientific instrument used to make a wave appears stationary when used)

118. Answer: **Option B** (Refraction, Interference and diffraction are all properties of waves)

CHAPTER TWENTY-ONE

Propagation of Sound Waves

The necessity for a material medium

119. Which of the following media allow the transmission of sound waves through them?

I. air
II. liquid
III. solids
A. I & II only
B. I & III only
C. II & III only
D. I, II & III
UTME, 2019

speed of sound in solids, liquids and air

120. If a sound wave goes from a cold air region to a hot air region, its wavelength will?

A. increase
B. decrease
C. decrease then increase
D. remains constant
UTME, 2020

Reflection of sound; echoes, reverberation and their applications

121. A boy standing some distance from the foot of a tall cliff claps his hands and hears an echo 0.5s later. If the speed of sound is 340ms^{-1}, how far is he from the cliff?

A. 680m
B. 170m
C. 34m
D. 85m
UTME, 2021

ANSWERS AND EXPLANATIONS

119. Answer: **Option D**
Explanation:
- sound travels through solids, liquids and gases
- sound travels faster in solid than in liquid and faster in liquid than in gases.

120. Answer: **Option B**
Explanation:
If a sound wave goes from a cold air region to a hot air region (which will be less dense), the velocity decreases, and since the frequency is always constant, the wave length decreases with the velocity

121. Answer: **Option D**
Explanation:
$V = \frac{2d}{t}$
$v = 340ms^{-1}$
$t = 0.5s$
$d=?$
$V = \frac{2d}{2}$
$d= \frac{340\times0.5}{2} = 85m$

CHAPTER TWENTY-TWO

Characteristics of Sound Waves

quality, pitch, intensity and loudness and their application to musical instruments;

122. Musical instruments playing the same note can be distinguished from one another owing to the difference in their

A. quality
B. pitch
C. intensity
D. loudness

UTME, 2018

simple treatment of overtones produced by vibrating strings and their columns

$F_0 = \frac{1}{2L}\sqrt{T/M}$

123. The fundamental frequency of vibration of a sonometer wire may be halved by

A. doubling the length of the wire
B. doubling the mass of the wire
C. reducing the tension by half
D. reducing the absolute temperature

UTME, 2020

124. The lowest note emitted by a stretched string has a frequency of 40Hz. How many overtones are there between 40Hz and 180Hz?

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

UTME, 2021

ANSWERS AND EXPLANATIONS

122. Answer: **Option A** (The quality of a note is a characteristic that distinguishes it from note of the same frequency played by another musical instrument).
Fo= 1/2L Square root T/M

123. Answer: **Option A** ($F \alpha \frac{1}{L}$)

124. Answer: **Option B**
Explanation:
f_0 = 40Hz
1st overtone = $2f_0$ = 80Hz
2nd overtone = $3f_0$ = 120Hz
3rd overtone = $4f_0$ = 160Hz
4th overtone = $5f_0$ = 200Hz
∴ Number of overtones between 40Hz and 180Hz = 3

CHAPTER TWENTY-THREE

Light Energy

Source of Light: Luminous and non-luminous objects

125. Which of the following is not a luminous object?

A. The sun
B. The moon
C. light candle
D. Star

UTME, 2015

Propagation of light: formation of shadows and eclipse

126. Shadows and eclipse result from the

A. Reflection of light
B. Rectilinear propagation of light
C. Diffraction of light
D. Refraction of light

UTME, 2018

the pin-hole camera

127. Calculate the light of the image formed by a pinhole camera of length 12cm used to photograph an object 60cm away from the hole and 70cm high

A. 10 cm
B. 16 cm
C. 5 cm
D. 14 cm

UTME, 2017

ANSWERS AND EXPLANATIONS

125. Answer: **Option B** (Sun are self-luminous source while Moon is a non-luminous)

126. Answer: **Option B** (In a homogenous transparent medium light travel in a straight line and this is known as rectilinear propagation of light).

127. Answer: **Option D**

Explanation:

Magnification = $\frac{\text{Length of camera}}{\text{distance of object from pin hole}}$

m = $\frac{12}{60}$

= 0.2

Also, magnification m = $\frac{\text{Height of image}}{\text{Height of object}}$

∴ Height of image = m × height of object

= 0.2 × 70

= 14cm

CHAPTER TWENTY-FOUR

Reflection of Light at Plane and Curved Surfaces

application of reflection of light

128. Total internal reflection will not occur when light travels from

A. water to air

B. water into glass

C. glass to air

D. glass into water

UTME, 2013

formation of images by plane, concave and convex mirrors and ray diagrams

129. A boy in a barber's shop sits between two parallel mirrors. The number of images observed by him will be

A. Infinite

B. Ten

C. Eight

D. Forty

UTME, 2016

130. Convex mirrors are used as driving mirrors because images formed are

A. erect, Virtual and diminished

B. erect, real and diminished

C. erect, virtual and magnified

D. inverted, virtual and diminished

UTME, 2018

131. A ray of light passes through the centre of curvature of a concave mirror and strikes the mirror. At what angle is the ray reflected?

A. 180°

B. 90°

C. 0°

D. 60°

UTME, 2019

132. A man stands 4m in front of a plane mirror. If the mirror is moved 1m towards the man, the distance between him and his new image is?

A. 3m

B. 5m

C. 6m

D. 10m

UTME, 2021

Use of the mirror formula $\left[\frac{1}{F} = \frac{I}{U} + \frac{I}{V}\right]$

133. When two mirrors are placed at an angle of 90 degrees to each other, how many images will be formed when an object is placed in front of the mirrors

A. 5

B. 4

C. 3

D. 2

UTME, 2017

134. The distance between the image and the object in a plane mirror is 40cm if the distance of the object is reduced by 9.2cm, what is the distance of the object from the mirror?

A. 17.50m

B.15.50m

C.10.80m

D.16.50m

UTME, 2020

135. The inside portion of part of a hollow metal sphere of diameter 20cm is polished. The portion will therefore form a?

A. concave mirror of focal length 5cm

B. concave mirror of focal length 10cm

C. convex mirror of focal length 5cm

D. convex mirror of focal length 10cm

UTME,2021

linear magnification

136. An object is placed 20cm from a concave mirror of focal length 10cm. The linear magnification of the image produced is?

A. 0

B. 1/2

C. 1

D. 2

UTME, 2018

ANSWERS AND EXPLANATIONS

128. Answer: **Option B** (total reflection occur when light travels from a less dense medium to a dense medium and glass is denser than water which is from water to glass)

129. Answer: **Option A**
Explanation: They all lie in a straight line. Therefore, the images are perpendicular to the mirrors and would be infinite.

130. Answer: **Option A**
Explanation: Image formed by convex mirror is always erect, virtual and diminished

131. Answer: **Option C**
Explanation:
- a ray of light passing through the center of a curvature is returned along the same path
- angle difference along the same path is zero

132. Answer: **Option C**
Explanation:
Objects distance (u) = image distance (v)
object distance = 3m
|uv| = 3 + 3 = 6m

133. Answer: **Option C**
Explanation: When two mirror are inclined at an angle θ, the number of images formed, n = 360θ - 1
$\therefore$ since $\theta = 90^{\circ}$
$\therefore \frac{360}{\theta} - 1$
$= \frac{360}{90} - 1$

= 4 - 1
= 3

134. Answer: **Option C**
Explanation:
For a plane mirror, the distance between the object and the plane mirror
$= \frac{40}{2}$ =20cm
So, we have
20 - 9.2 = 10.8cm

135. Answer: **Option A**
Explanation:
$f = \frac{m}{4} = f = \frac{d}{4}$
$f = \frac{20}{4}$ = 5cm

136. Answer: **Option C**
Explanation:
$\frac{1}{V} = \frac{1}{f} - \frac{1}{u}$
$\frac{1}{V} = \frac{1}{10} - \frac{1}{20}$
$= \frac{1}{20} V$
V = 20cm.
$M = \frac{V}{U}$
$= \frac{20}{20}$
= 1

CHAPTER TWENTY-FIVE

Refraction of Light Through Plane and Curved Surface:

explanation of refraction in terms of velocity of light in the media.

137. Which of the following may be used to explain a mirage?
I. Layers of air near the road surface have varying refractive indices in hot weather
II. Road surfaces sometimes become good reflectors in hot weather
III. Light from the sky can be reflected upwards after coming close to the road surface.
A. I and III only
B. II and III only
C. II only
D. I, II and III
UTME, 2018

determination of refractive index of glass and liquid using Snell's law

138. The velocities of light in air and glass are 3.0 x $10^8 ms^{-1}$ and 2.0 x $10^8 ms^{-1}$ respectively. If the angle of refraction is 30^0, the sine of the angle of incidence is?
A. 0.33
B. 0.50
C. 0.67
D. 0.75
UTME, 2021

Real and apparent depth and lateral displacement

139. A pool of water appears to be 1.00m deep when viewed vertically from above. What is the actual depth of the pool?
[Refractive index of water = 1.33]

A. 13.300m
B. 0.750m
C. 1.013m
D. 1.330m

UTME, 2016

Glass Prism:

use of the minimum deviation formula $\left(u = \frac{\sin (1/2)\ (A+D)}{\sin (1/2)\ A}\right)$

140. Calculate the angle of minimum deviation of a 60° prism of a refractive index 1.5 [$\sin^{-1} 0.75 = 49°$]

A. 38.00°
B. 19.47°
C. 16.25°
D. 49°

UTME, 2017

use of lens formula $\left(\frac{1}{f} = \frac{1}{u} + \frac{1}{v}\right)$

141. The distance between an object and its real image in a convex lens is 40cm. If the magnification of the image is 3, calculate the focal length of the lens

A. 6.5 cm
B. 7.5 cm
C. 8.5 cm
D. 4.5 cm

UTME, 2019

ANSWERS AND EXPLANATIONS

137. Answer: **Option D**
Explanation: The appearance of pool of water on road surfaces is called mirage. His observation show that light from the sun ray refracted through a layer of hot air(layer) which is closed to the ground, passes from a hot air layer to the cold layer

138. Answer: **Option D**
Explanation
$\frac{\sin i}{\sin r} = \frac{\text{velocity in air}}{\text{velocity in glass}}$
$\frac{\sin i}{\sin 30} = \frac{3\times10^8}{2\times10^8}$
Sin i = $\frac{3}{4}$ = 0.75

139. Answer: **Option D**
Explanation
n = $\frac{\text{Real depth}}{\text{Apparent depth}}$ = 1.33 = $\frac{Rd}{1}$
Rd = 1.33 x 1 = 1.330m

140. Answer: **Option A**
Explanation:
For a refractive index () = $\frac{\sin (1/2)\ (A+D)}{\sin (1/2)\ A}$
D = angle of minimum deviation
A = refractive angle of the prism
1.5 = $\frac{\sin (1/2)\ (60+D)}{\sin (1/2)\ 60}$
1.5 = $\frac{\sin (1/2)\ (60+D)}{\sin 30}$
Sin (½) (60 + D) = 1.5 × Sin 30
Sin (½) (60 + D) = 0.75
(½) (60 + D) = Sin-1 (0.75)
but Sin-1 (0.75) = 49

(½) (60 + D) = 49
60 + D = 2 × 49 = 98
D = 98 - 60
D = 38°

141. Answer: **Option B**
Explanation:
u + v = 40
$\frac{v}{u} = 3$
v = 3u
u + 3u = 40
4u = 40
u = 10cm
v = 3u = 30cm
$f = \frac{uv}{(u+v)} = \frac{10\times30}{10+30} = \frac{300}{40}$
= 7.5 cm

CHAPTER TWENTY-SIX

Optical Instruments

the principles of microscopes, telescopes, projectors, cameras and the human eye (physiological details of the eye are not required)

142. The following are parts of the eye

I. Retina

II. Pupil

III. Iris

The correct equivalent in the camera in the same order are

A. Diaphragm, Aperture, film

B. Aperture, Diaphragm, Film

C. Film, Diaphragm, Aperture

D. Film, Aperture, Diaphragm

UTME, 2019

143. An astronomical telescope is said to be in normal adjustment when the?

A. eye is accommodated

B. focal length of an object lens is longer than that of eye piece

C. final image is at the near point of eye

D. final image is at infinity

UTME, 2021

Power of a lens

144. Determine the focal length of a thin converging lens if the power is 5.0 diopters

A. 0.1 m

B. 0.2 m

C. 2.0 m

D. 2.5 m

UTME, 2017

Angular magnification

145. What is the angular magnification of a telescope having objective and eyepiece lenses of a focal lengths 30cm and 3cm respectively?

A. 60

B. 10

C. 30

D. 90

UTME, 2016

sight defects and their corrections

146. Myopic defects in the human eye can be corrected through the use of a

A. Concave Mirror

B. Concave lens

C. Prism

D. Convex lens

UTME, 2016

ANSWERS AND EXPLANATIONS

142. Answer: **Option D**
Explanation:
- retina is similar to film
- pupil is similar to aperture
- iris is similar to diaphragm

143. Answer: **Option D**
Explanation
A normal arrangement is an arrangement where the principal focus of objective coincides with the eyepiece so that the final image is at infinity

144. Answer: **Option B**
Explanation:
Power of a lens = $\frac{1}{f}$
f = focal length
f = $\frac{1}{p}$
= $\frac{1}{5}$
= 0.2m

145. Answer: **Option B**
Explanation
M = $\frac{y}{x} = \frac{30}{3}$
= 10

146. Answer: **Option B** (Myopia of the eye can be corrected by using Concave Lens.)

CHAPTER TWENTY-SEVEN

dispersion of light and colours

dispersion of white light by a triangular prism

147. The angle of deviation of light of various colours passing through a triangular prism increases in the order

A. red >green> blue
B. green > violet > blue
C. blue > red> green
D. blue > green > red

UTME, 2013

148. A narrow beam of white light can be split up into different Colours by a glass prism. The correct explanation is that

A. white light Is an electromagnetic wave
B. the prism has all the colours of the white light
C. different colours of white light travel with different speeds in glass
D. white light has undergone total Internal reflection in the prism

UTME, 2018

colour mixing by addition and subtraction

149. A mixture of blue and red pigment when illuminated by white light will appear

A. green
B. orange
C. purple
D. magenta

UTME, 2019

ANSWERS AND EXPLANATIONS

147. Answer: **Option A** (the colour red starts first because they follow the order of roygbiv)

148. Answer: **Option C** (the shorter the wavelength of any of these colours the more the dispersion of the colours for example red is least dispersed because they have large wavelength and violet is more dispersed because they have the least wavelength).

149. Answer: **Option D**
Explanation: from the diagram a mixture of red and blue will result to magenta

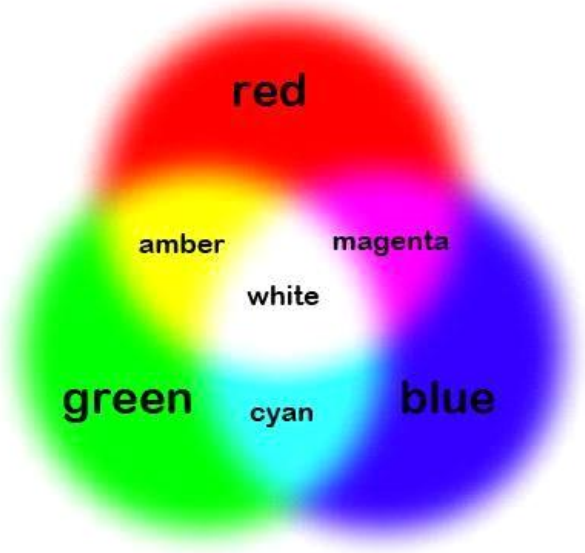


Diagram of a colour triangle

CHAPTER TWENTY-EIGHT

Electrostatics

existence of positive and negative charges in matter

150. Which of the following is true of an electrical charge?

A. Positive charge means deficit electrons

B. Negative charge means excess of electrons

C. electric current means movement of electrons

D. All of the above

UTME, 2018

charging a body by friction, contact and induction

151. A positively charged rod X is brought near an uncharged metal sphere Y and is then touched by a finger with X still in place. When the finger is removed, the result is that Y has

A. no charge and a zero potential

B. a positive charge and a zero potential

C. a negative charge and a positive potential

D. a negative charge and a negative potential

UTME, 2018

electroscope

152. Aluminum is sometimes used as the leaf of an electroscope because it

A. is a light material

B. is a good conductor

C. is a good insulator

D. can be converted into thin sheets

UTME, 2019

coulomb's inverse square law electric field and potential

153. Calculate the electric field intensity between two plates of potential difference 6.5V when separated by a distance of 35cm.

A. $18.57NC^{-1}$

B. $53.06NC^{-1}$

C. $2.28NC^{-1}$

D. $0.80NC^{-1}$

UTME, 2020

electric discharge and lightning

154. Which gas produces a red colored light in a discharge tube?

A. Mercury

B. Argon

C. Air

D. Neon

UTME, 2014

ANSWERS AND EXPLANATIONS

150. Answer: **Option D**
Explanation: gaining electron will result in negative charge which means more of electron (excess) while losing of electron will result in positive charge which means less of electron (deficit or lacking) and the last option (c) is also true because electric currents are explained in terms of movement of free electrons.

151. Answer: **Option D**
Explanation: when the positively charged rod is brought near the sphere, the sphere becomes negatively charged by induction, now when the sphere is touched by a finger the positive electron is conducted to the earth (earthed), when the finger is removed it leaves behind d negative electron in the sphere making the spere negatively charged, it is in negative potential because electron is conducted from the body to the earth. positive potential is when electron is conducted from the earth to a body.

152. Answer: **Option D**
Explanation:
- Aluminum can be made in thin sheet like Gold.
- the leaf is a thin material that can be diverged easily.

153. Answer: **Option A**
Explanation:
Electric Field Intensity (E) = $\frac{v}{d}$
= potential difference/distance
= $\frac{6.5V}{35cm}$
= $\frac{6.5}{35\times10^{-2}}$
= $18.57NC^{-1}$

154. Answer: **Option D** (Neon gives a red colored discharge)

CHAPTER TWENTY-NINE

Capacitors

Functions of capacitors

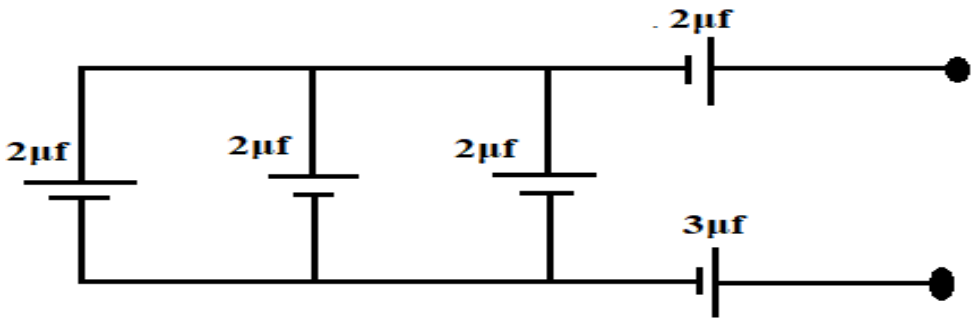
155. Capacitors are used in the induction coil to

A. control circuits
B. prevent distortion of electric fields
C. prevent electric sparks
D. dissipate energy

UTME, 2013

capacitors in series and parallel

156. Calculate the effective capacitance of the circuit in the diagram given



A. 4μf
B. 3μf
C. 2μf
D. 1μf

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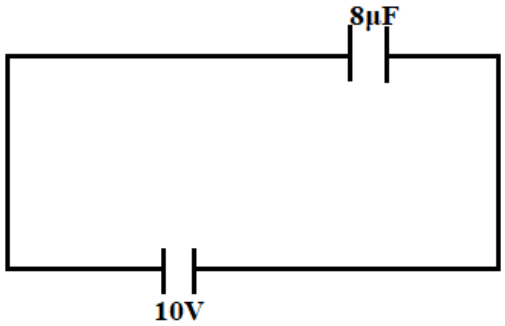
energy stored in a capacitor



157. From the diagram above, calculate the energy stored in the capacitor

A. 4.0×10^{-2}J

B. 4.0×10^{-4}J

C. 8.0×10^{-4}J

D. 8.0×10^{-2}J

UTME, 2017

ANSWERS AND EXPLANATIONS

155. Answer: **Option C**
Explanation: when an induction coil constructed and is set work, without a capacitor if it is switch on or off sparks will be noticed upon switching on or off. Hence to prevent sparks capacitor is used or included as part of the induction coil broken because a high induced voltage is used to charge a capacitor so as to prevent spark.

156. Answer: **Option D**
Explanation:
The three 2uf capacitors are in parallel to each other so u add them like this
2uf + 2uf + 2uf = 6uf
So, u have three capacitors in series
6uf 2uf and 3uf
They are in series so
$\frac{1}{C} = \frac{1}{6} + \frac{1}{3} = \frac{1}{2}$
C = 2uf
Then the same thing with the last two capacitor
$\frac{1}{2} + \frac{1}{2}$ = 1uf

157. Answer: **Option B**
Explanation:
c = 8μF, v = 10v
Energy stored = 12 cv^2
= 12 × $(8 \times 10^{-6}) \times 10^2$
= 4 × 10^{-4}

CHAPTER THIRTY

Electric Cells

simple voltaic cell and its defects;

158. Which of the following is correct about an electric cell

A. Primary cell produces a large current for a long time

B. Secondary cell has a very high internal resistance

C. Primary cell has a very low internal resistance

D. Secondary cell has a very low internal resistance

UTME, 2017

maintenance of cells and batteries (detail treatment of the chemistry of a cell is not required

159. Which of the following has the lowest internal resistance when new?

A. Leclanche cell

B. Daniell cell

C. Torch battery

D. Accumulator

UTME, 2018

Efficiency of a cell

160. A cell of internal resistance 2 π supplies current to a 6 π resistor. The efficiency of the cell is

A. 12.0%

B. 25.0%

C. 33.3%

D. 75.0%

UTME, 2017

ANSWERS AND EXPLANATIONS

158. Answer: **Option D**
Explanation: Primary cells are used up gradually often the cells are use and it can't be recharged while Secondary cells or accumulated can be recharged and used for a long period of time and their main advantage is that they have low internal resistance.

159. Answer: **Option D**
Explanation: Secondary cells offer the lowest internal resistance when new and are mostly rechargeable. Accumulator is a secondary cell because electrical energy is not generated within the cell itself but it is previously stored in it from the external source. The energy is stored in the form of chemical energy. So this cell is a storage cell or accumulator or storage battery.

160. Answer: **Option C**
Explanation:
Internal resistance determines the maximum current that can be supplied
Efficiency = $\frac{r}{R} \times 100$
= $\frac{2}{6} \times 100$
= 33.3%

CHAPTER THIRTY-ONE

Current Electricity

Electromagnetic force (emf), potential difference (p.d), current, internal resistance of a cell and lost Volt

161. The energy needed to move a unit positive charge around a complete electric circuit is called the

A. electromotive force

B. electric potential difference

C. electric energy

D. kinetic energy

UTME, 2018

Ohm's law

162. Which of the following obeys ohms laws?

A. electroytes

B. metals

C diode

D glass

UTME, 2018

measurement of resistance

163. If a metal wire 4m long and cross-sectional area 0.8 mm2 has a resistance of 60, find the resistivity of the wire

A. $5.3x10^{-7}$

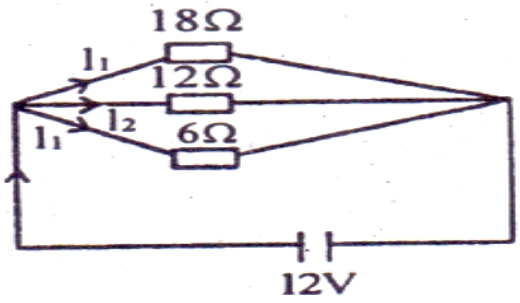
B. $3.0x10^{-5}$

C. $1.2x10^{-6}$

D. $3.2x10^{-6}$

UTME, 2014

Resistance in series and in parallel and their combination



164. From the diagram above, calculate the total current in the circuit

A. 5.0A

B. 3.7A

C. 4.5A

D. 4.0A

UTME, 2017

Electrical networks

165. Electrical appliances in homes are normally earthed so that

A. a person touching the appliances is safe from electric shock

B. both the a.c. and d.c. sources can be used

C. the appliances are maintained at a higher pd than the earth

D. the appliances are maintained at a lower pd than the earth

UTME, 2018

ANSWERS AND EXPLANATIONS

161. Answer: **Option B** (Potential difference is work done moving charge from a point to another point in the circuit)

162. Answer: **Option B**
Explanation: ohms law states that the flow of eletric current in a metalic conductor is directly proportional to the potential difference applied across the end, provide that the physical condition are kept constant and all other options are non-ohmic materials because they don't have a fixed resistance.
163. Answer: **Option C**
Explanation:
P= $\frac{Ra}{L}$ Ωm
P= $\frac{6\times0.8}{4}$ Ωm
P=1.2×10^{-6} Ωm

164. Answer: **Option B**
Explanation:
V = IR from ohms law
I = $\frac{V}{R}$
Since the resistance are in parallel
$\frac{1}{Reff} = \frac{1}{18} + \frac{1}{12} + \frac{1}{6}$
Finding the L.C.M.
$= \frac{2+3+6}{36} = \frac{11}{36}$
Reff = $\frac{36}{11}$ = 3.27
I = I1 + I2 + I3
$= \frac{V}{Reff} = \frac{12}{3.27}$
= 3.669A
I = 3.7A

165. Answer: **Option A**
Explanation: Electrical appliances are earthed to protect from an electric shock. On earthing, the appliance will not come in contact with wire, instead the current will pass through the earth and we remain protected from an electric shock.

CHAPTER THIRTY-TWO

Electrical Energy and Power

concepts of electrical energy and power

166. An a.c of 1A at a frequency of 800 cycles per second flows through a coil, the inductance of which is 2.5mH and the resistance of which is 5Ω. What is the power absorbed in the Coil?

A. 5W
B. 6W
C. 7W
D. 8W

UTME, 2019

commercial unit of electric energy and power

167. What is the cost of running seven 40 W lamps and five 80 W lamps for 12 hours of the electrical energy cost N7.00kWk?

A. N80.00
B. N45.36
C. N65.00
D. N57.12

UTME, 2020

electric power transmission

168. Ripple in a power supply unit is caused by

A. using an alternating current source
B. forward voltage drop
C. heavy load
D. using a Zener diode

UTME, 2019

ANSWERS AND EXPLANATIONS

166. Answer: **Option A**
Explanation:
I = 1A, F = 800 cycles/s = 800Hz
R = 5Ω, L = 2.5mH
P = I2R = 12 × 5 = 5W

167. Answer: **Option D**
Explanation:
Seven 40W lamps = 7 × 40 = 280W
Five 80W lamps = 5 × 80 = 400W
Total power = 280W + 400W
= 680W
$= \frac{680\text{KW}}{1000}$ = 0.68KW
The kilowatt hour = 0.68 KW × 12 hrs
= 8.16 KWh
Cost is N 7 per KWh
the cost of running them = 8.16KWh × N7/KWh
= N57.12

168. Answer: **Option A** (The fluctuation of d.c signal results from the rectification of A.C source to d.c)

CHAPTER THIRTY-THREE

Magnets and Magnetic Fields

methods of making magnets and demagnetization

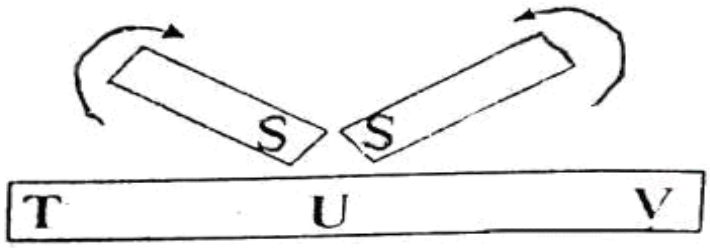
169. What is the best method of demagnetizing a steel bar magnet?

A Hammering
B Heating it
C Rough handling it
D Solenoid method

UTME, 2014

concept of magnetic field

170. In the diagram shown, If the south-poles of two magnets stroke a steel bar, the polarities at T and V will respectively be



A. north and south
B. south and south
C. north and north
D. south and north

UTME, 2018

magnetic field round a straight current carrying conductor, circular wire and solenoid

171. When the downward current flows in a straight vertical conductor, the direction of its magnetic field at a point due north of the wire is

A. Upward
B. North
C. South
D. West

UTME, 2019

properties of the earth's magnetic field; north and south poles, magnetic meridian and angle of dip and declination

172. The magnitude of the angle of dip at the equator is

A 360 degree
B 0 degree
C 90 degree
D 180 degree

UTME, 2014

ANSWERS AND EXPLANATIONS

169. Answers: **Option D** (electrical method is the best way to demagnetize a magnet

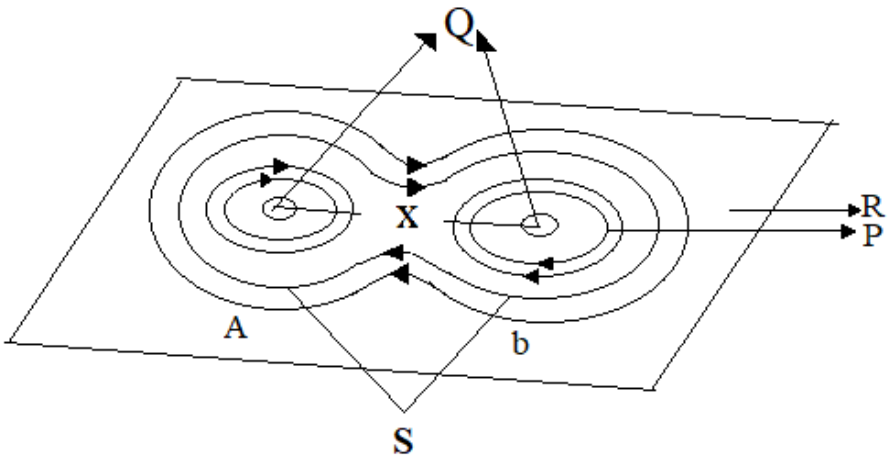
170. Answers: **Option C**
Explanation: In magnetization by stroking, the last touched has a pole opposite to that of the magnet used. Therefore, the poles T and V are N and N respectively.

171. Answers: **Option D**
Explanation:
At a point due N of the wire, the field is due west, at a point due S of the wire, the field is due east.

172. Answers: **Option B**
Explanation: The angle that the lines of force make with the Earth's surface at any given place is called the Angle of Dip and varies from 0 degrees at the magnetic equator, to virtually 90 degrees at the magnetic poles.
The lines of force around the magnetic equator of the Earth are perfectly horizontal. So, the magnetic needle will become horizontal there. Thus, the angle of dip at the magnetic equator of the Earth will be 0 degrees.

CHAPTER THIRTY-FOUR

Force on a Current-Carrying Conductor in a Magnetic Field: quantitative treatment of force between two parallel current-carrying conductors



173. In the diagram above, the neutral point is at

A. R

B. X

C. S

D. P

UTME, 2016

force on a charge moving in a magnetic field;

174. A straight wire 15cm long, carrying a current of 6.0A is in a uniform field of 0.40T. What is the force on the wire when it is at right angle to the field

A. 0.46N

B. 0.35N

C. 0.36N

D. 0,24N

UTME, 2019

Electromagnets

175. The strength of an electromagnet increase with

A Increase in the number of turn of the coil
B Decrease in current with the coil
C Increase in the distance between the pole
D Increase in current without the coil

UTME, 2015

176. Which of the following does Not use magnetic effect of current to function?

A. Lead acid accumulator
B. An electric bell
C. A moving coil galvanometer
D. A telephone receiver

UTME, 2016

moving coil and moving iron instruments

177. The device in which one circuit controls another, especially if the current in the second circuit is large or dangerous is known as

A. Electromagnetic devices
B. Magnetic relay device
C. None at all
D. Sextant

UTME, 2015

conversion of galvanometers to ammeters and voltmeter using shunts and multipliers

178. To convert a galvanometer to a voltmeter, a

A high resistance is connected to it in series
B high resistance is connected to it in parallel
C low resistance is connected to it in parallel
D low resistance is connected to it in series

UTME, 2013

ANSWERS AND EXPLANATIONS

173. Answer: **Option B** (They both lie in each of their magnetic field and the direction of force is attractive so the neutral point lies in point x)
174. Answer: **Option C**
Explanation:
F = BIL = 0.4 x 6 x $(\frac{15}{100})$
= 0.36N

175. Answer: **Option A** (The strength of an electromagnet can be increased by increasing the number of loops of wire around the iron core and by increasing the current or voltage).

176. Answer: **Option A** (An accumulator is the only device that is not an electromagnet in the options)

177. Answer: **Option B**
Explanation: Magnetic relay device is the device that controls a circuit (i.e., one circuit), if a current in the second circuit is large or dangerous.

178. Answer: **Option A** (To convert a moving coil galvanometer into a voltmeter a high resistance is connected in series with it).

CHAPTER THIRTY-FIVE

Electromagnetic Induction

Faraday's laws of electromagnetic induction

179. Induced emfs are best explained using

A. Ohm's law

B. Faraday's law

C. Coulomb's law

D. Lenz's law

UTME, 2013

a.c. and d.c generators

180. Which of the following operations can be used to convert an alternative current dynamo into a direct current dynamo

A. number of turns in the coil is increased

B. strength of the field magnet is increased

C. slip rings are replaced with split ring commutator

D. coil is wound on a soft iron armature

UTME, 2017

transformers

181. A transformer which can produce 10V from a 240V a.c supply has an efficiency of 60%. If the current in the secondary winding coil is 15A, the current in the primary coil is

A. 15.0 A

B. 1.04 A

C. 16.04 A

D. 13.96 A

UTME, 2020

Inductance: application/uses of inductors

182. Calculate the inductance of a coil of resistance 30Ω connected to a 100V a.c source if the coil draws an r.m.s current of 2A with a frequency of $100H_z$

A. 0.60H

B. 2.50H

C. 1.25H

D. 0.04H

UTME, 2016

Eddy Current: applications of eddy current

183. How can energy loss be minimized through Eddy-current?

A. By using high resistance wire

B. By using insulated soft iron wires

C. By using low resistance wires

D. Bu using turns of wires

UTME, 2020

ANSWERS AND EXPLANATIONS

179. Answer: **Option B** (Faraday law of electromagnetic induction state the induced emf is directly proportional to the rate of magnetic flux).

180. Answer: **Option C**
Explanation: A d.c generator is one in which its current is allowed to flow in one direction even though it may vary in value an a.c generator can only be made to produce a d.c by replacing the two slip rings with a single split ring or commutator.

181. Answer: **Option B**
Explanation:
Efficiency = $\frac{I_S V_S}{I_P V_P}$ x 100
60 = $\frac{15\times10}{I_P\times240}$ X100
$\frac{60}{100} = \frac{150}{240\times I_P}$
IP = $\frac{150}{240\times0.6}$
= 1.04 A

182. Answer: **Option D**
Explanation: let inductive inductance (resistance in d inductor), be, R
frequency be, F
inductance be, P
pi= 3.142 or 22/7
according to the question,
R= 30ohms
F=100Hz
pi= 3.142
using formulae,
R= 2 × 3.142 × F × P
30=2 × 3.142 × 100 × P

P= $\frac{30}{2\times3.142\times100}$
P= 0.04H

183. Answer: **Option A**
Explanation:
Eddy currents are produced by the varying flux cathode, the iron core of an equipment thus reducing efficiency due to power consumption. It can be reduced by laminating the core by breaking up the path of eddy current or by increasing the resistance of the core.
The usage of insulated soft iron wire helps to reduce hysteresis loss, using low resistance wire (thick wire) helps to reduce I^2R loss, also the usage of thick wire helps to reduce leakage heat loss due to leakage of magnetic flux. Thus, the correct answer is to use high resistance wire or thin wire

CHAPTER THIRTY-SIX

Simple A. C. Circuits
explanation of A.C. current and voltage

184. An alternating current can induce voltage because it has
A. ripple value
B. varying magnetic field
C. weaker magnetic field than direct current
D. high peak value
UTME, 2019

peak and r.m.s. values

185. When the r.m.s value of a source of electricity supply is given as 240v, it means that the peak value of the supply is
A. 240v
B. 340v
C. 480v
D. 57600v
UTME, 2017

a.c source connected to an inductor inductive reactance

186. A 2H inductor has negligible resistance and is connected to a 50/π Hz A.C supply. The reactance of the inductor is?
A. 200Ω
B. 50Ω
C. 100π
D. 25πΩ
UTME, 2021

Resonance and resonance frequency

187. In a series R-L-C circuit at resonance, the voltages across the resistor and the inductor are 30V and 40V respectively. What is the voltage across the capacitor?

A. 30V

B. 70V

C. 50V

D. 40V

UTME, 2021

ANSWERS AND EXPLANATIONS

184. Answer: **Option B**
Explanation: Due to the change in the voltage in an AC, which either increases or decreases, the magnetic field around it is always either collapsing or expanding (varying magnetic field).

185. Answer: **Option B**
Explanation: The relationship between the peak value and r.m.s value of electricity supply is given as
$V_{r.m.s.} = \frac{V_0}{\sqrt{2}}$
where V_o = peak voltage
$\therefore V_o = V_{r.m.s.} \times \sqrt{2}$
$= 240 \times \sqrt{2}$
$= 339.5v$
$= 340v$

186. Answer: **Option A**
Explanation:
Given;
L = 2H
F = 50π H2
XL =?
$XL = 2\pi fL = 2\pi \times \frac{50}{\pi} \times 2$
$= 200\Omega$

187. Answer: **Option D**
Explanation:
At resonance, inductive reactant X_L is equal to the capacitive reactance X_C
i.e., $X_L = X_C$
and $X_L = \frac{V_L}{I_L}$

and $X_C = \frac{V_c}{I_c}$

Again, since the components are in series, the same current flows in the series arrangement

i.e., $I_L = I_C$

at resonance, $\frac{V_L}{I_L} = \frac{V_c}{I_c}$

$\therefore V_L = V_C$

$= 40V$

CHAPTER THIRTY-SEVEN

Conduction of Electricity Through liquids:

electrolytes and non-electrolyte

188. The lead-acid accumulator consists of

A. lead as the positive electrode

B. lead acid as the negative electrode

C. hydrochloric acid as the electrolyte

D. tetraoxosulphate (vi) acid as the electrolyte

UTME, 2019

Faraday's law of electrolysis

189. The electrochemical equivalent of silver is 0.0012g/C. If 36.0g of silver is to be deposited by electrolysis on a surface by passing a steady current for 5mins, the current must be?

A. 6000A

B. 100A

C. 10A

D. 1A

UTME, 2018

Gases:

discharge through gases (quantitative treatment only)

190. Gases conduct electricity under

A. high pressure & high voltage

B. low pressure & low voltage

C. normal pressure & low voltage

D. low pressure & high voltage

UTME, 2019

ANSWERS AND EXPLANATIONS

188. Answer: **Option D**
Explanation:
- the positive pole is lead peroxide (PbO_2)
- the negative pole is head
- the electrolyte is H_2SO_4

189. Answer: **Option B**
Explanation:
Given Data: Mass of Ag = 36.0g,
Z which is electrochemical equivalent of Ag = 0.0012coulomb
t = 5mins → 5 X 60 = 300secs.
Using $M = Z \times I \times t$
make I the subject of the formula
$I = \frac{M}{Z \times t} \rightarrow \frac{36}{0.0012 \times 300}$
Current (I) = 100A

190. Answer: **Option D**
Explanation: Gasses are usually made to conduct electricity (and possibly glow) when they are subjected to low pressure and quite high potential difference (or voltage). So, the ultimate condition for electrical conduction of gasses is low pressure and high voltage or cold cathode emission.

CHAPTER THIRTY-EIGHT

Elementary Modern Physics
models of the atom and their limitations

191. Which of the following is/are the limitations to Rutherford's atomic models?
I. It is applicable when energy is radiated as electrons are revolving
II. It is applicable when energy is radiated in a continuous mode
III. It is applicable to an atom with only one electron in the other shell
A. I only
B. II only
C. I & II only
D. I, II & III only
UTME, 2019

elementary structure of the atom;

192. Which of the following statements are TRUE of isotopes?
I. Isotopes of an element have the same chemical properties because they have the same number of electrons
II. Isotopes of elements are normally separated using physical properties
III. Isotopes of an element have the same number of protons in their nuclei
A. I and II only
B. I and III only
C. II and III only
D. I, II and III
UTME, 2018

energy levels and spectra

193. An electron in a hydrogen atom makes a transition from the ground level to the third level. If the energy at the ground level, calculate the energy at the third level. [h = 6.6 x 10^{-34}Js; f = 10^{15}Hz]

A. 1.41eV

B. 1.71eV

C. 1.61Ev

D. 1.51eV

UTME, 2016

thermionic and photoelectric emissions;

194. Cathode rays are

A. High-energy electromagnetic waves

B. protons

C. neutrons

D. streams of electrons

UTME, 2018

applications of thermionic emissions and photoelectric effects

195. The particle nature of light is demonstrated by the

A. photoelectric effect

B. speed of light

C. colours of light

D. diffraction of light

UTME, 2013

simple method of production of x-rays

196. The equation $X_{62}^{150} => Y_{63}^{150} + -1 + Energy$, represents

A. Alpha decay

B. Beta-decay

C. Gamma decay

D. Photon emission

UTME, 2020

properties and applications of alpha, beta and gamma rays

197. A certain radioactive source emits radiation that was found to be deflected by both magnetic and electric fields. The radiation is?

A. beta rays
B. gamma rays
C. x-rays
D. ultra-violet rays

UTME, 2021

half-life and decay constant

198. If the fraction of the atoms of a radioactive material left after 120years is $\frac{1}{64}$, what is the half-life of the material?

A. 20 years
B. 10 years
C. 2 years
D. 24 years

UTME, 2021

simple ideas of production of energy by fusion and fission

199. What type of reaction is represented by the equation

$$^{2}_{1}\mathrm{X} + ^{2}_{1}\mathrm{X} = ^{3}_{2}\mathrm{Y} + ^{1}_{0}\mathrm{n} + \mathrm{Energy}$$

A. Ionization
B. Fusion
C. Fission
D. Chain

UTME, 2014

200. In a nuclear plant, the final mass of the products is 6.32×10^{-27}kg, while the initial mass of the reactant is 6.30×10^{-27} kg, the energy released in the process is (speed of light in vacuum 3.0×10^{8}m/s, 1eV = 1.6×10^{-19}J)

A. 11.25meV

B. 11.25 MJ

C. 12.25MJ

D. 12.25meV

UTME, 2020

ANSWERS AND EXPLANATIONS

191. Answer: **Option C**
Explanation: Rutherford assumed that (I) energy is radiated when electrons are revolving (II) energy is radiated in a continuous mode. These are limitations of Rutherford's model.

192. Answer: **Option D**
Explanation: Isotopy occurs when one element exists in different atomic masses, but same atomic number. That is, isotopes are atoms of same element existing in different number of neutrons, but same number of proton and electron. Therefore:
-Isotopes of an element truly have same chemical properties due to same number of valence electrons.
-In the industry, advantage is often taken of the differences in atomic mass of isotopes to separate them, so, they can be separated by physical means.
-Yes, isotopes of an element have the same number of protons.

193. Answer: **Option D**
Explanation:
$E = \frac{E_0}{n^2} = \frac{13.6}{3^2} = \frac{13.6}{9}$
= 1.51eV

194. Answer: **Option D**
Explanation: Cathode rays (electron beam or e-beam) are streams of electrons observed in vacuum tubes. Thomson showed that cathode rays were composed of a previously unknown negatively charged particle, which was later named the electron.

195. Answer: **Option A**
Explanation: The photoelectric effect supports a particle theory of light in that it behaves like an elastic collision (one that conserves mechanical energy) between two particles, the photon of light and the electron of the metal.

196. Answer: **Option B**
Explanation: β-decay is a type of radioactive decay in which a beta particle (fast energetic electron or positron) is emitted from an atomic nucleus, transforming the original nuclide to an isobar of that nuclide.

197. Answer: **Option A**
Explanation:
Both the electric field and magnetic field affect the β-particles

198. Answer: **Option A**
Explanation:
1/64 is the usual fraction left of any radioactive material after 4 half-lives, since 1/64 = (1/2)6
This implies that 6 half-lives have elapsed.
Thus 6 half-lives = 120 years
∴ 1 half-life = $\frac{120}{6}$ = 20 years

199. Answer: **Option B** (Nuclear fusion is a reaction in which two or more atomic nuclei are combined to form one or more different atomic nuclei and subatomic particles).

200. Answer: **Option B**
Explanation: Energy released = Δmc^2
Change in mass = $6.32 \times 10^{-27} - 6.30 \times 10^{-27}$
$= 2 \times 10^{-29}$
$E = 2 \times 10^{-29} \times (3 \times 10^{8})^2$
$= 1.8 \times 10^{-13}$ J

Converting to eV

E= $\frac{1.8\times10^{-13}}{1.6\times10^{-19}}$

=11250000

=11.25 MJ

CHAPTER THIRTY-NINE

Introductory Electronics
distinction between metals, semiconductors and insulators (elementary knowledge of band gap is required)

201. Semiconductor is a class of solid whose conductivity increases with an increase in
A. Pressure
B. Temperature
C. Current
D. Voltage
UTME, 2016

n-type and p-type semi-conductors

202. If silicon is doped with phosphorus, what type of semiconductor material will be formed?
A. Zener material
B. P-n junction
C. n-type
D. p-type
UTME, 2017

use of semiconductors and diodes in rectification and transistors in amplification.

203. In a common emitter configuration, the output voltage is through the
A. Resistor
B. Base
C. Collector
D. Emitter
UTME, 2014

ANSWERS AND EXPLANATIONS

201. Answer: **Option B** (As the temperature increases, more electrons get the energy to jump from Conduction band to valence band, and thereby increases the conductivity of the semiconductor).

202. Answer: **Option C**
Explanation: When silicon is doped with a trivalent atom. A p-type semi-conductor will be formed when silicon is doped with a pentavalent atom such as arsenic, a n-type semi-conductor will be formed. Phosphorous is a pentavalent element, so it will produce a N -type semi-conductor.

203. Answer: **Option D** (in a common emitter configuration, the output is through the emitter)