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North Western Province  
අනාවරණ පරීක්ෂණය - 2024  
Diagnosis Test - 2024

Physics - I

Grade 13 Term II

01 E I

Time: two hours

**Important :**

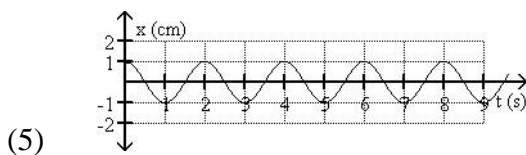
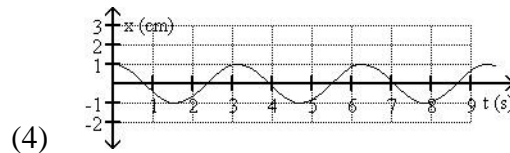
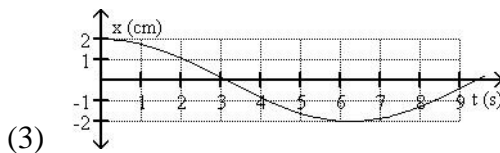
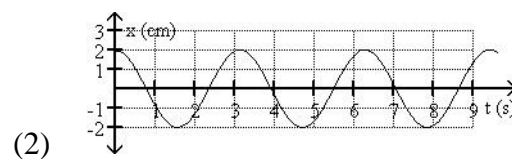
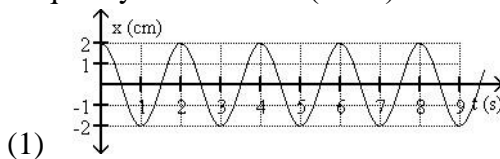
- \* This question paper consists of **50** questions in **10** pages.
- \* Answer **all** the questions.
- \* Write your **index number** in the space provided in the answer sheet.
- \* In each of the question **1** to **50** pick one of the alternatives from (1), (2), (3), (4), (5) which is **correct** or **most appropriate** and **mark your response on the answer sheet with a cross (X)** on the number of the correct option in accordance with the instructions given on the back of the answer sheet.

Name/indx number : .....

**Use of calculators is not allowed.**  
**(  $g = 10 \text{ m s}^{-2}$  )**

- Which of the following does not represent a fundamental unit in the SI system?  
(1) A                      (2) C                      (3) kg                      (4) s                      (5) K
- A gas has a pressure  $P$ , volume  $V$  and temperature 300 K. The pressure is doubled at constant volume and then the volume is reduced to one quarter at constant pressure. The final temperature of the gas is  
(1) 600 K                      (2) 450K                      (3) 300 K                      (4) 250 K                      (5) 150K
- Which of the following pairs of physical quantities have the same units?  
(1) Pressure and force                      (2) Energy and power  
(3) Velocity and acceleration                      (4) Impulse and momentum  
(5) Charge and voltage
- Two spheres of masses  $M$  and  $2M$  are initially at rest at a distance  $R$  apart. Due to mutual force of attraction they approach each other. When they are at separation  $\frac{R}{2}$ , the acceleration of their centre of mass would be  
(1) Zero                      (2)  $g$                       (3)  $\frac{g}{2}$                       (4)  $\frac{2M}{3}g$                       (5)  $Mg$
- Consider the following statements made about a transformer:  
(A) The efficiency of a transformer improves with a higher load resistance.  
(B) Transformers are used to increase or decrease AC voltage levels but not DC voltage levels.  
(C) The core of a transformer is made from copper to minimize resistance.  
Of the above statements:  
(1) Only (A) is true.                      (2) Only (B) is true.                      (3) Only (A) and (B) are true.  
(4) Only (B) and (C) are true.                      (5) All (A), (B), and (C) are true.

6. A block of wood is floating on water at  $0^{\circ}\text{C}$  with a certain volume  $V$  above water level. The temperature of water is slowly raised to  $20^{\circ}\text{C}$ . How does the volume  $V$  change with the rise of temperature?
- (1) remain unchanged                      (2) decrease continuously  
 (3) increase continuously                (4) increase till  $4^{\circ}\text{C}$  and then decrease  
 (5) decrease till  $4^{\circ}\text{C}$  and then increase
7. A sphere, a cube, a cylinder and a thin circular disk, all having the same mass and made of the same material are heated to the same temperature and then allowed to cool. Which of them cools fastest?
- (1) sphere      (2) cube      (3) circular disk    (4) cylinder      (5) all at the same rate
8. Which relation correctly shows the relationship between the intensity of a sound wave and the vibrations of the molecules?
- (1) intensity  $\propto$  amplitude                (2) intensity  $\propto$  displacement  
 (3) intensity  $\propto$  (displacement) $^2$       (4) intensity  $\propto$  frequency  
 (5) intensity  $\propto$  (amplitude) $^2$
9. Which of following is a graph of simple periodic motion with amplitude  $2.00\text{ cm}$ , angular frequency  $2.00\text{ rad s}^{-1}$ ? ( $\pi = 3$ )



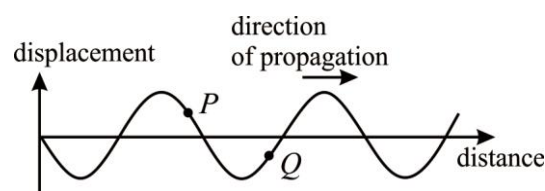
10. The r.m.s. speed of the molecules of a given mass of an ideal gas will increase by
- (A) increasing the pressure keeping the volume constant  
 (B) increasing the pressure keeping the temperature constant  
 (C) increasing the volume keeping pressure constant.

Of the above statements

- (1) only (A) is true                      (2) only (C) is true      (3) only (A) and (B) are true.  
 (4) only (A) and (C) are true        (5) only (B) and (C) are true

11. The given graph shows a particular instant of a transverse wave traveling from left to right on a rope. What is the direction of motion of points  $P$  and  $Q$ ?

	movement of $P$	movement of $Q$
(1)	downwards	downwards
(2)	downwards	upwards
(3)	upwards	upwards
(4)	upwards	no motion
(5)	upwards	downwards

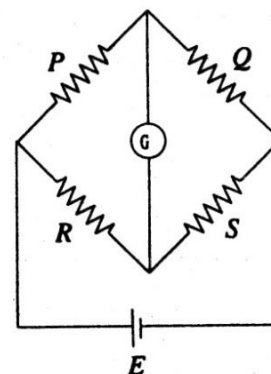


12. Wheatstone bridge shown in the diagram is balanced.

Consider the following statements.

The balance condition does not change when

- (A) the galvanometer  $G$  is replaced by another one with different resistance.  
 (B) the cell  $E$  is replaced by another one with different internal resistance.  
 (C) the resistances  $Q$  and  $R$  are interchanged.



Of the above statements

- (1) only (A) is true.                      (2) only (B) is true.                      (3) only (C) is true.  
 (4) only (A) and (B) are true.      (5) all (A), (B) and (C) are true.

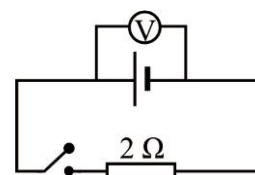
13. Two drones,  $X$  and  $Y$ , are flying horizontally towards each other at the same altitude. Drone  $X$  is moving with a velocity of  $8 \text{ m s}^{-1}$  to the right, and Drone  $Y$  is moving with a velocity of  $3 \text{ m s}^{-1}$  to the left.  $X$  is carrying a small ball, and  $Y$  is carrying a small cube. Both objects are dropped simultaneously from the drones when they are 100 meters apart. Assuming no air resistance, what is the relative velocity of the ball with respect to the cube during their free fall?

- (1) It is  $5 \text{ m s}^{-1}$  horizontally and does not remain constant until both hit the ground.  
 (2) It is  $11 \text{ m s}^{-1}$  horizontally and does not remain constant until both hit the ground.  
 (3) It is  $5 \text{ m s}^{-1}$  horizontally and remains constant until both hit the ground.  
 (4) It is  $11 \text{ m s}^{-1}$  horizontally and remains constant until both hit the ground.  
 (5) It is  $5 \text{ m s}^{-1}$  vertically and remains constant until both hit the ground.

14. The Earth may be assumed to be spherical with radius  $r$  and density  $\rho$ . Which equation correctly relates the gravitational field strength  $g$  at its surface to these quantities and the gravitational constant  $G$ ?

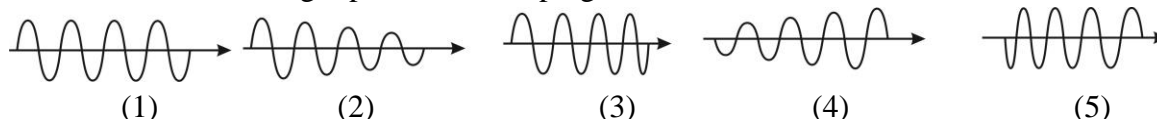
- (1)  $g = \frac{G\rho}{r^2}$       (2)  $g = \frac{4\pi\rho G}{3}$       (3)  $g = \frac{3G}{4\pi\rho}$       (4)  $g = \frac{4\pi^2\rho G}{3}$       (5)  $g = \frac{3\pi^2\rho G}{4}$

15. The given circuit diagram shows a battery connected in series with a  $2 \Omega$  resistor and a switch. A voltmeter is also connected across the battery. It reads  $12 \text{ V}$  when the switch is open and  $8 \text{ V}$  when it is closed. Which of the following is the internal resistance of the battery?



- (1)  $4 \Omega$                       (2)  $3 \Omega$                       (3)  $2 \Omega$                       (4)  $1 \Omega$                       (5)  $0.5 \Omega$

16. Which of the following represents a damping wave?

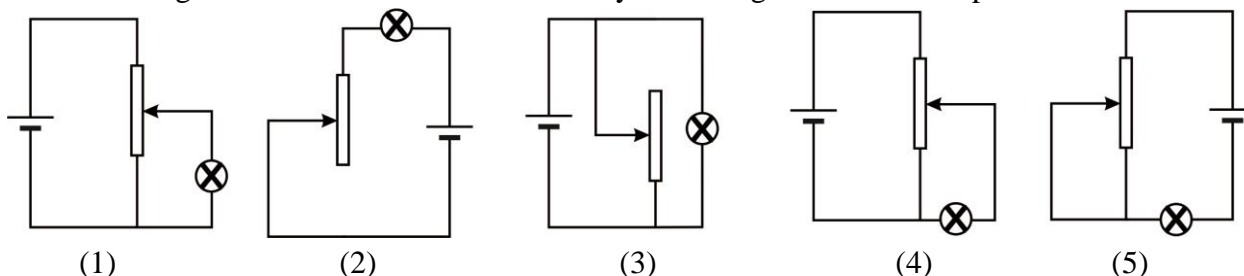


17. A progressive wave of frequency 500 Hz is travelling with a speed of  $350 \text{ m s}^{-1}$ . A compressional maximum appears at a place at a given instant. The minimum time interval after which a rarefactional maxima occurs at the same position is  
 (1) 0.004 s    (2) 0.0025 s    (3) 0.002 s    (4) 0.001 s    (5) 0.00125 s

18. The three lowest frequencies (in Hz) with which a 20 cm long pipe, closed at one end, can vibrate are (speed of sound =  $340 \text{ m s}^{-1}$ )  
 (1) 425, 850, 1275    (2) 425, 1275, 2125    (3) 900, 1800, 2700  
 (4) 900, 2700, 4500    (5) 450, 900, 1350

19. An illuminated needle of length 5 cm. placed 45 cm from a lens forms an image on a screen placed 90 cm on the other side of the lens. The type of lens, its focal length and the size of the image are  
 (1) convex, 30 cm, 10 cm    (2) convex, 15 cm, 10 cm    (3) convex, 60 cm, 5 cm  
 (4) concave, 30 cm, 5 cm    (5) concave, 30 cm, 20 cm

20. A power supply of negligible internal resistance is connected to a lamp. Which of the following circuits **could not** be used to vary the voltage across the lamp?



21. The tangent to the displacement - time graph of a particle moving with a constant acceleration makes an angle of  $45^\circ$  with the time axis at a certain instant. After one second it makes an angle of  $60^\circ$ . The acceleration of the particle is  
 (1)  $\sqrt{3} \text{ m s}^{-2}$     (2)  $(\sqrt{3} + 1) \text{ m s}^{-2}$     (3)  $(\sqrt{3} - 1) \text{ m s}^{-2}$   
 (4)  $\frac{\sqrt{3}}{2} \text{ m s}^{-2}$     (5)  $\frac{1}{\sqrt{3}} \text{ m s}^{-2}$

22. Which of the following statements is incorrect?

- (1) The resistance of an intrinsic semiconductor decreases with increasing temperature.  
 (2) A half-wave rectifier cannot produce a constant d.c. output voltage for a sinusoidal input.  
 (3) In a Metal-Oxide-Semiconductor Field-Effect Transistor (MOSFET), the source and drain regions are typically lightly doped.  
 (4) The base region in a bipolar junction transistor is lightly doped and thin compared to the emitter and collector regions.  
 (5) A closed-loop configuration is not suitable when it is used as a switch.

23. It is observed that readings of a mercury thermometer calibrated in cm, reads 7.6 cm in melting ice, 22.6 cm in steam and 3.4 cm in a freezing liquid. Then the temperature of the freezing mixture is

(1)  $-7^{\circ}\text{C}$       (2)  $-14^{\circ}\text{C}$       (3)  $-28^{\circ}\text{C}$       (4)  $-32^{\circ}\text{C}$       (5)  $-56^{\circ}\text{C}$

24. A beam of monochromatic light is incident on a glass prism placed in air. Consider the following statements about the dispersion of light through the prism.

(A) The angle of deviation increases as the refractive index of the prism material increases.

(B) The angle of deviation initially decreases and then increases as the angle of incidence is gradually increased.

(C) The angle of deviation increases with the increase in the angle of the prism.

Of the above statements:

(1) Only (A) is true.

(2) Only (A) and (B) are true.

(3) Only (A) and (C) are true.

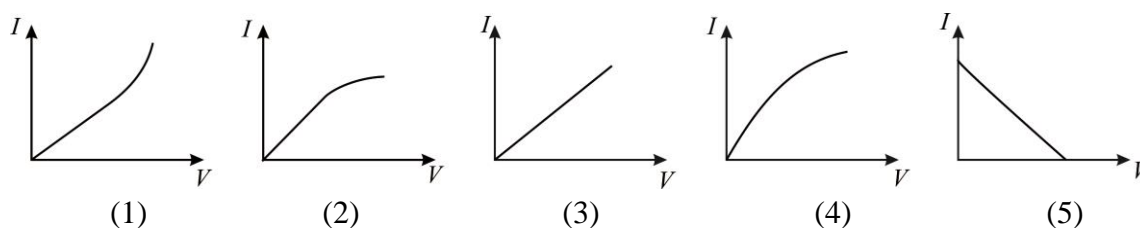
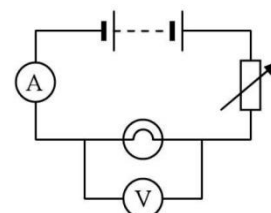
(4) Only (B) and (C) are true.

(5) All (A), (B), and (C) are true.

25. Rotating disk with a moment of inertia of  $0.6 \text{ kg m}^2$  is spinning with a constant angular velocity of  $15 \text{ rad s}^{-1}$ . A braking force is applied, causing the disk to decelerate uniformly. If the braking force exerts a power of  $90 \text{ W}$  to bring the disk to a stop, what is the angular deceleration of the disk?

(1)  $3 \text{ rad s}^{-2}$       (2)  $5 \text{ rad s}^{-2}$       (3)  $10 \text{ rad s}^{-2}$       (4)  $15 \text{ rad s}^{-2}$       (5)  $20 \text{ rad s}^{-2}$

26. A metal filament lamp is connected in series with a battery, an ammeter and a variable resistor, as shown. There is also a high resistance voltmeter connected across the lamp. Which of the following graphs correctly shows the variation of the current  $I$  through the lamp with the potential difference  $V$  across it?

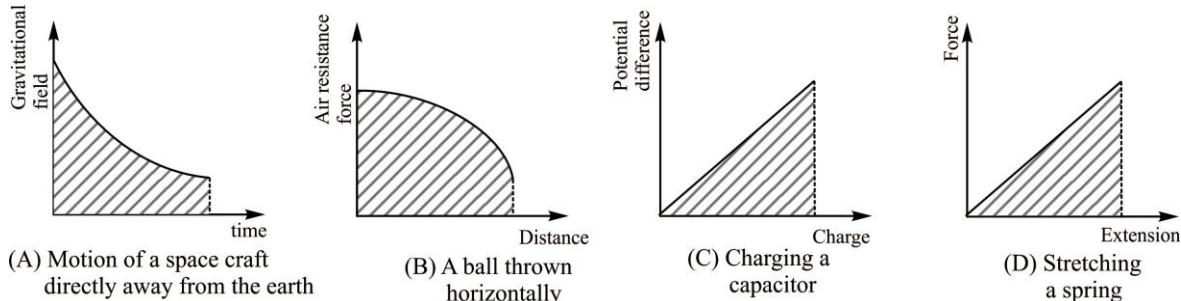


27. Two identical open pipes, each of length  $40 \text{ cm}$ , are sounded with their fundamental notes at  $20^{\circ}\text{C}$ . The variation of the velocity of sound  $v$  (in  $\text{m s}^{-1}$ ) in air with temperature is given by  $v = 331 + 0.6\theta$  where  $\theta$  is the temperature in  $^{\circ}\text{C}$ . If the temperature of one pipe is increased to  $40^{\circ}\text{C}$ , how many beats per second are produced?

(1) 2      (2) 4      (3) 8      (4) 10      (5) 15

28. A boy on a bicycle approaches a brick wall as he sounds his horn at a frequency 400 Hz. The sound he hears reflected back from the wall is at a frequency 408 Hz. At what speed does the boy riding his bicycle toward the wall? Assume the speed of sound in air is  $340 \text{ m s}^{-1}$ .  
 (1)  $3.68 \text{ m s}^{-1}$ . (2)  $333 \text{ m s}^{-1}$ . (3)  $6.67 \text{ m s}^{-1}$ . (4)  $6.80 \text{ m s}^{-1}$ . (5)  $3.37 \text{ m s}^{-1}$ .

29. Results obtained from four different experiments are represented by the graphs below. Which graph units of energy for the shaded area under its curve?



- (1) Only (A) and (C) (2) Only (A) and (D) (3) Only (A), (C) and (D)  
 (4) Only (A), (B) and (D) (5) Only (B), (C) and (D)
30. Which of the following equations is/are based on the principle of conservation of energy? (all the symbols have their usual meanings)

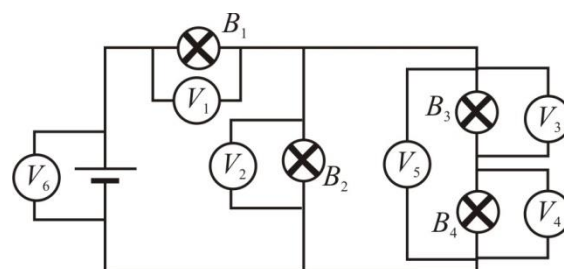
(A)  $m_1 u_1 + m_2 u_2 = m_1 v_1 + m_2 v_2$

(B)  $\Delta U = \Delta Q + \Delta W$

(C)  $p + \rho gh + \frac{1}{2} \rho v^2 = \text{constant}$

- (1) (C) only (2) (A) and (B) only (3) (B) and (C) only  
 (4) (A) and (C) (5) (A), (B) and (C)

31. In the circuit below  $B_1$ ,  $B_2$ ,  $B_3$ , and  $B_4$  are identical lightbulbs. There are six ideal voltmeters connected to the circuit as shown. All voltmeters are connected so that they display positive voltages.



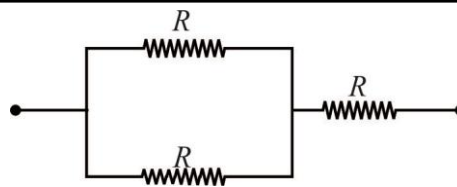
If  $B_2$  were to burn out, opening the circuit, which voltmeter(s) would read zero volts?

- (1) Only  $V_2$  (2) Only  $V_3$  and  $V_4$  (3) Only  $V_3$ ,  $V_4$  and  $V_5$   
 (4) all of them would read zero (5) non would read zero.
32. A projectile is launched vertically upward from the ground. The total time it takes for the projectile to return to the ground is 10 seconds. Above which height above the ground does the projectile spend only duration of 2 seconds? (Neglect air resistance)

- (1) 125 m (2) 120 m (3) 110 m (4) 100 m (5) 50 m
33. A 10 km long underground cable XY consists of two parallel conducting wires of the same dimensions and are separated from each other. A short circuit has occurred between the two wires at a single point inside the cable. In a test conducted to find the faulty position, the measured resistance between the two wires at end X of the cable was found to be  $4 \text{ k}\Omega$ , while the same measurement done at end Y of the cable gave  $6 \text{ k}\Omega$ . The distance to the faulty position from the end X of the cable is:

- (1) 2.50 km (2) 3.75 km (3) 4.00 km (4) 5.00 km (5) 6.25 km

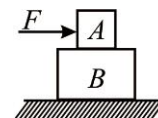
34. The maximum power dissipation allowed for a certain resistor is 4 W. If three such resistors are connected as shown, what is the maximum power dissipated in this combination without damaging any of the resistors?



- (1) 4 W      (2) 6 W      (3) 8 W      (4) 9 W      (5) 10 W
35. Two adjacent rooms *A* and *B* at the same temperature, connected by a closed door are initially at relative humidity (RH) 50% and 80% respectively. The volume of room *A* is three times that of room *B*. If the door is kept open for a long time at the same temperature, what would be the final relative humidity of the rooms?
- (1) 72.5 %      (2) 65 %      (3) 62.5 %      (4) 57.5 %      (5) 55%
36. A body of mass 20 kg mass is placed 4 m above the Earth's surface. What are the gravitational field strength and gravitational force acting on the body?

	Gravitational field strength ( $\text{N kg}^{-1}$ )	Gravitational force. (N)
(1)	05	10
(2)	10	20
(3)	10	200
(4)	20	200
(5)	20	100

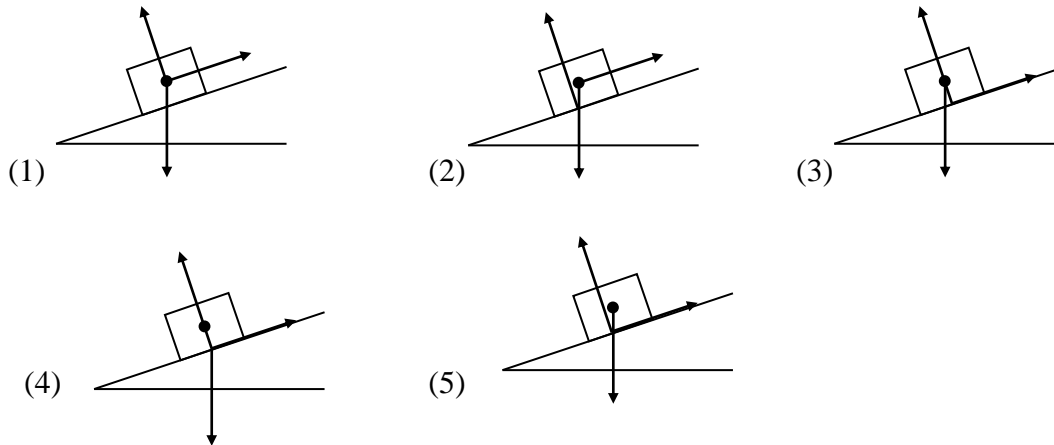
37. Two blocks *A* and *B* are placed on a horizontal table surface as shown. A horizontal force  $F$  is applied to *A* but the system remains stationary. Which of the following statements is/are correct regarding this?



- (A) The frictional force acting on *A* by *B* is towards the left.
- (B) The frictional force acting on *B* by the table surface is greater than  $F$ .
- (C) The system would remain stationary if  $F$  is applied to *B* instead.
- (1) (A) only      (2) (B) only      (3) (C) only
- (4) (A) and (B) only      (5) (A) and (C) only
38. A compound microscope in normal adjustment has a total magnifying power of 150. The focal length of the objective lens is 3.0 cm, and the object distance is 3.2 cm. What is the magnification of the eyepiece?
- (1) 6      (2) 10      (3) 15      (4) 20      (5) 25



39. A block rests on a rough inclined plane. Which of the following diagrams correctly shows the lines of application of all the forces acting on the block? (The dot • represents the center of mass of the block.)



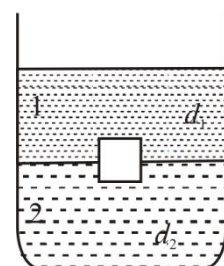
40. A 60 W bulb takes 150 ms to reach its full brightness when connected across a constant voltage supply of 220 V.

Consider the following statements:

- (A) During the 150 ms period, the resistance of the filament increases.  
 (B) During the 150 ms period, the power drawn from the supply decreases to 60 W, starting from a higher value.  
 (C) The filament emits energy primarily in the form of visible light.

Of the above statements:

- (1) Only (A) is true. (2) Only (A) and (B) are true.  
 (3) Only (A) and (C) are true. (4) Only (B) and (C) are true.  
 (5) All (A), (B), and (C) are true.
41. A cylindrical block of density  $d$  stays fully immersed in a beaker filled with two immiscible liquids of different densities  $d_1$  and  $d_2$ . The block is in equilibrium with half of it in liquid 1 and the other half in liquid 2 as shown in the figure. If the block is given a displacement downwards and released, then (neglect any other forces)



Consider following statements

- (A) it executes simple harmonic motion only if its horizontal faces do not cross the interface.  
 (B) The displacement of the centre of the cylinder is symmetric about its equilibrium position  
 (C) If it executes simple harmonic motion, the period is independent of the size of the block.

Of the above statements

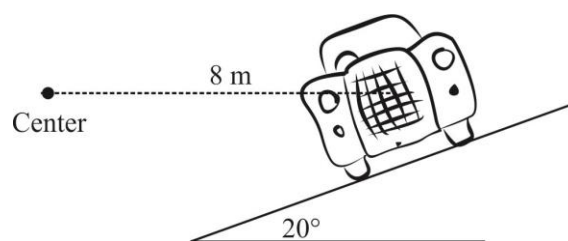
- (1) only (A) is true (2) only (B) is true (3) only (A) and (B) are true  
 (4) only (A) and (C) are true (5) all (A), (B) and (C) are true



42. A guitar string is supposed to have a fundamental frequency 256 Hz. It currently has a fundamental frequency 248 Hz. What percentage increase in tension is required to bring the guitar string into tune?

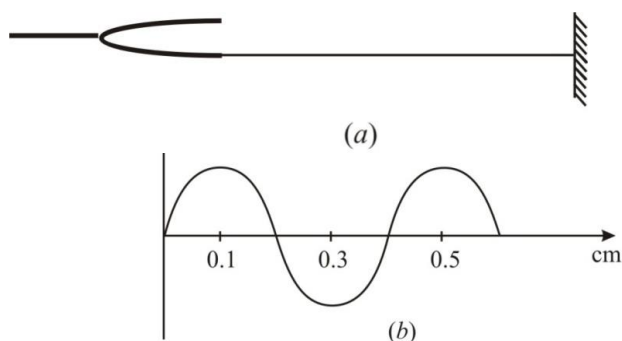
(1) 3.13%      (2) 6.56%      (3) 1.60%      (4) 7.15%      (5) 3.23%

43. The figure shows a car moving round a corner with a radius of 8 m on a banked road of inclination  $20^\circ$ . At what speed would there be no friction acting on the car along OA? (take  $\tan 20 \approx 0.3645$ )



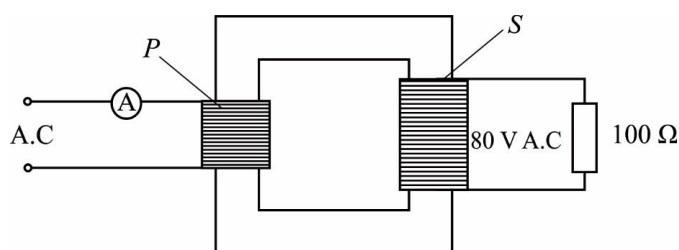
(1) 5.0 m/s      (2) 5.2 m/s      (3) 5.4 m/s      (4) 5.6 m/s      (5) 5.8 m/s

44. A string is connected to tuning fork of frequency 250 Hz as shown in the figure (a). The wave on the string is shown in the figure (b). The speed of the wave on the string is



(1)  $1.0 \text{ m s}^{-1}$       (2)  $1.5 \text{ m s}^{-1}$   
(3)  $2.0 \text{ m s}^{-1}$       (4)  $2.5 \text{ m s}^{-1}$   
(5)  $3 \text{ m s}^{-1}$

45. A sinusoidal a.c. supply is connected to the primary  $P$  coil of an ideal transformer as shown in the figure. Its primary coil  $P$  contain 200 turns and the secondary  $S$  coil contain 1000 turns. What is the reading of the ammeter?



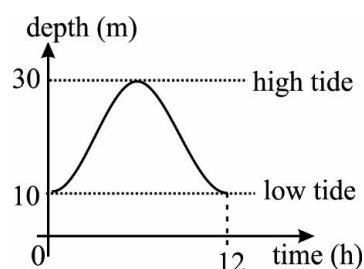
(1) 0.4 A      (2) 0.8 A      (3) 1.6 A      (4) 4.0      (5) 16.0 A

46. Let the specific heat capacities of ice and water be  $2.0 \times 10^3 \text{ J kg}^{-1} \text{ }^\circ\text{C}^{-1}$  and  $4.0 \times 10^3 \text{ J kg}^{-1} \text{ }^\circ\text{C}^{-1}$  respectively, and the specific latent heat of fusion of ice be  $3.4 \times 10^5 \text{ J kg}^{-1}$ .

If the heat exchange with the surrounding is **not neglected**, what is the **best suitable maximum** mass of ice that you can select out of the following masses? Assume that the heat capacity of the container is negligible.

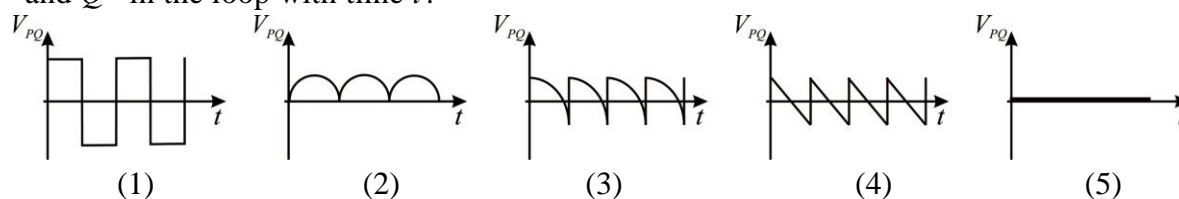
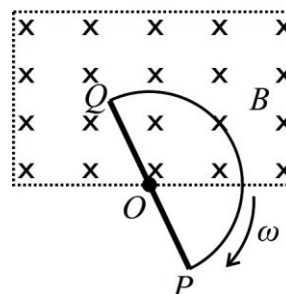
(1) 300 g      (2) 340 g      (3) 398 g      (4) 400 g      (5) 405 g

47. The depth of water in a harbor varies in a simple harmonic manner between 10.0 m at low tide and 30 m at high tide as shown in the graph. The duration between successive low tide is 12 hours. Certain cargo ship requires a minimum depth of water of 15 m to enter the harbor. If this ship approaches the harbor right at the low tide, minimum time it has to wait outside the harbor before entering?



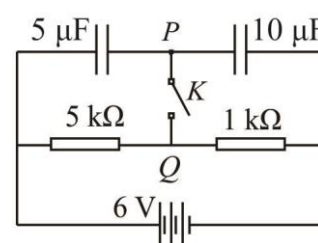
- (1) 0.5 h      (2) 1.0 h      (3) 1.5 h      (4) 2.0 h      (5) 3.0 h
48. Which of the following statements regarding electric fields and electric potential is correct?
- (1) The electric field is always directed from regions of lower electric potential to regions of higher electric potential.
  - (2) If the electric potential is constant throughout a region, the electric field must be zero in that region.
  - (3) A non-zero electric field implies that the electric potential is non-zero.
  - (4) If the electric field is zero at a point, then the electric potential at that point must be at its maximum.
  - (5) The electric field intensity is proportional to the rate of change of electric potential in a given direction.

49. A uniform magnetic field is directed perpendicularly into the plane of the paper everywhere within a rectangular region as shown. A **semi circular** conducting wire is connected with a plastic rod  $PQ$  as shown in the figure. The loop is rotated clockwise with a constant angular velocity in the plane of the paper about an axis perpendicular to the paper and passing through  $O$  the center of plastic rod  $PQ$ . Which of the following graphs best represents the variation of the potential difference between  $P$  and  $Q$  in the loop with time  $t$ ?



50. In the circuit, the battery has constant e.m.f. 6 V and negligible internal resistance. Initially switch  $K$  is open. Switch  $K$  is then closed and after some time a steady state is reached. The charges passing switch  $K$  during this time interval and the direction should be

- (1)  $+15 \mu\text{C}$ , from  $P$  to  $Q$ .      (2)  $+15 \mu\text{C}$ , from  $Q$  to  $P$ .  
 (3)  $+35 \mu\text{C}$ , from  $P$  to  $Q$ .      (4)  $+35 \mu\text{C}$ , from  $Q$  to  $P$ .  
 (5)  $+25 \mu\text{C}$ , from  $Q$  to  $P$ .



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