TEST NO.1

1. Electron is a particle whose mass is:

(A) Greater than that of a proton

(B) Smaller than that of a proton and greater than mass of neutron

(C) Smaller than that of a proton or a neutron

(D) Greater than that of an atom.

Mass of an electron = 9.1093×10^{-31} kg

Mass of a proton = 1.6726×10^{-27} kg

Mass of a neutron = 1.6749×10^{-27} kg

2. In the equation $E = mc^2$, value of c is:

(A) 1,86,000 miles per hour

(B) 1,86,000 miles per sec

(C) 3×10^8 m/sec

(D) Both A and C

(E) Both B and C

Because according to scientific notation, there should be only one non-zero digit left of decimal.

3. $1\ m^3$ is equal to:

(A) 10^6 cm^3

(B) 10^9 mm^3

(C) 10^{-6} cm^3

(D) Both A and B

$1\ m^3$ = 1 m × 1 m × 1 m

= 10^2 cm × 10^2 cm × 10^2 cm = 10^6 cm^3 = 10^6 c.c.

= 10^3 mm × 10^3 mm × 10^3 mm = 10^9 (mm)^3

4. On conversion, Kg-m^2 sec^{-2} becomes:

(A) Newton

(B) Joule

(C) Pascal

(D) Watt

kg m^2 sec^{-2} = (kg m sec^{-2}) × m

= N × m = Joule.

6. The ratio of 1 nanometre to one attometre is:

(A) 10^9

(B) 10^8

(C) 10^{-9}

(D) 10^{-8}

$$\frac{1 \text{ nanometre}}{1 \text{ atto metre}} = \frac{10^{-9} \text{ metre}}{10^{-18} \text{ metre}} = 10^{9}$$

7. **1 kg/m³ is equal to:**
   - (A) 10^3 gm-cm^{-3}
   - (B) 10^{-3} gm-cm^{-3}
   - (C) 1 gm-cm^{-3}
   - (D) 10^6 gm. cm^3

$$\frac{1 \text{ kg}}{\text{m}^3} = \frac{1000 \text{ grams}}{10^2 \times 10^2 \times 10^2 \text{ cm}^3} = 10^{-3} \frac{\text{gm}}{\text{cm}^3}$$

8. **The prefix micro represents the _____ th part of a quantity.**
   - (A) 10^{12}
   - (B) 10^6
   - (C) 10^{-6}
   - (D) 10^{-2}

1 micro = 10^{-6}
Or 10^6th part of certain quantity.

9. **Conversion of 10^{-6} micro-centimeter in meters is:**
   - (A) 10^{-12}
   - (B) 10^{-14}
   - (C) 10^{-2}
   - (D) 10^{-10}

10^{-6} micro-centimetre
$= 10^{-6} \times 10^{-6} \times 10^{-2}$ metres
$= 10^{-14}$ metres

10. **Tick the correct statement:**
    - (A) All digits 1 to 9 are significant.
    - (B) Zeros to the left of a significant digit but not between two digits, is not significant.
    - (C) Zero is significant if it lies between two digits.
    - (D) Only A and C are true
    - (E) All are true

The options A, B, C are true and these are actually the rules to determine the significant figures.

11. **Significant figures in 0.0010 are:**
    - (A) Four
    - (B) Three
    - (C) Two
    - (D) One

Because zeros to the extreme left of a significant figures are not significant.

12. **Significant figures in 1.0011000 are:**
    - (A) Eight
    - (B) Seven
    - (C) Six
    - (D) Five

Because the zeros in between any two significant figures and to the extreme right of significant figures are significant.

13. **If the absolute uncertainty of an instrument is 0.01 cm, then its least count will be:**
    - (A) 0.005 cm
    - (B) 0.01 cm
    - (C) 0.02 cm
    - (D) 0.001 cm

Absolute uncertainty and least count bear the same meanings.

14. **The distance x determined by the difference between two separate position measurements are $x_1 = 10.5 \pm 0.1$ cm and $x_2 = 26.8 \pm 0.1$ cm. Then x will be recorded as:**
    - (A) 16.3 cm
    - (B) 16.3 ± 0.1 cm
    - (C) 16.3 ± 0.2 cm
    - (D) 16.3 ± 0.01 cm

When two quantities are added or subtracted, their absolute uncertainties are added.

15. **In the formula $V = \frac{\pi d^2 l}{4}$, if the percentage uncertainty in diameter is 0.8% and in length is 0.2%, then the total uncertainty in measuring the volume is:**
    - (A) 1.8%
    - (B) 1.0%
    - (C) 0.6%
    - (D) 4%

Since diameter occurs in square, hence percentage uncertainty in diameter will be entered as $2 \times 0.8 = 1.6$. Next rule is that when two quantities (e.g., diameter and length in this case) are multiplied, their uncertainties are added.

16. **For multiplication and division purposes, percentage uncertainties are:**
    - (A) Added
    - (B) Subtracted
    - (C) Multiplied
    - (D) Divided

This is the rule which has been applied in Q. No. 39.

17. **In case of power factor like r^3 in $V = \frac{4}{3}\pi r^3$, percentage uncertainty in radius is _____ the power factor.**

(A) Added into   (B) Subtracted from
(C) Multiplied by   (D) Divided by

Explanatory Answer: (C)

This is the rule which has been applied in Q. No. 39.

18. The time of 30 vibrations of a simple pendulum is recorded as 54.6 seconds by a stop-watch whose least count is 0.1 second. The time period in seconds will be quoted as:

(A) 1.82 ± 0.006 (B) 0.54 ± 0.003
(C) 1.82 ± 0.003 (D) 0.54 ± 0.006

Explanatory Answer: (C)

The uncertainty in the time period of a vibrating body is found by $= \dfrac{\text{least count of a timing device}}{\text{number of vibrations}}$

$= \dfrac{0.1}{30} = 0.0031$

and time period $T = \dfrac{54.6}{30} = 1.82$ seconds.

19. Volume of an object has been calculated as 47.7 cm^3 with 1.2% uncertainty. The result in cm^3 will be recorded as:

(A) 47.7 ± 1.2 (B) 47.7 ± 0.6
(C) 47.7 ± 0.3 (D) 47.7 ± 0.1

Explanatory Answer: (B)

Because 1.2% of 47.7 gives 0.6.

20. The maximum possible error in the reading of an instrument is _____ its least count.

(A) Half of   (B) Quarter of
(C) Equal to   (D) Double than

Explanatory Answer: (A)

The reason is well-explained by an example of meter rod in article 1.6 page 10 of the textbook.

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TEST NO.2

1. A body moving with an acceleration of 5 m/sec^2 started with velocity of 10 m/sec. What will be the distance traversed in 10 seconds?

(A) 150 m   (B) 250 m
(C) 350 m   (D) 400 m

Explanatory Answer: (C)

Use $s = v_i t + \dfrac{1}{2} at^2$

2. A ball is dropped from a height of 4.2 metres. To what height will it rise if there is no loss of KE after rebounding?

(A) 4.2 m   (B) 8.4 m
(C) 12.6 m   (D) None of these

Explanatory Answer: (A)

The ball will rebound to the same height from which it was dropped.

3. A body is moving with constant velocity of 10 m/sec in the north-east direction. Then its acceleration will be:

(A) 10 m/sec^2 (B) 20 m/sec^2
(C) 30 m/sec^2 (D) Zero

Explanatory Answer: (D)

As the body is moving with constant velocity, hence acceleration is zero.

4. A certain force gives an acceleration of 2 m/sec^2 to a body of mass 5 kg. The same force would give a 20 kg object an acceleration of:

(A) 0.5 m/sec^2 (B) 5 m/sec^2
(C) 1.5 m/sec^2 (D) 9.8 m/sec^2

Explanatory Answer: (A)

$a = 2$ m sec^{-2}, $m = 5$ kg, $F = ma = 2 \times 5 = 10$ N

Now $F = 10$ N, $m = 20$ kg, $a = \dfrac{F}{m} = \dfrac{10}{20} = 0.5$ m sec^{-2}

5. An object is dropped from a height of 100 m. Its velocity at the moment it touches the ground is:

(A) 100 m/sec   (B) 140 m/sec
(C) 1960 m/sec   (D) 196 m/sec

Explanatory Answer: (B)

Use $v_f^2 - v_f^2 = 2as$ where $v_i = 0$ since the object is simply dropped and not thrown.

6. If the initial and final velocities of a

moving body are 30 cm/sec and 3.70 m/sec, respectively, then the distance covered in 5 seconds will be:

(A) 1 m (B) 2 m
(C) 5 m (D) 10 m

1st Method = Use $s = \left(\dfrac{v_f - v_i}{t}\right) \times t$

2nd Method = Firstly find "a" by $v_f = v_i + at$

and then use $s = v_i t + \dfrac{1}{2} at^2$

7. Acceleration of 1.5 m sec^{-2} expressed in km hr^{-2} is:

(A) 324 (B) 5.4
(C) 5400 (D) 19440

$1.5 \dfrac{m}{sec^2} = 1.5 \times \dfrac{\frac{1}{1000} km}{\frac{1}{3600} hr \times \frac{1}{3600} hr}$

$= 1.5 \times \dfrac{1}{1000} \times 3600 \times 3600$ km hr^{-2}

$= 19440$ km hr^{-2}

8. A train covers 90 km in half an hour. The time taken by it to travel 15 km will be:

(A) 20 minutes (B) 48 minutes
(C) 10 minutes (D) 5 minutes

v = 90 km in half on hour = 180 km/hr

s = 15 km, t = ?

$s = vt$ or $t = \dfrac{s}{v} = \dfrac{15}{180} = \dfrac{1}{12}$ hours

= 5 minutes

9. A body starting from rest covers a distance of 0.45 km and acquires a velocity of 300 km/hr. Its acceleration will be:

(A) 0.092 m sec^{-2} (B) 0.5 m sec^{-2}
(C) 7.71 m sec^{-2} (D) 0.15 m sec^{-2}

s = 0.45 km, v_i = 0

v_f = 300 km/hr, a = ?

$2as = v_f^2 - v_i^2$

$a = \dfrac{v_f^2 - v_i^2}{2s} = \dfrac{300 \times 300}{2 \times 0.45} = 100,000$ km-hr^{-2}

$= \dfrac{100,000 \times 1000}{3600 \times 3600} = 7.71$ m sec^{-2}

10. When a climber reaches the top of a mountain:

(A) His weight is now greater (B) His mass is now slightly smaller
(C) His weight is now slightly less (D) None of these

At the top of the mountain, value of g becomes less and hence weight becomes less.

11. According to the law of conservation of momentum, $m_1 v_1 - m_1 v_1' = $ _____

(A) $m_2 v_2 + m_2 v_2'$ (B) $m_2 v_2' - m_2 v_2$
(C) $m_2 v_2 - m_2 v_2'$ (D) None of these

Law of conservation of momentum is

$m_1 v_1 + m_2 v_2 = m_1 v_1' + m_2 v_1'$

Thus $m_1 v_1 - m_1 v_1 = m_2 v_2' - m_2 v_2'$

12. Force can also be defined as:

(A) Rate of change of momentum (B) Product of mass per second and change in velocities
(C) Both A and B are correct (D) None of these

Force = rate of change of momentum

$= \dfrac{mv_f - mv_i}{t}$

$= \dfrac{m}{t}(v_f - v_i)$

Force = mass per sec × change in velocity

13. When a bullet is fired by a gun, the gun moves backward with a:

(A) Velocity equal to that of bullet (B) Velocity less than that of bullet

(C) Velocity greater than that of bullet

(D) None of these

The option B is according to law of conservation of momentum i.e.,

$$mv_1 + Mv_2 = mv_1' + Mv_2'$$
$$0 + 0 = mv_1' + Mv_2'$$
$$v_2' = -\frac{m}{M} v_1'$$

i.e., $v_2' << v_1'$

14. **A force of 100 N acts upon a body for five seconds. What will be the change in momentum?**

(A) 200 NS
(B) 500 Kg m/sec
(C) 20 Kg m/sec
(D) $\frac{1}{20}$ NS

Change in momentum = impulse = F × t

15. **Suppose water comes out of a pipe at the rate of 3 kg per second and its velocity changes from 5 m/sec to zero on striking the wall perpendicularly. The force exerted on the wall is:**

(A) 15 N
(B) 8 N
(C) −2 N
(D) 1.66 N

$$\frac{m}{t} = 3 \frac{kg}{sec}, \quad v_f - v_i = 5 - 0 = 5 \text{ m/sec}$$

$$F = \frac{m(v_f - v_i)}{t} = \frac{m}{t}(v_f - v_i)$$

16. **Range of the projectile is the same for the following pair of angles:**

(A) 0° and 45°
(B) 35° and 55°
(C) 15° and 60°
(D) 30° and 75°

When the sum of two angles of projection is equal to 90°, their horizontal ranges are the same.

17. **For any value of initial velocity, the minimum range of a projectile is obtained by throwing it at an angle of:**

(A) 45°
(B) 40° or 50°
(C) 30° or 60°
(D) 0° or 90°

Minimum range means zero range and the body is no more projectile. Either it is moving horizontally or vertically.

18. **In a projectile motion, the maximum height reached equals the horizontal range. The angle of the projectile with the horizontal will be:**

(A) $\tan^{-1}\left(\frac{1}{4}\right)$
(B) $\tan^{-1}(1)$
(C) $\tan^{-1}(2)$
(D) $\tan^{-1}(4)$

maximum height = horizontal range

$$\frac{v_i^2 \sin^2\theta}{2g} = \frac{v_i^2 \sin 2\theta}{g}$$

$$\frac{\sin^2\theta}{2} = (\sin 2\theta) = 2\sin\theta\cos\theta$$

$$\frac{\sin\theta}{2} = 2\cos\theta \text{ i.e., } \tan\theta = 4$$

19. **At the highest point, we can claim that:**

(A) Resultant velocity is zero
(B) Only horizontal component of velocity is zero
(C) Only v_y is zero
(D) Nothing of above

As the projectile moves from point of projection to the highest point, v_y goes on decreasing and becomes zero at the highest point.

20. **Select formulae for time of flight and maximum horizontal range:**

(A) $\dfrac{v_i^2 \sin 2\theta}{g}, \dfrac{v_i^2 \sin^2\theta}{2g}$

(B) $\dfrac{2v_i \sin\theta}{g}, \dfrac{v_i^2 \sin 2\theta}{g}$

(C) $\dfrac{2v_i \sin\theta}{g}, \dfrac{v_i^2 \sin^2\theta}{2g}$

(D) $\dfrac{2v_i \sin\theta}{g}, \dfrac{v_i^2}{g}$

There is no need of calculation. The

projectile projected at 15° and 75° will have same value of horizontal range, since their total is 90°.

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TEST NO.3

1. Which is correct?

(A) $\vec{A} = \dfrac{A}{\hat{A}}$

(B) $\hat{A} = \dfrac{A}{\vec{A}}$

(C) $A = \dfrac{\vec{A}}{\hat{A}}$

(D) $A = \dfrac{\hat{A}}{\vec{A}}$

Explanatory Answer. (C)

Vector quantity is defined by its magnitude and direction *i.e.*,

$$\vec{A} = A\hat{A}$$

or $\quad A = \dfrac{\vec{A}}{\hat{A}}$

2. Parallel vectors of same magnitudes:

(A) Are equal
(B) Are unequal
(C) When added, give the sum equal to zero
(D) When multiplied, give the answer equal to zero

Explanatory Answer. (A)

Direction of parallel vectors is always same. According to the question, magnitude of given vectors is always same, hence they are equal.

3. Which one is correct?

(A) $\vec{A} = \vec{A}_x\,\hat{i} + \vec{A}_y\,\hat{j}$

(B) $\vec{A} = A_x\,\hat{i} + A_v\,\hat{k}$

(C) $\vec{A} = A_x\,\hat{j} + A_v\,\hat{i}$

(D) $\vec{A} = A_x\,\hat{i} + A_y\,\hat{j}$

Explanatory Answer. (D)

$$\vec{A} = \vec{A}_x + \vec{A}_y$$

where $\vec{A}_x = A_x\,\hat{i},\ \vec{A}_y = A_y\,\hat{j}$

4. If a vector $\vec{A}$ makes an angle θ with x-axis, then:

(A) $A_x = A\sin\theta$
(B) $A_x = A\cos\theta$
(C) $A = A_x\cos\theta$
(D) $A = A_x\sin\theta$

Explanatory Answer. (A)

In the right angled triangle, the line opposite to angle θ is always called perpendicular.

Hence $\dfrac{OQ}{OP} = \sin\theta$

$\dfrac{A_x}{A} = \sin\theta$ *i.e.*, $A_x = A\sin\theta$

5. Distance AB between the points A (2,3,4) and B (-5,6,7) is given by:

(A) $7\hat{i} + 9\hat{j} + 11\,\hat{k}$
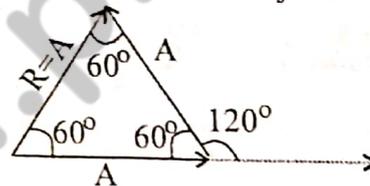(B) $-7\hat{i} - 9\hat{j} - 11\,\hat{k}$
(C) $-3\hat{i} - 3\hat{j} - 3\,\hat{k}$
(D) $-7\hat{i} + 3\hat{j} + 3\,\hat{k}$

Explanatory Answer. (D)

A (2,3,4) is written as $2\hat{i} + 3\hat{j} + 4\hat{k}$ and B (-5,6,7) is written as $-5\hat{i} + 6\hat{j} + 7\hat{k}$.

The distance $\vec{AB} = (-5\hat{i} + 6\hat{j} + 7\hat{k}) - (2\hat{i} + 3\hat{j} + 4\hat{k})$

$$= -7\hat{i} + 3\hat{j} + 3\hat{k}$$

6. If $\vec{A} = 2\hat{i} + 3\hat{j} - 4\hat{k}$, then its magnitude will be:

(A) $\sqrt{-3}$
(B) $\sqrt{-1}$
(C) -1
(D) $\sqrt{29}$

Explanatory Answer. (D)

If $\vec{A} = A_x\hat{i} + A_y\hat{j} + A_z\hat{k}$

then $|\vec{A}| = \sqrt{A_x^2 + A_y^2 + A_z^2}$

7. When the magnitude of two component vectors are equal to that of their resultant, then the angle between the components is:

(A) 60°
(B) 90°
(C) 120°
(D) 150°

Explanatory Answer: (C)

Note that while determining the angle between two vectors, we join their tails.

8. The rectangular components of a vector are equal in magnitude when the vector makes an angle _____ with their x-component.
   (A) 0° (B) 30°
   (C) 45° (D) 60°

Explanatory Answer: (C)

If the rectangular components of a vector are equal to each other, then angles opposite to these sides will also be equal i.e., 45° each.

9. If the vector 5 N lies along x-axis, then its component along y-axis will be:
   (A) Zero (B) 5 N
   (C) 7 N (D) 10 N

Explanatory Answer: (A)

A vector of 5 N along X-axis cannot be resolved. So its Y-component is zero.

10. A vector of magnitude 5 N is added to a vector of magnitude 8 N while the orientations are changeable. Range of their possible sum will vary from:
    (A) Zero to 3 N (B) 1 N to 13 N
    (C) 13 N to 3 N (D) None of these

Explanatory Answer: (C)

If both the vectors are parallel, they will give resultant equal to 13 N and if they are anti-parallel, the resultant will be of magnitude 3 N.

11. A person starts his journey from a point O, travels 4 Km SE, then 4 Km SW, then 4 Km NW, and finally 4 Km North-east. At what distance is he now from point O?
    (A) 0 km (B) 4 km
    (C) 8 km (D) 12 km

Explanatory Answer: (A)

Firstly draw the direction indicator. Then draw the diagram with scale (say) 4 km = 1 cm and note that 4 km SE means that vector makes an angle of 45° with East as well as South direction.

12. The unit vector of the vector $\vec{A} = 4\hat{i} + 3\hat{j}$ is given by:

    (A) 7 (B) $\dfrac{4\hat{i} + 3\hat{j}}{5}$

    (C) 5 (D) $\dfrac{3\hat{i} + 4\hat{j}}{5}$

Explanatory Answer: (B)

$$\vec{A} = A\hat{A} \; i.e., \; \hat{A} = \frac{\vec{A}}{A} = \frac{4\hat{i} + 3\hat{j}}{\sqrt{4^2 + 3^2}} = \frac{4\hat{i} + 3\hat{j}}{5}$$

13. If $\vec{A} + \vec{B} = 7\hat{j} + 7\hat{k}$ and $\vec{A} - \vec{B} = -\hat{j} + \hat{k}$, then magnitude of $\vec{A}$ and $\vec{B}$ are:
    (A) 3 and 4 (B) 7 and −1
    (C) 7 and 7 (D) 5 and 5

Explanatory Answer: (D)

$$\vec{A} + \vec{B} = 7\hat{j} + 7\hat{k} \qquad (1)$$
$$\vec{A} - \vec{B} = -\hat{j} + \hat{k} \qquad (2)$$
$$2\vec{A} = 6\hat{j} + 8\hat{k}$$
$$\vec{A} = 3\hat{j} + 4\hat{k} \quad \text{Its magnitude} \quad |\vec{A}| = \sqrt{9 + 16} = 5$$

Similarly

$$\vec{A} + \vec{B} = 7\hat{j} + 7\hat{k} \qquad (1)$$
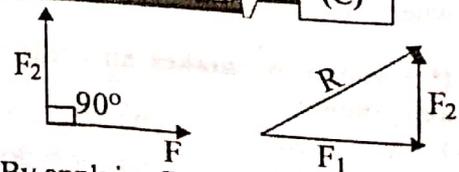$$\vec{A} - \vec{B} = -\hat{j} + \hat{k} \qquad (2)$$
$$\underline{\;- \;+\; \; \; + \;-\;}$$
$$2\vec{B} = 8\hat{j} + 6\hat{k}$$
$$\vec{B} = 4\hat{j} + 3\hat{k} \quad \text{Its magnitude} \quad |\vec{B}| = \sqrt{16 + 9} = 5$$

14. Angle between two forces $\vec{F_1}$ and $\vec{F_2}$ acting on a body is 90°. Their resultant F will have magnitude equal to:

    (A) $F_1^2 + F_2^2$ (B) $\dfrac{F_1^2 + F_2^2}{2}$

    (C) $\sqrt{F_1^2 + F_2^2}$ (D) None of these

Explanatory Answer: (C)

By applying Pythagorean theorem,
$$R^2 = F_1^2 + F_2^2 \quad \text{or} \quad R = \sqrt{F_1^2 + F_2^2}$$

15. Two forces each of 10 N magnitude act on a body. If the forces are inclined at 30° and 60°, respectively with x-axis, then x-component of their resultant is:

(A) 20 N   (B) 13.66 N
(C) 10 N   (D) 8.66 N

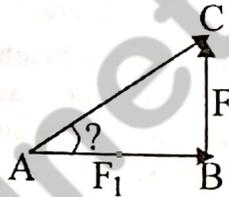**Explanatory Answer:** (B)

$$R_x = F_{1x} + F_{2x}$$
$$= F_1 \cos \theta_1 + F_2 \cos \theta_2$$
$$= 10 \cos 30 + 10 \cos 60$$
$$= 10 \times 0.866 + 10 \times 0.5$$
$$= 8.66 + 5 = 13.66 \text{ N}$$

16. Two forces each of magnitude F act perpendicular to each other. The angle made by the resultant force with the horizontal will be:

(A) 30°   (B) 45°
(C) 60°   (D) 90°

Explanatory Answer: (B)

When two sides of a triangle are equal, the angles in front of these sides are also equal.

$$90 + A + C = 180°$$
$$A + C = 180°$$
$$- 90° = 90$$
$$A = 45°, C = 45°$$

17. All trigonometric functions (sine, cosine, tangent etc.) are positive in:

(A) 1st quadrant   (B) 2nd quadrant
(C) 3rd quadrant   (D) 4th quadrant

Explanatory Answer: (A)

Sin θ is positive above x-axis.

Sin θ is negative below x-axis.
Cos θ is positive on the right side of y-axis.
Cos θ is negative on the left side of y-axis.

18. A force of 5 N is acting Y-axis. Its component along X-axis is:

(A) 7 N   (B) 5 N
(C) Zero   (D) 10 N

Explanatory Answer: (C)

A vector cannot have its component in a direction perpendicular to itself.

19. The angle of a vector $\vec{A} = A_x \hat{i} - A_y \hat{j}$ with the X-axis will be in between:

(A) 0° to 90°   (B) 90° to 180°
(C) 180° to 270°   (D) 270° to 360°

Explanatory Answer: (D)

$\vec{A} = A_x \hat{i} - A_y \hat{j}$ tells that x-component of the vector $\vec{A}$ is positive and y-component is negative, therefore, vector lies in 4th quadrant i.e., range of the angles is 270° to 360°.

20. The x and y components of a force are 3 N and 5.2 N, respectively. The angle made by the force with X-axis is:

(A) 30°   (B) 60°
(C) 75°   (D) 90°

Explanatory Answer: (B)

$$\tan \theta = \frac{F_y}{F_x} = \frac{5.2}{3} = 1.733; \theta = 60°$$