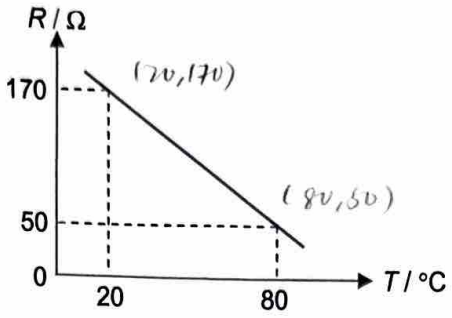
There are 26 questions. Where necessary, take $g = 9.81\ ms^{-2}$.

1. A thermometer makes use of the resistance R of a material to measure temperature. The figure below shows how R varies with temperature T.



What is the temperature when R is 100 Ω?

A 25 °C

B 45 °C

C 55 °C

D 105 °C

$\frac{170-50}{20-80} = \frac{100-50}{T-80}$

$\frac{120}{-60} = \frac{50}{T-80}$

$120T - 9600 = -3000$

$120T = 6600$

2. Which of the following statements about the internal energy and temperature of two objects is/are correct?

(1) The object with larger internal energy must have a higher temperature. ×

(2) The object with particles of larger average kinetic energy must have a higher temperature.

(3) When the objects are in contact, heat is transferred from the one with larger internal energy to the other.

A (1) only

B (2) only

C (1) and (3) only

D (2) and (3) only

3. Ken boils some water with a kettle. The water is heated from 15 °C to 100 °C in 10 min. If he forgets to shut it down, how long will it take to vaporize the water completely?

$E = 4200(100-15)(m)$

$E = 357,000m$

$P = \frac{E}{T} = \frac{357,000}{600} = 595m$

Specific heat capacity of water = 4200 J kg^{-1} $°C^{-1}$

Specific latent heat of vaporization of water = 2.26×10^6 J kg^{-1}

$595m = \frac{(2.26\times10^6)(m)}{T}$

A About 50 min

B About 60 min

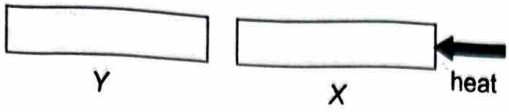
C About 70 min

D Cannot be determined since the mass of water is not given

$T =$

$Pt = mL$

4. Two metal rods X and Y are put close together without touching on the same horizontal level as shown below.



When the right end of X is heated, Y also becomes warm. Which of the following processes are involved in heating up X and Y?

(1) Conduction

(2) Convection

(3) Radiation

A (1) and (2) only

B (1) and (3) only

C (2) and (3) only

D (1), (2) and (3)

5. A fixed mass of an ideal gas is enclosed in a thin wall sealed syringe. When the piston is pushed slowly, which of the following physical quantities of the gas will change?

(1) Pressure

(2) Temperature

(3) Internal energy

A (1) only

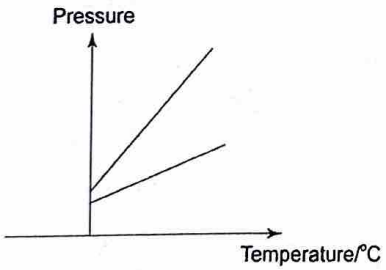
B (1) and (3) only

C (2) and (3) only

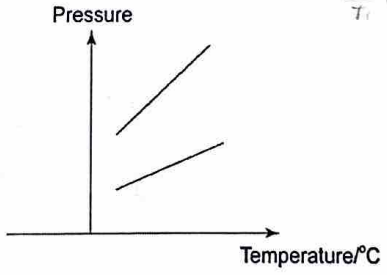
D (1), (2) and (3)

6. Two sealed glass vessels of different volume contain the same mass of air. Which of the following graphs can correctly show the pressure-temperature relationships of the air in the two vessels ?

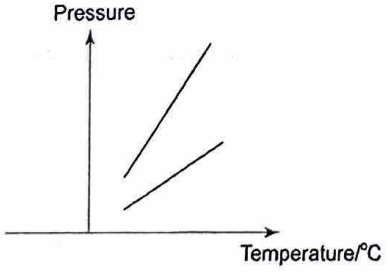
A.



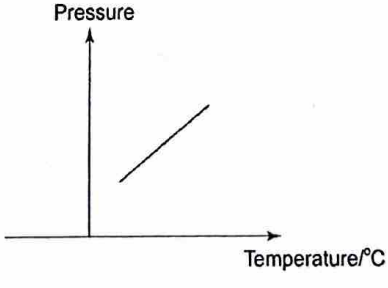
C.



B.



D.



7. Two vessels X and Y, which contain the same kind of ideal gas at the same temperature, are connected by a tap which is initially closed. The volume and pressure of the gas in the vessels are listed as follows:

Vessel	Pressure / Pa	Volume / m^3
X	4×10^5	1.3×10^{-2}
Y	3×10^5	7×10^{-3}

When the tap is opened, what will be the final pressure in the vessels if the volumes of the vessels and the temperature of the gas are constant throughout the process?

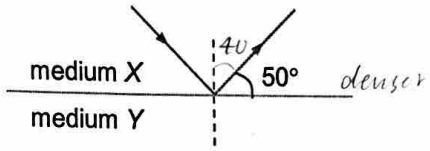
A 3.12×10^5 Pa

B 3.42×10^5 Pa

C 3.50×10^5 Pa

D 3.65×10^5 Pa

8. A ray of light travels from medium X to medium Y and total internal reflection occurs as shown.



Which of the following statements must be correct?

(1) The critical angle for the interface between medium X and medium Y is 40°.

(2) Light travels faster in medium Y than in medium X.

(3) Medium Y is air.

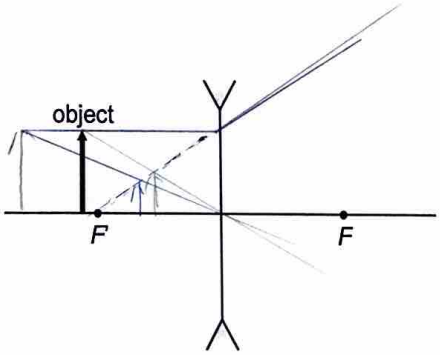
A (2) only

B (1) and (2) only

C (1) and (3) only

D (1), (2) and (3)

9.



An object is placed in front of a concave lens as shown. When the object moves away from the concave lens, how does the image move?

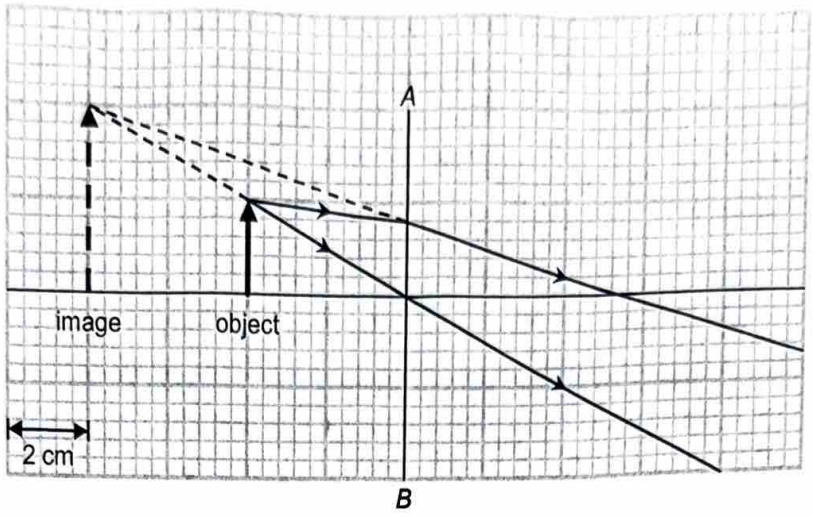
A. The image moves towards F' and away from the lens.

B. The image moves away from F' and towards the lens.

C. The image moves towards F and away from the lens.

D. The image moves away from F and towards the lens.

10.



Lens *AB* forms an image as shown above. What is the focal length of the lens *AB*?

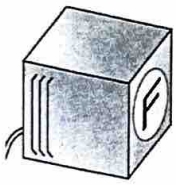
A. 2 cm

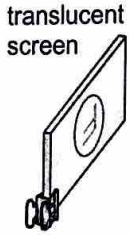
B. 4 cm

C. 5.2 cm

D. 8 cm

11. A student sets up the following apparatus (Fig a) to study the relationship between the linear magnification *m* of the image produced by the convex lens and the image distance *v*. A graph of *m* against *v* is obtained (Fig b).





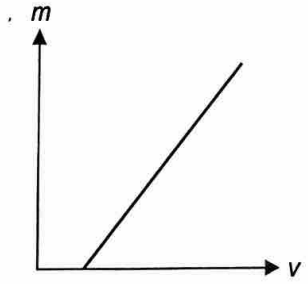
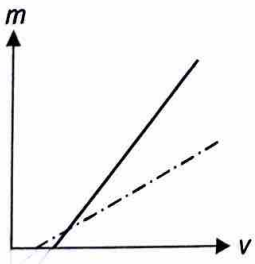


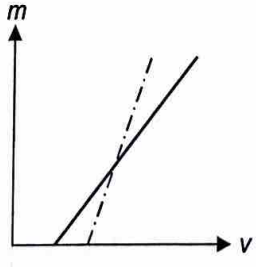
Fig a ***Fig b***

If another convex lens of greater refractive index is used, which of the following graphs (in dotted line) best shows the new *m*–*v* graph?

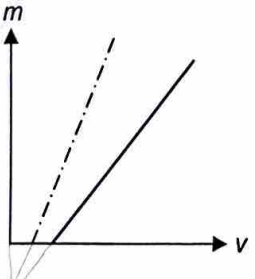
A



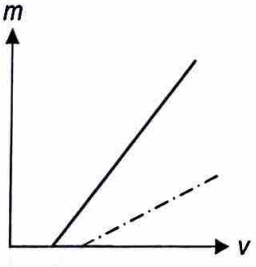
B



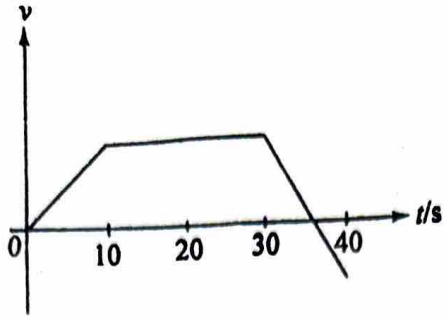
C



D

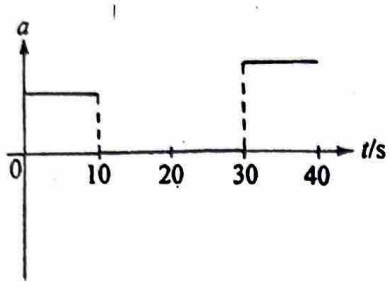


12.

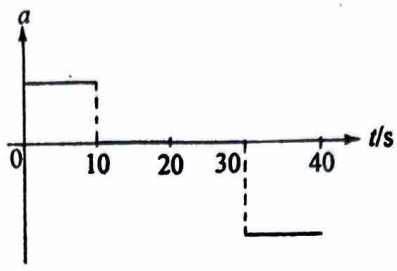


The velocity-time graph of a car travelling along a straight road is shown above. Which of the following graphs shows the variation of the acceleration a of the car with time t ?

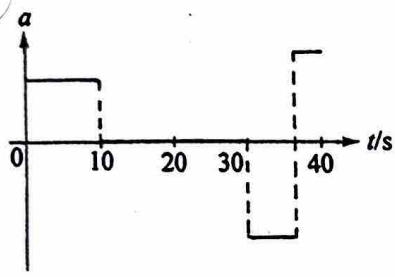
A.



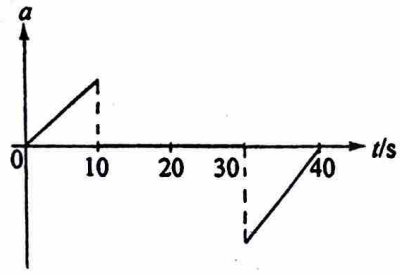
B.



C.



D.



13. A car undergoes uniform deceleration along a straight road. Its velocity decreases from 30 ms^{-1} to 20 ms^{-1} after travelling a distance of 100 m. How much further will the car travel before it comes to a rest ?

A. 180 m

B. 100 m

C. 80 m

D. 50 m

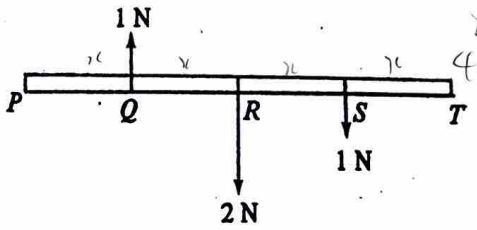
$v^2 = u^2 + 2as$

$20^2 = 30^2 + 2(a)(100)$

$-500 = 200a$

$a = -2.5\ ms^{-2}$

14.



$20^2 = 0^2 + 2(-2.5)(s)$

$400 = -5s$

$s = 80$

The above diagram shows a light rod under the action of three vertical forces. The points P, Q, R, S and T are equally spaced along the rod. At which point must an upward vertical force of 2N be applied to hold the rod in equilibrium ?

A. T

B. S

C. R

D. P

$3x + 2d = 5x$

$2d = 2x$

$d = x$

$3x + 2(d)$ & $4x + x$

$= 5x$

15. Which of the following pairs of forces is/are action and reaction pair(s) according to Newton's third law of motion ?

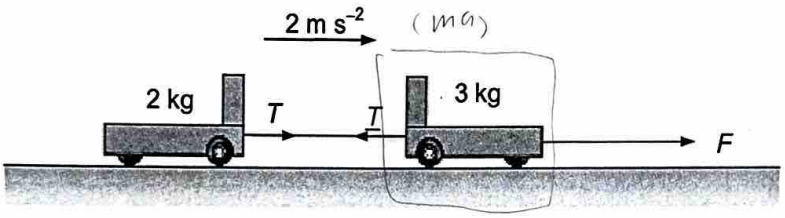
(1) The weight of a man standing on a chair. **and** The force acting on the man by the chair.

(2) The gravitational force acting on the earth by the moon. **and** The gravitational force acting on the moon by the earth.

(3) The force exerted by a swimmer on the water to push the water backward. **and** The force exerted by the water to push the swimmer forward.

A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

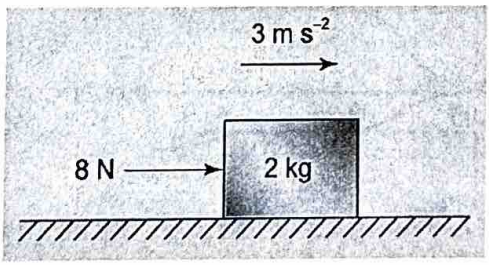
16. In the following figure, two trolleys of mass 2 kg and 3 kg are tied together on a smooth plane. A horizontal force F pulls them.



If the trolleys have an acceleration of 2 m s^{-2}, what are the values of tension T and horizontal force F?

	T	F
A.	4 N	10 N
B.	6 N	10 N
C.	4 N	6 N
D.	2 N	6 N

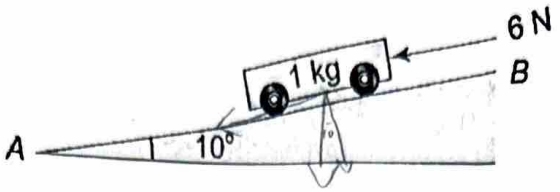
17.



A horizontal force of 8 N acts on a mass of 2 kg placed on a horizontal surface. The mass accelerates at a rate of 3 ms^{-2}. If the 8 N force is removed, what will be the subsequent motion of the mass ?

A. The mass will continue accelerating at a rate of 3 ms^{-2}.
B. The mass will continue moving with a uniform velocity.
C. The mass will stop immediately.
D. The mass will continue moving with a deceleration of 1 ms^{-2}.

18.



AB is a friction-compensated runway for a trolley of mass 1 kg. The runway is inclined at an angle of 10° to the horizontal. The trolley is pushed down the runway by a force of 6 N as shown in the diagram. What is the acceleration of the trolley ?

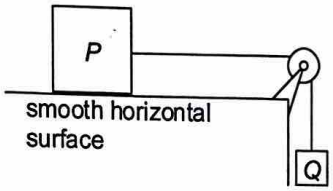
A. 1.7 ms^{-2}

B. 4.3 ms^{-2}

C. 6.0 ms^{-2}

D. 7.7 ms^{-2}

19. Two blocks *P* and *Q* are connected by a light and inextensible string passing over a light and smooth pulley as shown. The mass of block *P* is greater than that of block *Q*.



When the blocks are released,

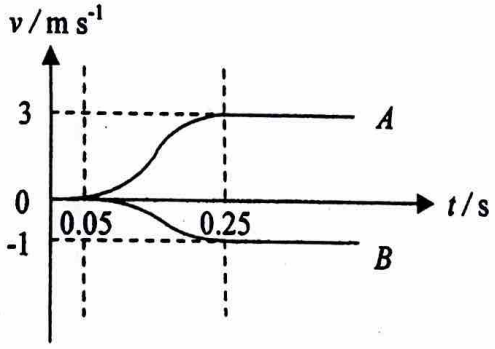
A. the potential energy gained by block *P* is equal to the potential energy lost by block *Q*.

B. the potential energy gained by block *P* is more than the potential energy lost by block *Q*.

C. the kinetic energy gained by block *P* is equal to the kinetic energy gained by block *Q*.

D. the kinetic energy gained by block *P* is more than the kinetic energy gained by block *Q*.

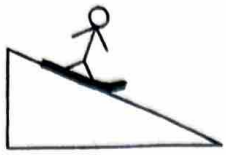
20.



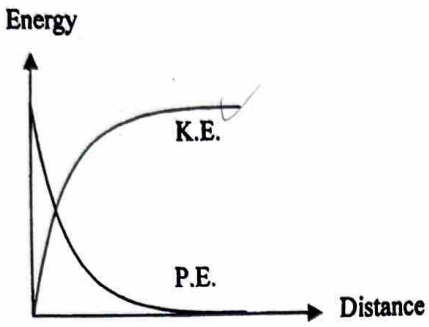
In an explosion, an object is blown into 2 pieces, *A* and *B*, which fly off in opposite directions. The mass of *A* is 0.3 kg. The graph shows the variation of velocity of *A* and *B* with time before and after the explosion. What is the mass of *B* and the estimated magnitude of the average net force acting on *B* during the explosion ?

	Mass of *B*	**Magnitude of the average net force acting on B**
A.	0.1 kg	0.4 N
B.	0.1 kg	0.5 N
C.	0.9 kg	3.6 N
D.	0.9 kg	4.5 N

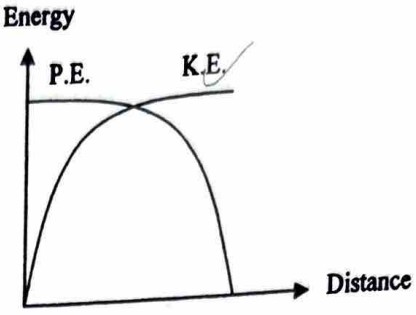
21. A skier slides down a slope as shown in the diagram below. Assume constant friction along the slope, which of the following graphs best describes the change of energy of the skier with distance down the slope ?



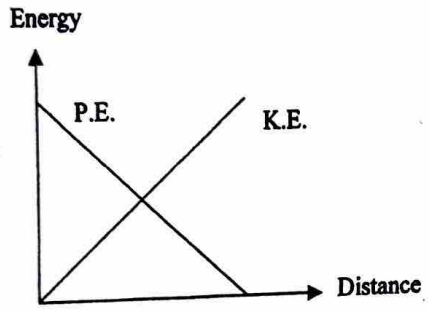
A.



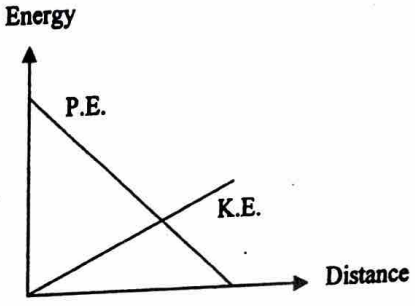
B.



C.



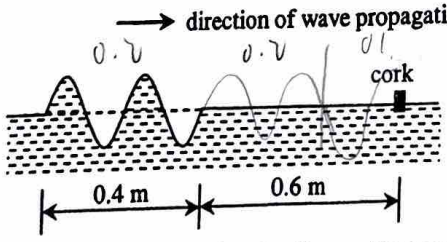
D.



22. A rocket of mass 5000 kg is at rest in space. It then explodes and breaks into two parts P_1 and P_2 of mass 1000 kg and 4000 kg respectively. Find the ratio of the kinetic energy of P_1 to that of P_2.

A. 1 : 16
B. 1 : 64
C. 4 : 1
D. 16 : 1

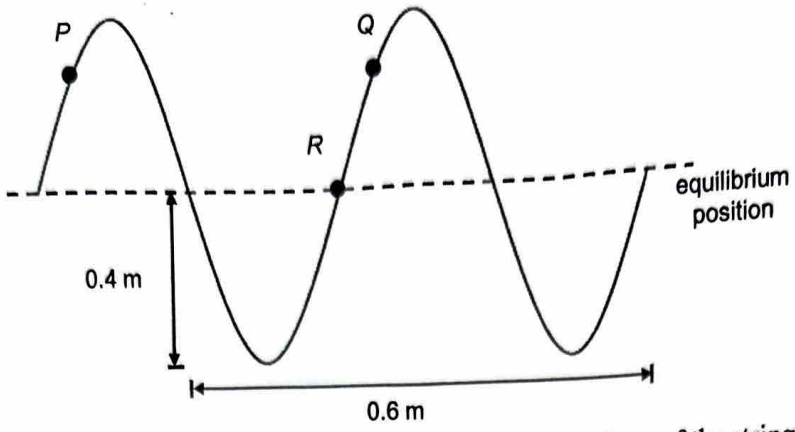
23.



A cork is floating on a calm water surface. At time t = 0, a water wave is travelling towards the cork with a speed of 0.2 ms^{-1} as shown in the figure above. When will the cork rise to its highest position for the first time ?

A. 3.00 s
B. 3.50 s
C. 3.75 s
D. 4.00 s

24.



A transverse wave travels along a string. The figure above shows the shape of the string and the positions of particles *P*, *Q* and *R* at a certain instant. Which of the following statements is **incorrect**?

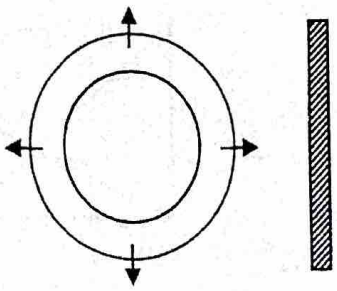
A. Particle R is at rest at the instant shown.

B. The motions of particles *P* and *Q* are in phase.

C. The wavelength of the wave is 0.4 m.

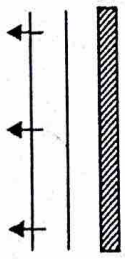
D. Amplitudes of vibrations of particles *P* and *R* are the same.

25.

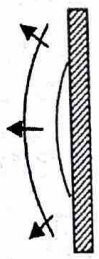


The above figure shows two circular pulses produced by drops of water falling on a ripple tank. The pulses are then reflected by a straight barrier. Which diagram best shows the reflected pulses ?

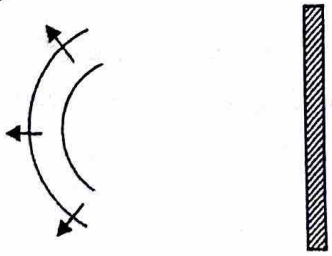
A.



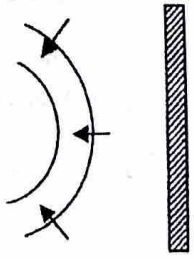
B.



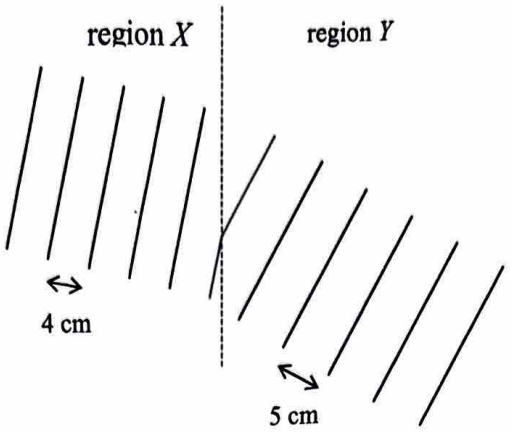
C.



D.



26. The figure shows plane water waves travelling from region X to region Y. The wavelengths of the water waves in regions X and Y are 4 cm and 5 cm respectively.



Which of the following statements is correct ?

A. The speed of the water waves in region X is higher than that in region Y.

B. The direction of travel of the water waves bends towards the normal as they enter region Y.

C. The frequency of the water waves is the same in both regions.

D. If plane water waves of wavelength 5 cm travel from region Y to region X, the wavelength becomes 6 cm after the waves enter region X.

END OF SECTION A