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Dr./Nermien Ismail Schools

★ N.I.A.S ★

MR. AYMAN ELSANGARY

CHAPTER 1 MECHANICS

Physics!

| Grade 12 (Credit and SAT)

Mechanics, Kinematics,

Kinematics is the study of how things move (distance and displacement), how fast they move (speed and velocity), the rate of change of velocity (acceleration), and how much time passes during the changes. Kinematics is the study of the relationship between all of these things without regard to why something is moving.

Distance and Displacement

Distance can be defined as total length moved. If you run around a circular track, you have covered distance equal o the circumference of the track. Distance has no direction associated with it, which means it is scalar.

Displacement represents a change in position, defined as the straight-line distance between two points. In the previous example, if you run around a circular track and end up the same place you started, your displacement is zero, displacement is a vector.

Speed and Velocity

***Speed* is the time rate of motion, or simply, the distance traveled within a given time unit. To calculate speed, the equation is S = d/t**
Where s is the speed, d is the distance traveled, and t is the time to travel the distance. For example, an athlete were to run 100 meters in a time of 10 seconds, his speed would be 100 m/10 s, which is 10 m/s.
***Velocity* consists of two parts, speed and direction. If a mass travels in a given direction, its time rate of motion is now considered a velocity. Examples of a velocity values are 350 m/s north, or 70 m/s 10o north of east. When calculating velocity values, the equation is similar to the speed equation. V = d/t**
Where v is the velocity, d is the distance, and t is the time.
A common example of speed is the number given by the speedometer in a car. A speedometer tells us the car's speed, not its velocity, because it gives only a number and not a direction. Speed is a measure of the distance an object travels in a given length of time Average speed = total distance / total time while Average velocity = change in displacement / time

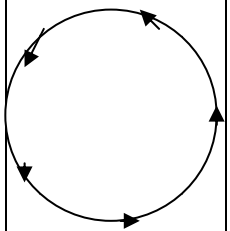
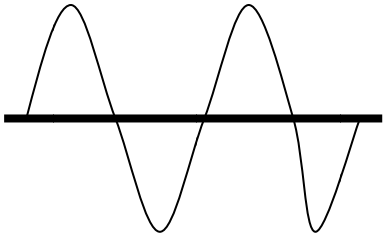
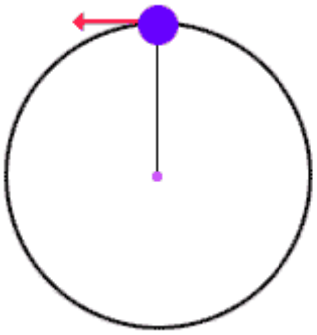
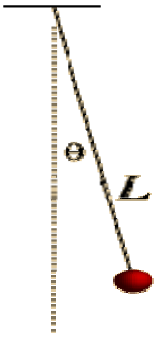
Acceleration

When you step on the gas pedal in your car, the car speed increases; step on the brake and the car's speed decreases. Turn the wheel, and the car direction of motion changes. In all of these cases, the velocity changes. This change in velocity is called acceleration, another common example, a car traveling around a circular racetrack is constantly accelerating even if the car's speed is constant, because the direction of the car's velocity vector is constantly changing. $a = \Delta v / \Delta t$
Average acceleration = change in velocity / time
The unit of acceleration is meter per second2, m/s^2

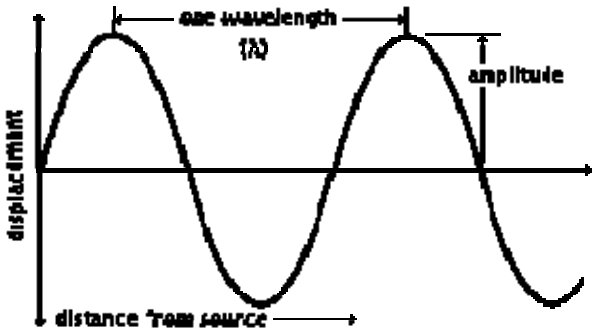
Kinds of motion:

Translator motion: **When a body moves from one place to another in a straight line, Or the movement of projectiles.**

Periodic motion: **When a body repeats its motion within equal intervals of time.**

Circular motion	Wave motion:	Rotatory motion	Vibratory motion
			

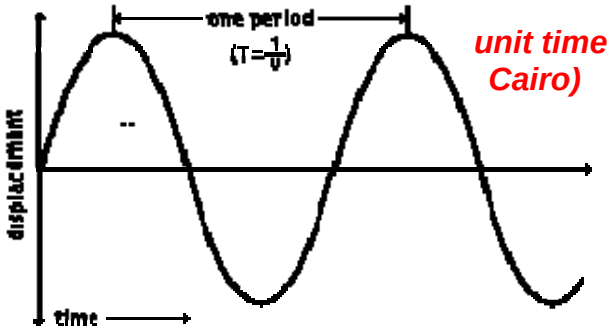
Concepts in motion



Displacement:-Distance in a given direction…… (e.g. 500 km from Suhag to Cairo)

Distance represents the length between two points

Speed Represents the distance covered in a unit time(e.g. 100km/hr)



Velocity Represents the distance covered in a unit time in a given direction.(E.g. 200 km/hr from Suez to Cairo)

Velocity

- ***Distance covered in unit time in a given direction. Or***
- ***Displacement covered in unit time.***
- ***Rate of displacement with respect to time.***

Velocity = $\frac{\text{Displacement}}{\text{time}} m/s$

V= $\frac{S}{t} m/s$

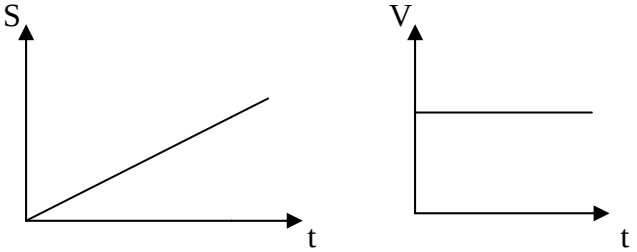
Dimensional formula of velocity: Lt^{-1}

Types of velocity

Uniform (constant) velocity:- When a body covers equal distances in equal intervals of time in a given direction.

V1	V2	V3	V4	V5
8Km/h	8Km/h	8Km/h	8Km/h	8km/h

Graphical representation of uniform velocity .



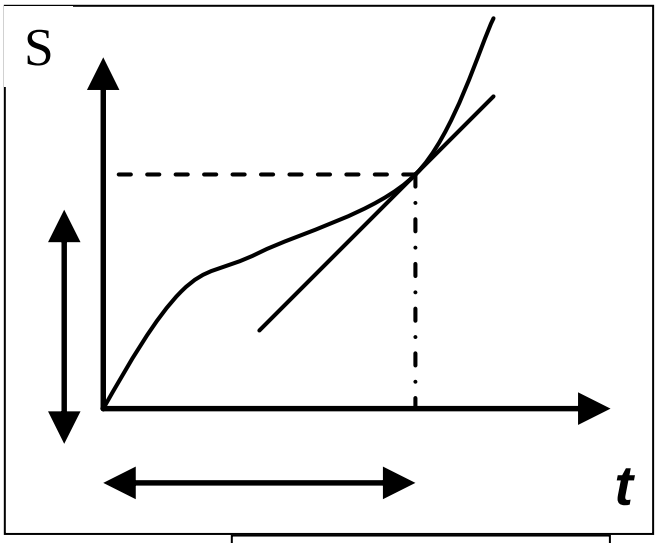
$V=\frac{V1+V2+V3+V4+V5}{5}$

$V=\frac{8+8+8+8+8}{5}=8Km\backslash h$

Graphical representation of body at rest

Instantaneous velocity
It is the velocity at any instant (moment)
Read by the speed meter.
At this instant we draw a tangent then we Draw a right angle.
The vertical represents (S)
The horizontal represents (t)

Instantaneous velocity = $\frac{S}{t}$ ***= the slop of the tangent***



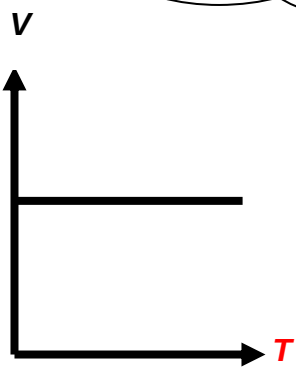
Instantaneous velocity

Acceleration

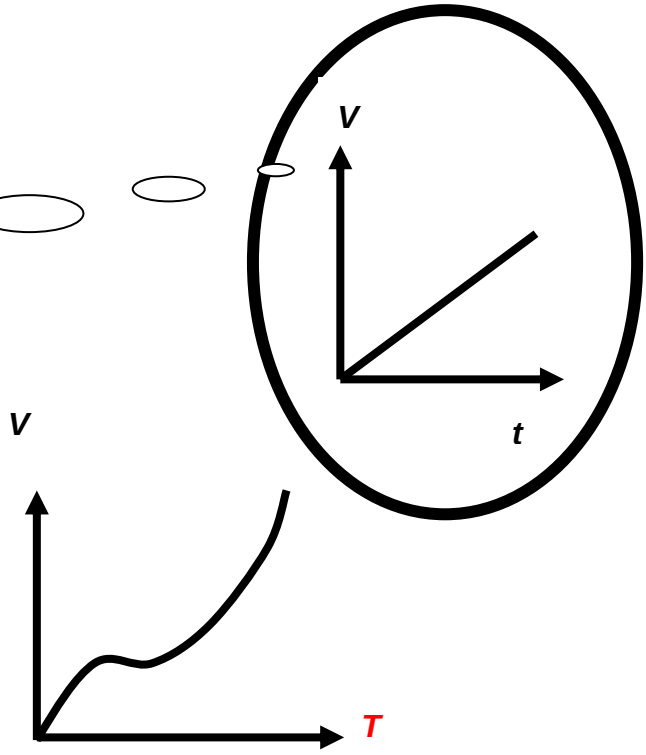
- ***The change in velocity in unit time or***
- ***The rate of change in the velocity or***

- ***final velocity – starting velocity / time***
- $a = \frac{V - V_0}{t}$
- ***Unit of acceleration m/sce^2***
- ***Dimensional formula Lt^{-2}***

Uniform acceleration = changes in velocity in equal intervals of time



Uniform(constant acceleration)



Non uniform acceleration.

Review questions 2:

1- The study of how things move (distance and displacement), how fast they move (speed and velocity), the rate of change of velocity (acceleration), and how much time passes during the changes is called:

A. Kinematics
B. Physics
C. Engineering
D. May be any of the above
E. Non of the above

2- …… can be defined as total length moved. It has no direction associated with it, which means it is scalar.

A. Distance
B. Displacement
C. Speed
D. Velocity
E. Acceleration

3- It represents a change in position, defined as the straight-line distance between two points. In the previous example, if you run around a circular track and end up the same place you started, your displacement is zero, displacement is a vector.

A. Distance
B. Displacement
C. Speed
D. Velocity
E. Acceleration

4- It is the time rate of motion, or simply, the distance traveled within a given time unit.

A. Distance
B. Displacement
C. Speed
D. Velocity
E. Acceleration

5- An athlete were to run 100 meters in a time of 10 seconds, his speed would be 100 m/10 s, which is:

A. 10 m/s.
B. 20m/s
C. 30m/s
D. 5m/s
E. 1m/s

6- It consists of two parts, speed and direction.

A. Distance
B. Displacement
C. Speed
D. Velocity
E. Acceleration

7. If a mass travels in a given direction, its time rate of motion is now considered a

A. Distance
B. Displacement
C. Speed
D. Velocity
E. Acceleration

8- 350 m/s north, is an example of:

A. Distance
B. Displacement
C. Speed
D. Velocity

E. Acceleration

9 . When calculating velocity values, the equation is similar to the …… equation.

A. Distance
B. Displacement
C. Speed
D. Velocity
E. Acceleration

10- d/t where d is the distance, and t is the time refers to:

A. Distance
B. Displacement
C. Speed
D. Velocity
E. Acceleration

11- Average …… = change in velocity / time

A. Distance
B. Displacement
C. Speed
D. Velocity
E. Acceleration

12- The unit of ……. is meter per second^2, m/s^2

A. Distance
B. Displacement
C. Magnitude
D. Velocity
E. Acceleration

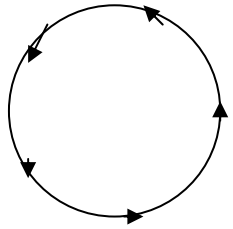
13- When a body moves from one place to another in a straight line, Or the movement of projectiles.

A. Translator motion
B. Periodic motion
C. Circular motion
D. Wave motion
E. Vibratory motion

14- When a body repeats its motion within equal intervals of time.

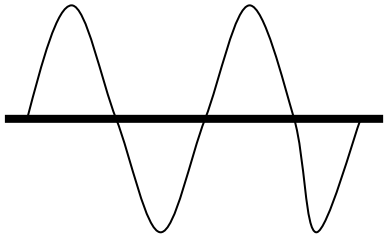
A. Translator motion
B. Periodic motion
C. Circular motion
D. Wave motion
E. Vibratory motion

15- The opposite figure represents



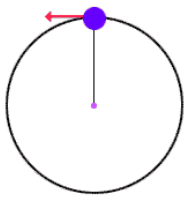
A. Translator motion
B. Periodic motion
C. Circular motion
D. Wave motion
E. Vibratory motion

16- The opposite figure represents



A. Translator motion
B. Periodic motion
C. Circular motion
D. Wave motion
E. Vibratory motion

17- The opposite figure represents



A. Translator motion
B. Periodic motion
C. Circular motion

D. Wave motion
E. Vibratory motion

18- Distance in a given direction…… (e.g. 500 km from Suhag to Cairo)

A. Distance
B. Displacement
C. Speed
D. Velocity
E. Acceleration

19- Represents the length between two points

A. Distance
B. Displacement
C. Speed
D. Velocity
E. Acceleration

20- Represents the distance covered in a unit time(e.g. 100km/hr)

A. Distance
B. Displacement
C. Speed
D. Velocity
E. Acceleration

21- Represents the distance covered in a unit time in a given direction.(200 km/hr from Suez to Cairo)

A. Distance
B. Displacement
C. Speed
D. Velocity
E. Acceleration

21- Distance covered in unit time in a given direction.

A. Distance
B. Displacement
C. Speed
D. Velocity
E. Acceleration

22- Displacement covered in unit time.

A. Distance
B. Displacement
C. Speed
D. Velocity
E. Acceleration

23- Rate of displacement with respect to time.

A. Distance
B. Displacement
C. Speed
D. Velocity
E. Acceleration

24- Dimensional formula of velocity:

A- Lt^{-1}
B- Lt
C- L/t
D- may be any of the above
E- non of the above

Chapter 3 Equations of motion

1st

$$a = \frac{v - v_0}{t}$$

$At = V - V_0$

$V = V_0 + at$

2nd

$$\overline{V} = \frac{S}{t} = \frac{V + V_0}{2}$$

$$S = \frac{(V + V_0)\, t}{2}$$

Substitute with the value of (V) from the first law.

$$S = \left(\frac{(V_0 + at + V_0)}{2}\right) t$$

$$S = \frac{2V_0\, t + at^2}{2}$$

$$S = \frac{2V_0\, t}{2} + \frac{at^2}{2}$$

$$S = V_0 t + \frac{1}{2} at^2$$

3rd

By squaring the first law.

$V^2 = (V_0 + at)^2$

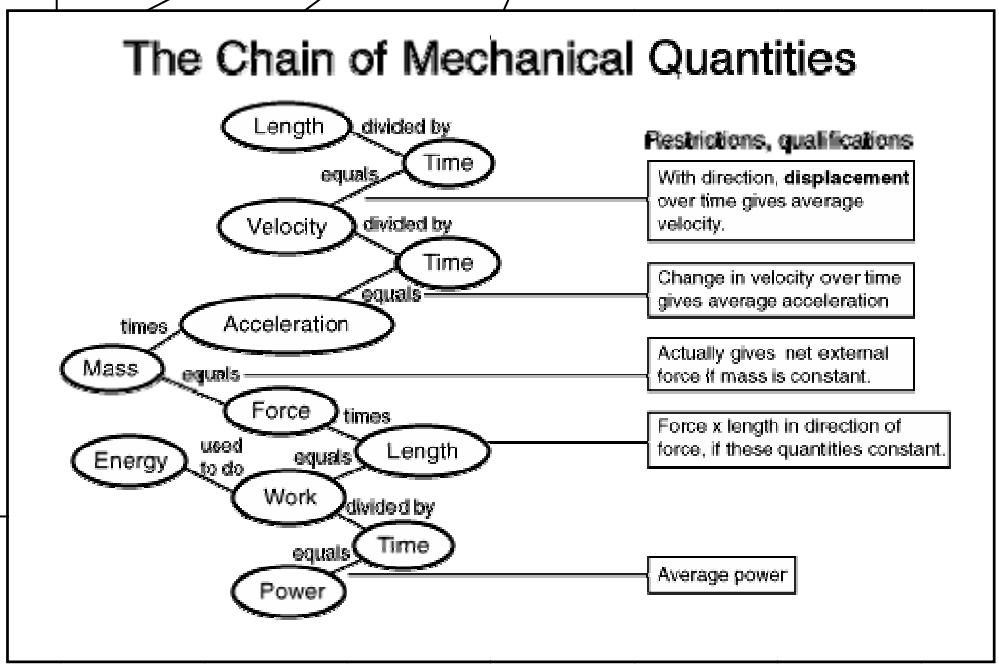
$V^2 = V_0^2 + 2\, V_0\, at + a^2\, t^2$

$V^2 = V_0^2 + 2\, a(V_0 t + 1/2\, at^2)$

$V^2 = V_0^2 + 2\, as$

Sir Isaac Newton

Isaac Newton's work represents one of the greatest contributions to science ever made by an individual. Most notably, Newton derived the law of universal gravitation, invented the branch of mathematics called calculus, and performed experiments investigating the nature of light and color



Gravity

Gravity: It is the free falling acceleration.

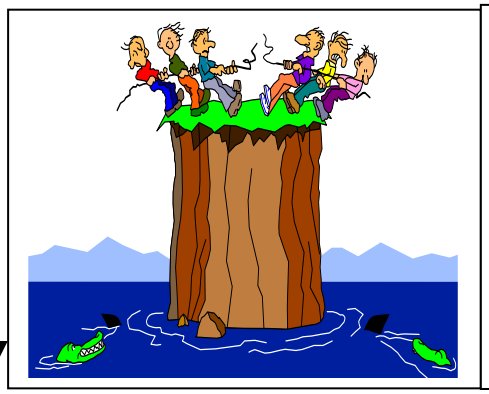
I.e.: The acceleration in the vertical direction

$$g = \frac{V - V_0}{t}$$

Gravity differs from one place to another because. The earth is not a complete sphere

Gravity in Egypt = 9.81 m/sec^2. Or approximately 10 m/sec^2

If a body is left to fall:



$V_0 = 0$

. g= 9.8 m\sec^2

V= velocity when they reached the ground(sea in this case)

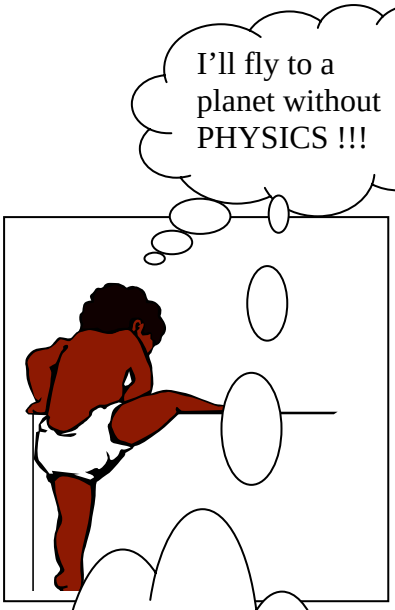
If a body is thrown upwards

V = zero

(Because the body stops for a part of a second to change direction.)

g = - 9.8 m/sec.

V_0 = V (at the starting point)



Put G for gravity instead of a for acceleration because gravity is a special case of acceleration

$V = V_0 + g\,t$

$S = V_0 + 1/2\ gt^2$

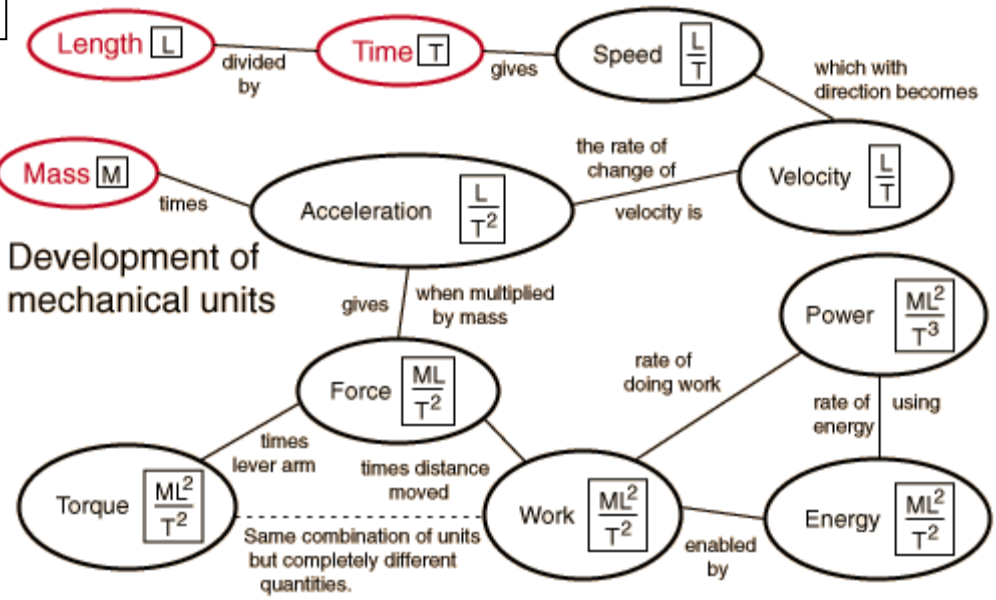
$V^2 = V_0^2 + 2\,g\,s$

If the starting velocity = zero then

$V = g\,t$

$S = 1/2\ gt^2$

$V^2 = 2g\,S$



Review questions 3:

1- 1st law of motion states that:

A. $V=V_0+at$

B. $S = V_0t + \frac{1}{2}at^2$

C. $V^2 = V_0^2 + 2as$

D. May be any of the above

E. Non of the above

2- 2nd law of motion states that:

A. $V=V_0+at$

B. $S = V_0t + \frac{1}{2}at^2$

C. $V^2 = V_0^2 + 2as$

D. May be any of the above

E. Non of the above

3- 3rd law of motion states that:

A. $V=V_0+at$

B. $S = V_0t + \frac{1}{2}at^2$

C. $V^2 = V_0^2 + 2as$

D. May be any of the above

E. Non of the above

4- V in the previous laws stands for:

A. Initial velocity

B. Final velocity

C. Acceleration

D. Displacement

E. Time

5- V_0 in the previous laws stands for:

A. Initial velocity

B. Final velocity

C. Acceleration

D. Displacement

E. Time

6- a in the previous laws stands for:

A. Initial velocity

B. Final velocity

C. Acceleration

D. Displacement

E. Time

7- t in the previous laws stands for:

A. Initial velocity
B. Final velocity
C. Acceleration
D. Displacement
E. Time

8- S in the previous laws stands for:

A. Initial velocity
B. Final velocity
C. Acceleration
D. Displacement
E. Time

9- ……. is the free falling acceleration. (I.e.: The acceleration in the vertical direction)

A. gravity
B. Final velocity
C. Acceleration
D. Displacement
E. Distance

10- Gravity differs from one place to another because.

A. The earth is not a complete sphere
B. The bodies fall in different speeds
C. The mass of the bodies differe
D. May be any of the above
E. Non of the above

11- V_0 = zero if:

A. a body is left to fall
B. a body is thrown upwards
C. a body was at rest
D. may be any of the above
E. non of the above

12- g has a +ve sign if

A. a body is left to fall
B. a body is thrown upwards
C. a body was at rest
D. may be any of the above

E. non of the above

13- V= velocity when a body reaches the ground if:

A. a body is left to fall
B. a body is thrown upwards
C. a body was at rest
D. may be any of the above
E. non of the above

14- V= zero if:

A. a body is left to fall
B. a body is thrown upwards
C. a body was at rest
D. may be any of the above
E. non of the above

15- g has a -ve sign if

A. a body is left to fall
B. a body is thrown upwards
C. a body was at rest
D. may be any of the above
E. non of the above

16- V_0 is greater than V if

A. a body is left to fall
B. a body is thrown upwards
C. a body was at rest
D. may be any of the above
E. non of the above

17- V_0 is less than V if

A. a body is left to fall
B. a body is thrown upwards
C. a body was at rest
D. may be any of the above
E. non of the above