It is the phenomenon whereby light rays traveling [illegible] medium are completely reflected inside the denser medium.

Conditions for Total Internal Reflection to Occur

- Two different media of different optical density must be in contact.
- Light ray must be passing from denser into a less dense medium
- The angle of incidence in the denser medium must be greater than the critical angle.

Application of Total internal Reflection

1. Prism periscope
2. Fish eye-view
3. Mirage
4. Multiple images in thick mirror e. Prism Binoculars
5. Inversion correction
6. Optical fiber (light tube)

SAMPLE QUESTIONS

QUIZ QUESTIONS

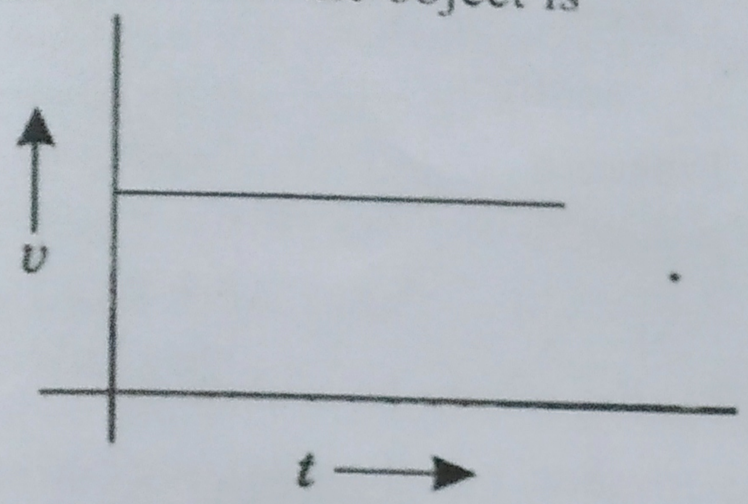
1. In physics we study
A. matter and energy only
B. interaction between matter and energy only
C. composition of matter
D. matter & energy and interaction between matter and energy

2. A way to express a number as a number between 1 and 10 having an appropriate power is called
A. scientific notation
B. prefix
C. base units
D. derived units

3. Kilo, mega, giga, milli are the example of
A. base units
B. derived units
C. prefixes
D. square units

4. Volume, area, speed, electric charge, force and work are the examples of
A. quartile quantities
B. base quantities
C. derived quantities
D. prefixes

5. From the given v– t graph, it can be inferred that the object is



A. in uniform motion
B. at rest
C. in non-uniform motion
D. moving with uniform acceleration

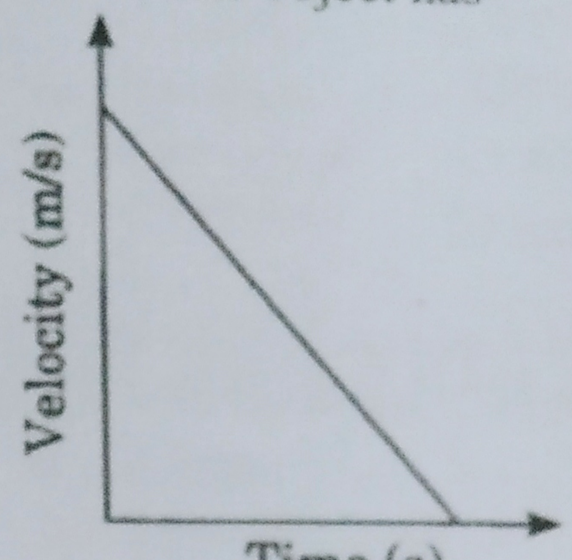
6. The prefix for 10^9 is
A. giga
B. Milli
C. nano
D. pico

7. The greatest height h to which a body thrown vertically upward with velocity u will rise is,
A. u/g
B. $\mathbf{u^2/2g}$
C. u^2/g
D. u/2g

8. What is the dimension of pressure is
A. ML^2T^{-2}
B. $ML^{-1}T^{-2}$
C. MLT^{-2}
D. M^2LT^{-2}

9. A boy goes from A to B with a velocity of 20 m/min and comes back from B to A with a velocity of 30 m/min. The average velocity of the boy during the whole journey is
A. 24 m/min
B.25 m/s
C. Zero
D. 20 m/min

10. Velocity-time graph of an object is given below. The object has



A. Uniform velocity
B. Uniform speed
C. Unifofm retardation
D. Variable acceleration

11. A stone is throne outward from the top of a 59.4 m cliff with an upward velocity component of 19.5 m/s. How many seconds will the stone be in the air?
A. 4s
B. 5s
C. 6s
D. 7s

12. What must be the component of a vector which when added to the following two vectors 10i -7j and 4i+2j gives rise to vector 6j?
A. 6i+7j
B. -14i +5j
C. -14i + 11j
D. 11i - 5j

13. What are the values of **x,y and z** such that $(x+4)I + (y-5)j + (z-1)k = 0$
A. -4, 5,1
B. 2, 5,3
C. 5,4,-1
D. 2,4,-1

14. The dot product of vectors A and B is defined as

A. AB sin⊙

B. AB cos⊙

C. A-B sin ⊙

D. A-B cos ⊙

15. If A =3i+4j-k, and B =-2i+3j+k, find A.B

A. 5

B. -6

C. 12

D. -1

16. Using the definition of scalar product, determine the value of a such that the vectors

-2i-2j+4k and 3i+aj+3k are perpendicular.

A. 2

B. 3

C. 5

D. 9

17. If A = 12i -2j +4k and B =24i +10j. What is the magnitude of vector C =2A -B

A. 90

B. 64

C. 42

D. 22

18. A velocity of a particle moving at an angle of 120° to the horizontal is 20 m/s. What is the vertical component of the velocity.

A. -10.0N

B. 17.32 N

C. 10.0 N

D. -17.32 N

19. Determine the SI unit of the quantity whose dimension is ML^2T^{-3}

A. Power

B. Momentum

C. Pressure

D. Force

20. If $F= GMm/r^2$ where M and m are separate masses, r is the distance between the masses, G is the universal gravitational constant and F is the force of attraction between M and m. What is the dimension of G?

A. $M^{-1}L^{-1}T^{-3}$

B. $M^{-1}L^{-5}T^{-2}$

C. $M^{-1}L^{3}T^{-2}$

D. $M^{-1}L^{-1}T^{-2}$

Answer all questions

1. Pressure has dimensions

a. $ML^{-1}T^{-1}$

b. MLT^{-1}

c. ML^2T^{-2}

d. $ML^{-1}T^{-2}$

2. A force of 1.0 N is equivalent to?

a. 1.0 $kgm\ s$

b. 1.0 $kgm^2\ s$

c.1.0 $kgm\ /s^2$

d. 1.0 $kgm^2\ s^2$

3. The construction and operation of the hydrometer is based on the

a. principle of moment

b. Hooke's law

c. Pascal's law

d. principle of flotation

4. A hot-air balloon floating at a certain altitude in air, has a total weight of 200N. Assuming the air density is $1.2kgm^{-3}$, the volume of the balloon in cm^3 is?
   a. $16.67cm^3$
   b. $166.7 \times 10^5 cm^3$
   c. $1.667 \times 10^{-5} cm^3$
   d. $1667cm^3$

5. Which of the following is the correct way of writing units?
   a. 25ms length
   b. 30Kg
   c. 5 Newton
   d. 10N

6. If 'x' is in meters and 'a' is in m/s^2. Find the SI unit of $\sqrt{\frac{x}{a}}$
   a. S
   b. S^2
   c. S^{-1}
   d. $S^{1/2}$

7. Which of the following pairs does not have the same dimensions?
   I. Energy and work II. Speed and velocity III. Moment and momentum
   a. I only
   b. II only
   c. III only
   d. I and II only

8. An insect inside a moving bus flies from back towards the front at a speed of $5ms^{-1}$. If the bus is moving in straight line with a speed of $50ms^{-1}$, determine the speed of the insect relative to a stationary observer on the ground.
   a. $5ms^{-1}$
   b. $10ms^{-1}$
   c. $45ms^{-1}$
   d. $55ms^{-1}$

9. What type of motion is generally performed by the molecules of a liquid in container?
   a. Circular
   b. Random
   c. Rectilinear
   d. Rotational

10. A force of 16N acts on a body of mass 4kg for 2s. Calculate the change in velocity.
    a. $0.5ms^{-1}$
    b. $2.0ms^{-1}$
    c. $8.0ms^{-1}$
    d. $32.0ms^{-1}$

11. A body moves such that its displacement from a fixed point is always constant. The motion is
    a. linear
    b. circular
    c. random
    d. rotational

12. Two forces 12N and 7N act in opposite direction on a body of mass 15kg. Calculate the acceleration produced on the body.
    a. $0.33ms^{-2}$
    b. $0.63ms^{-2}$
    c. $0.80ms^{-2}$
    d. $1.27ms^{-2}$

13. The force between the molecules of a liquid in contact with that of a solid is
    a) cohesive
    b) adhesive
    c) frictional
    d) viscous

14. A piece of stone of mass 50.0 g thrown vertically upwards returns to the point of projection after 4.20 s. Calculate the energy of projection. [g = 9.8 m/s^2]
    a) 10.59 J
    b) 21.18 J
    c) 41.16 J
    d) 42.35 J

15. Which of the following quantities is a vector?
    a) speed
    b) mass
    c) work
    d) displacement

16. A ball is thrown horizontally above the ground. Neglecting air resistance, the horizontal component of the velocity
    a) increases
    b) decreases
    c) is constant
    d) increases and later remains constant.

17. Passengers in a bus moving in a straight road jerk forward when the driver suddenly applies the brakes. This observation is explained by
    a) Newton's law of gravitation
    b) Newton's first law of motion
    c) Newton's second law of motion
    d) Newton's third law of motion

18. Which of the following quantities is a measure of the inertia of a body?
    a. Density
    b. Mass
    c. Pressure
    d. Weight

19. A centripetal force is one that
    a. Acts in the direction of motion
    b. Keeps an object moving in a circular track
    c. Acts tangentially to a circular track
    d. Accelerates an object in the direction of motion

20. A stone is projected up from the ground with a velocity of 90 m/s. Calculate the time it takes to travel up and back to the ground. ($g = 10\ ms^{-2}$)
    a. 6.0 s
    b. 9.0 s
    c. 18.0 s
    d. 36.0 s

21. The equation for the speed of sound in a gas state that $v = \frac{\sqrt{gB\,T}}{m}$ Speed v is measured in m/s, g is a dimensionless constant, T is temperature in kelvins (K), and m is mass in kg. What are the units for the Boltzmann constant, B?
    a. $kg \cdot m^2 \cdot s^2 \cdot K$
    b. $kg \cdot m^2 \cdot s^{-2} \cdot K^{-1}$
    c. $kg^{-1} \cdot m^{-2} \cdot s^2 \cdot K$
    d. kg·m/s

22. A 3.0-kg object is initially at rest. It then receives an impulse of magnitude 15 N·s. After the impulse, the object has
    a. a speed of 45 m/s.
    b. a momentum of magnitude 5.0 kg·m/s.
    c. a speed of 7.5 m/s.
    d. a momentum of magnitude 15 kg·m/s.

23. What is the fundamental difference between speed and velocity?
    a. Velocity depends on gravitation, but speed does not.
    b. Velocity depends on mass but speed does not.
    c. Velocity depends on force but speed does not.
    d. There is no difference; speed and velocity are exactly the same thing.

24. A velocity vector has components of
    a. magnitude and direction
    b. speed and mass
    c. time and mass
    d. speed and time

25. A leopard starts from rest at t = 0 and runs in a straight line with a constant acceleration until t = 3.0 s. The distance covered by the leopard between t = 1.0 s and t =2.0 s is

a. **the same as the distance covered during the first second.**

b. twice the distance covered during the first second.

c. three times the distance covered during the first second.

d. four times the distance covered during the first second

26. A car moving at 60 km/h comes to a stop in 10 s when the driver slams on the brakes. In this situation, what does 60 km/h represent?

a. average speed

b. final speed

c. initial speed

d. constant speed

27. A body moves with a constant speed but has acceleration. This is because the body;

a. Is moving in a straight line

b. **Is moving in a circular path**

c. Is doing oscillatory motion

d. Is in a state of equilibrium.

An effort of 50N is applied over a distance of 15m and a load of 120N moves through 4m. Use the information to answer Q 34 to Q38

28. What is the mechanical advantage?

a. 2.4

b. 0.4

c. 3.8

d. 0.3

29. What is the velocity ratio?

a. 2.4

b. 0.4

c. 3.8

d. 0.3

30. What is the efficiency of the machine?

a. 63.2

b. 36.2

c. 62.3

d. 32.5

31. What is the work output?

a. 750J

b. 480J

c. 200J

d. 1800J

32. What is the work input?

a. 750J

b. 480J

c. 200J

d. 1800J

33. . An object weighs 96.0 N in air and 32.0 N when completely immersed in water. Calculate the volume of the object. [Density of water = 1.0×10^{3} Kgm^{-3}]

a) 6.40×10^{-3} m^3

b) 6.30×10^{-3} m^3

c) 3.20×10^{-3} m^3

d) 3.00×10^{-3} m^3

34. The mass of a solid is 2000g. If its volume is $0.0015m^3$. Calculate its density

a. $133.0kgm^{-3}$

b. $1333.33kgm^{-3}$

c. $13.33kgm^{-3}$

d. $1.33kgm^{-3}$

41a. Dimension of a physical quantity in the power to which the fundamental quantity must be raised to in order to represent it. OR It is an algebraic symbol assigned to a physical quantity. **[2 Marks]**

b.

$$V = KT^X L^Y M^Z \quad k=1$$

$[V] = [T]^X [L]^Y [M]^Z$ [1mark]

$LT^{-1} = (MLT^{-2})^X L^Y . M^Z$ [2 marks]

$LT^{-1} = M^{X+Z} . L^{X+Y} . T^{-2X}$ [1 marks]

Comparing Powers **[½ mark]**

$M^0 = M^{X+Z}$

$0 = X+Z$ ..... (1) **[½ mark]**

$L^1 = L^{x+y}$

$1 = x + y$ ..... (2) **[½ mark]**

$T^{-1} = T^{-2X}$

$-1 = -2X$ **[½ mark]**

Therefore, $X = \frac{1}{2}$ **substituting X= ½ into (1) and (2** **[½ mark]**

$$0 = \frac{1}{2} + Z$$

$$\boldsymbol{Z = -\frac{1}{2}}$$

$$1 = \frac{1}{2} + y$$

$$Y = ½$$

Thus X= ½, y = ½ and Z = -½ **[3 marks]**

Therefore, $V = kT^{\frac{1}{2}} L^{\frac{1}{2}} M^{-\frac{1}{2}}$

$$V = \sqrt{\frac{TL}{M}}$$

c.

41d.

1. it help to identify the unit of physical quantities.
2. it helps to check the validity of an equation.
3. it helps to derive an equation between quantities. **[4 marks]**

42.

u =8 m/s

a =0.5 m/s^2 **[4 marks]**

t_1 = 45 s

t_2 = 5 s

t_3 = 1 ½ minutes = 90 s

ii. $v = u + at$

$v = 8 + 0.5(45) = 30.5m/s$

Maximum velocity = 30.5 m/s

[2 marks]

iii. final velocity

u = 30.5 m/s

t =5 secs

a =-2 m/s

$v = u - at$

$v = 30.5 - 10 = 20.5\ m/s$

[2 marks]

iv. total distance = total area under the graph

= 2838.75 m

[4 marks]

b.

1.A body at rest will continue to be at rest and a body in motion will continue to be in motion unless acted upon by an external unbalanced force.

2. The time rate of change of momentum is directly proportional to the force applied and the change takes place in the direction of the force.

3. To every action, there is an equal but opposite reaction. **[3marks]**

ii. In a system of colliding objects the momentum before collision is equal to the momentum after collision.

[2 marks]

Kinetic energy = ½ mv^2

Momentum,$\rho = mv$

Therefore, kinetic energy = $\frac{1}{2}(\rho)v$

Therefore, $K.E = \frac{1}{2}\rho v$

[3 marks]

b. m_1 =5 g = 0.05 kg

u_1 =120 m/s

m_2 =25.0 g = 0.25 kg

u_2 =0 m/s

[2 marks]

$\rho\ b4\ collision = \rho\ after\ collision$

[2marks]

$m_1u_1 + m_2u_2 = (m_1 + m_2)v$

$0.05x120 + 0.25 = (0.05 + 0.25)v$

[2 marks]

$v = 20\ m/s$

c.

Initial velocity = u

Time = t [1 mark]

Acceleration = a [1 mark]

Average velocity $= \frac{v+u}{2}$

$= \frac{s}{t}$ [1 mark]

$\frac{v+u}{2} = \frac{s}{t}$

$s = \frac{v+u}{2}\ t$

$a = \frac{v-u}{t}$

$v = u + at$

$s = (\frac{u+at+u}{2})t$

$s = \frac{2ut+at^2}{2}$

$\boxed{s = ut + \frac{at^2}{2}}$ [2 marks]

4. $\rho_{metal} = 6.0 \times 10^3\ kgm^{-3}$

$w_{in\ air} = 18N$

Mass of metal = w/g = 18/9.8 = 1. 84 kg

$Volume\ of\ metal = \frac{mass}{density} = \frac{1.84}{6.0 \times 10^3} = 3.06 \times 10^{-4} m^3$ [1 mark]

Volume of metal = volume of liquid displaced. [1 mark]

Upthrust = weight in air – apparent weight in liquid [1 mark]

Upthrust = $\rho_{liquid} \times vol \times g$

$\rho_{liquid} = 4.3 \times 10^3\ kgm^{-3}$

$upthrust = 4.3 \times 10^3 \times 3.06 \times 10^{-4} \times 9.8 = 12.89\ N$

Therefore, apparent weight = $18 - 12.89 = 5.11\ N$ [2 marks]

b.

i. Archimedes principle states that "when a body is wholly or partially immersed in a fluid, it experiences and upthrust which is equal to the weight of the fluid displaced".

ii. the principle of floatation states that "a floating body displaces its own weight on the fluid in which it floats"

c. **appropriate diagram with explanation for 6 marks.**

d. $\tan \emptyset = \frac{v^2}{rg}$ [1 mark]

v = velocity = 40 km/h = 11.11 m/s [1 mark]

r = radius = 55 m

g = acceleration due to gravity

$\tan \emptyset = \frac{11.11^2}{55\times10}$

$\emptyset = \tan^{-1} \frac{11.11^2}{55\times10} = 12.65$

$\emptyset = 13°$

[1 mark]

[2 mark]

Section B

Answer any two questions

1. a. State **three** differences between density and relative density. **(6marks)**

   b. A metal block weighs 1.8N in air and 1.5N in water. What will be its weight in a liquid of relative density 0.6? **(3marks)**

   c. A body travelling with a uniform acceleration covers a distance *s* metres after time *t* seconds as shown in the table below

s/m	0	2	4	6	8	10	12	14	16	18	20
t/s	0	5	10	15	20	25	30	35	40	45	50

   i. Draw a distance-time graph of the motion **(5marks)** ii. Find the slope of the graph. **(3marks)** iii. Determine from the graph the distance covered by the body after 22.5s. **(3marks)**

2. a. An object is thrown vertically upwards with an initial velocity of 15m/s. (Take g $=10m/s^2$)

   i. What is the maximum height it reaches? **(5marks)**

   ii. Calculate the time it takes to reach that height. **(4marks)** b. State the first law of motion. **(2marks)**

   c. State the law of magnetism and give two properties of magnetic field. **(6 marks)**

   d. List **three** sources of electricity. **(3marks)**

(4 marks)

3. a. State *Archimedes' principle*

b. A ship of mass 1200 tonnes floats in sea-water.

i. What volume of sea-water will it displace if the ship enters fresh water? **(5 marks)**

ii. What mass of cargo must be unloaded so that the same volume of water is displaced as before? **(5 marks)**

(Density of fresh water = 1000 kgm-^{3}, Relative density of sea-water = 1.03, 1 tonne = 1000 kg)

c. State any *three* differences between *forward* and *reverse biaing* **(6 marks)**

Section B Question 1

a. Differences between density and relative density.

Density	Relative density
It has unit.	It has no unit.
It is a measured quantity.	It is a comparison between measured quantities.
It is mass per unit volume of a substance.	It is the ratio of the mass of any volume of a substance to the mass of an equal volume of water.
There may be errors in volume measurement.	There is high degree of accuracy in all measurements.

(Any 3 corresponding points × 2marks = 6marks)

b. Weight in air (WA) = 1.8N

Weight in water = 1.5N

Relative density (RD) = 0.6

Weight in liquid (WL) =

$$RD = \frac{WA-WL}{WA-WW}$$

$$0.6 = \frac{1.8-WL}{1.8-1.5}$$

$$0.6 = \frac{1}{0.3} \quad \frac{8-WL}{}$$

$$WL = 1.8\ (0.6 \times 0.3) = 1.62N$$

(F1, S1, A1 = 3marks)

c. i. A distance-time graph of the motion

Title: Distance-time graph of the motion **(1mark)**

Scale: Any appropriate scale indicted **(1 mark)**

Axes labelling (with their units): **(1mark)**

Graph: **(2marks)**

ii. The slope of distance-time graph = speed of the motion speed = distance/time

Any distance with its corresponding distance

speed = 2/5 = 0.4m/s

(F1, S1, A1 = 3marks)

iii. On the graph, the distance is 9m. **(3marks)**

1c.

Properties of magnetic fields.

i. The field strength decreases further away from a source producing the field.
ii. It has direction and magnitude. Thus, a vector quantity.

(2 points × 2marks = 4marks)

- d. **Sources of electricity** are chemical cells or batteries, generators (electromagnetic induction), solar cells (solar panel), photo-electric emission, thermionic emission, thermoelectricity, hydrothermal source.

(Any 3 points × 1mark = 3marks)

Question 3

a. Archimedes principle states that when an object is totally or partially immersed in a fluid, it experiences an upthrust, which is equal to the weight of the fluid displaced.

(Correct statement = 4marks)

b. The ship displaces a weight of sea-water equal to its own weight and therefore mass of sea-water displaced is equal to mass of ship.

i. Volume of sea-water displaced

$$\text{Relative Density} = \frac{\textit{density of sea water}}{\textit{density of fresh water}}$$

$$1.03 = \frac{\textit{density of sea water}}{1000}$$

Density of sea-water = $1.03 \times 1000 = 1030 kg/m^3$

Mass of sea-water displaced = 1200 tonnes

$= 1200 \times 1000kg$

$= 1200000kg$

iii. Forward bias sets up the electric field across the potential which reduces the strength of the potential barrier whereas reverse bias increases the strength of the potential barrier.

iv. In forward biasing, the voltage of the anode is greater than the cathode whereas in reverse biasing, the voltage of the cathode is greater than the anode.

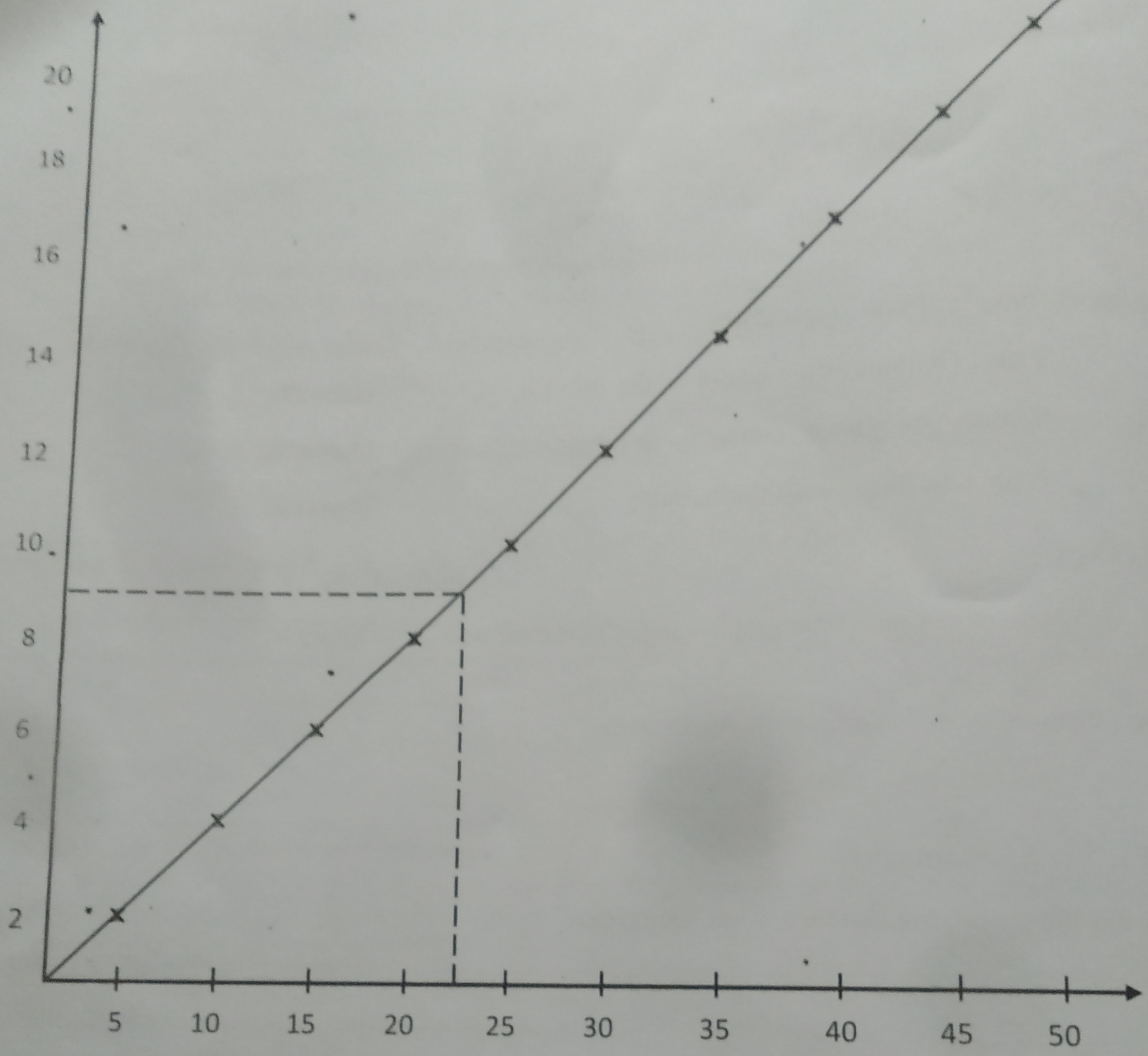
v. Forward bias has a large forward current while the reverse bias has a very small forward current. vi. The depletion layer of the diode is very narrow during forward bias and wide during reverse bias. vii. Forward bias decreases the resistance of the diode whereas reverse bias increases resistance of the diode.

viii. In forward biasing, the current easily flows through the circuit whereas reverse biasing does not allow the current to flow through it.

ix. In forward biasing, the magnitude of the current depends on the forward voltage whereas in reverse biasing, the magnitude of the current is very small or negligible.

x. In forward biasing, the device operates as a conductor whereas in reverse biasing, the device acts as an insulator.

(Any 3 points × 2marks = 6marks) **Page 99**



Question 2

a. u = 15m/s g
=10m/s^2

i. the maximum height it reaches? $h = u^2$

$2g$

$h = \frac{152}{2(10)} = \frac{225}{20}$

h = 11.25m

OR

At the maximum height $v = 0m/s^2$

$s = h\ a = -g\ v^2 = u^2$

$-2gh\ 0^2 = 15^2 - 2$

$(10)h$

$= 225 - 20h$

$225 = 20h\ h = \frac{225}{20} =$

$11.25m$

(F1, S3, A1 = 5marks)

ii. Calculate the time it takes to reach that height. $t = u = 15$

$g \quad 10$

$t = 1.5s$

OR

$t = v\_\_\_\_u = \frac{0-15}{-10}$

$-g$

$t = 1.5s$

(F1, S2, A1 = 4marks)

b. The first law of motion

The law states that an ôbject or a body will remain motionless unless it is acted on or upon by a resultant external force **OR** a body or any object continues in its state of rest or uniform motion in a straight line unless an external force acts on it.

(Correct statement = 2marks)

c. The law of magnetism states that like poles repel each other and unlike poles of magnets attract each other.

(Correct statement = 2marks)

Volume of sea-water displaced = $\frac{mass\ of\ the\ sea\text{-}water}{density\ of\ sea\text{-}water}$

Volume of sea-water displaced = $\frac{1200000}{1030}$

Volume of sea-water displaced = $1165m^3$

(F1, S3, A1 = 5marks)

ii. Mass of the cargo to be unloaded

Therefore, the Volume of fresh water displaced = $1165m^3$

Mass of fresh water = volume of fresh water × density of fresh water

Mass of fresh water displaced = $1165m^3 \times 1000kg/m^3$

= 1165000kg

Mass of the cargo to be unloaded = mass of sea-water – mass of fresh water

= 1200000 - 1165000kg

= 35000kg

Therefore, Mass of the cargo to be unloaded = 35 tonnes

(F1, S3, A1 = 5marks)

c. Difference between forward and reverse biasing

i. The forward bias reduces the potential barrier and allows a large current to flow easily across the junction, whereas reverse bias increases the potential barrier and obstructs the flow of charge carrier.

ii. In forward biasing, the positive terminal of the battery is connected to the p-region and the negative terminal is connected to the n-type material while in reverse biasing, the positive terminal of the supply is connected to the n-region material and the negative terminal is connected to the p-type material of the device.