

Physics First Paper (Creative)

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Time: 2Hrs 35 min

Full marks: 50

[Read the following stems and answer any five of the following questions:]

1. ►

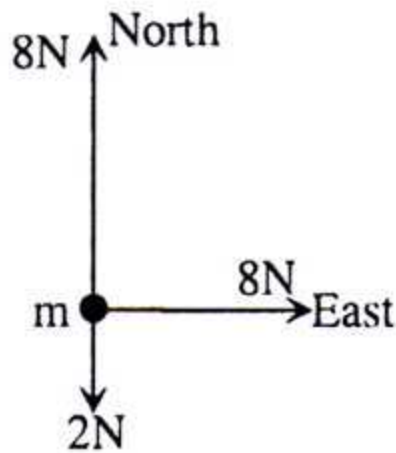


Figure-1

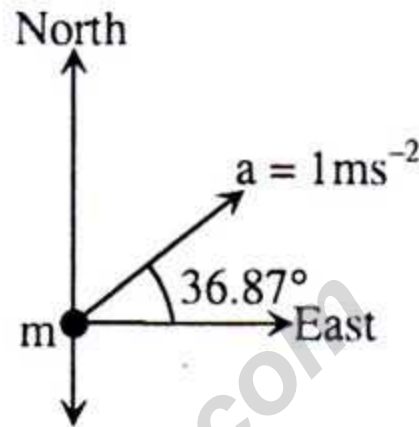


Figure-2

At the same time, three forces are acting on a body of mass ($m=10\text{kg}$) which is shown in the figure : 1.

- a. What is called angular velocity? 1
- b. Though force and displacement are vector quantities, work is derived from them is a scalar quantity — Explain. 2
- c. What is the magnitude of net force acting on the body of figure-1? 3
- d. Justify the validity of figure-2 with respect to figure-1. 4

2. ★ In a cricket field of average radius 66m, team 'A' is doing fielding and B is doing batting. A batsman hits the ball at an angle of 30° with the horizontal when a bowler bowls a ball with a velocity 100kmh^{-1} towards the batsman. As a result the ball gains the equal velocity of the ball when struck bowler. A fielder at a position just 20m away from the corresponding batsman starts running towards just after the ball was batted with a velocity 10ms^{-1} .

- a. What is surface energy? 1

- b. How will a passenger of a bus determine the average velocity of the running bus using the kilometer stones by the sides of the road and a hand watch with him? — Explain. 2
- c. What is the maximum height reached the ball in the stem? 3
- d. Give your opinion whether the batsman could be 'caught out' in the event of the stem. 4
- 3. ►** Apu can ride his bicycle around a circular field of radius 20m safely when he is inclined to the centre of the field with an angle up to the maximum value of 30° . He was riding at 20kmh^{-1} .
- a. What is torque? 1
- b. Fictional force is a non conservative force— Explain. 2
- c. How many times are needed to move around the field in crossing the circular path of 5 km? 3
- d. Apu will be able to cross the path safely at a double speed as mentioned in the stem. Justify. 4
- 4. ★** There is a baby in a family dwelling in an apartment of top floor of a 10 storied building of height 5 m of each floor. A tennis ball of mass 100g released by the baby through the grill of the balcony hits the ground after few moments.
- a. What is radius of gyration? 1
- b. Explain the causes of creasing elastic fatigue of a body. 2
- c. After how many time will the tennis ball as mentioned in the stem hit the ground? 3
- d. Determining the total energy of the ball at 7th and 4th floors of the building by using the data in the stem will obey the conservation of energy — give your opinion verifying the truth of this statement. 4
- 5. ►** Two tuning forks A and B are taken to produce 5 beats per second. The intensity of sound created by the tuning fork A is $1.01 \times 10^5 \text{ Wm}^{-2}$ and amplitude is 0.02m. The frequency of the tuning fork B is 161 Hz (density of the medium is 1.25kgm^{-3} and velocity of sound as 350ms^{-1})

- a. What is called resonance? 1
- b. Write down the difference between the light wave and sound wave? 2
- c. Determine the distance travelled by the sound when the tuning fork 'B' makes 250 complete vibration. 3
- d. What change in tuning fork 'A' should be made to produce beats mentioned in the stem — give your opinion through mathematical analysis. 4
6. ► An object of 5kg mass is thrown from the earth's surface by escape velocity to another planet of the space whose mass is 16 times of the earth and the diameter is 8 times of the earth radius (earth's mass 6×10^{24} kg, earth's radius = 6.4×10^3 km).
- a. Write down the work energy theorem. 1
- b. The power of a machine is 50 MW — Explain. 2
- c. Determine the value of gravitational acceleration on the surface of other planet as mentioned in the stem. 3
- d. Will the required escape velocity of the body when its mass is half of the mass as mentioned in the stem is thrown from the another planet be the same as the escape velocity at the earth's surface? Give your opinion through mathematical analysis. 4
7. ★ Each of two masses having 0.05kg is attached at the free ends of each of two wires with the same length of 1m and of same element suspended from firm support. The diameters of the wires are respectively 2mm and 4mm (young's modulus = 2×10^{11} Nm⁻²).
- a. What is called viscosity? 1
- b. Why is drop of rain spherical? 2
- c. Determine the potential energy per unit volume of the first wire. 3
- d. Which one will move slowly if each of the suspended wires with the attached mass behaves as simple pendulum? — Explain with mathematical analysis. 4

8. ► The volume of an air bubble becomes double when it comes at the surface of a lake at the location A from its bottom. In the lake the pressure of air is 10^3 Nm^{-2} , the temperature of air is 18.6°C and the relative humidity is 52.4%. On the other day, in a lake of another location B, the temperature of air is equal to that of the lake of the location A and the dew point is 7.4°C . At temperature 7°C , 8°C , 15°C and 19°C the saturated vapour pressures are respectively $7.5 \times 10^3 \text{ m}$, $8.2 \times 10^3 \text{ m}$, $15.6 \times 10^3 \text{ m}$ and $16.5 \times 10^3 \text{ m}$ mercury.

- What is standard pressure? 1
- Clothes are dried out in rainy season slower than that in winter. — Explain 2
- Determine the depth of the lake at the location A. 3
- At what place as mentioned in the stem will a man feel more comfort? Explain with mathematical analysis. 4

1. When a spring is compressed, what form of energy does it possess?

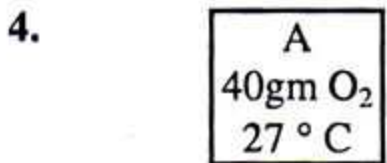
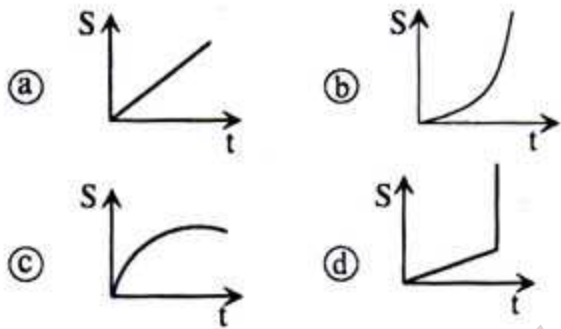
- (a) Heat energy
- (b) Kinetic energy
- (c) Potential energy
- (d) Internal energy

2. The acceleration due to gravity on the earth, at a height (h) above the earth and at a depth (h) from the earth are g , g_h and g_{bh} respectively. Then —

- (a) $g_{bh} < g_h < g$
- (b) $g_h < g_{bh} < g$
- (c) $g_h > g_{bh} > g$
- (d) $g_h > g > g_{bh}$

N.B: The value of g is maximum at the surface of the Earth. If the value of h is less than 3955.4175 km, the value of g is greater at more depth than at a higher place. If $h = 3955.4175$ km, then g 's value is equal everywhere. If $h > 3955.4175$ km, then the value of g is greater at a higher place.

3. Which graph (distance s VS time t) below is not possible?



$R = 8.31JK^{-1} \text{ mole}^{-1}$, atomic mass of $O_2 = 32gm$

According to the diagram the total kinetic energy of the gas in the container A is —

- (a) $33.65 \times 10J$
- (b) $42.07 \times 10J$
- (c) 37.39×10^2J
- (d) 46.74×10^2J

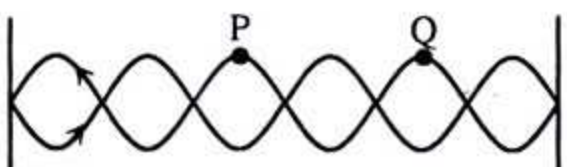
5. If the least constant of a spherometer is 0.02 mm, which of the following thickness can be measured accurately?

- (a) 0.005 mm
- (b) 0.001 mm
- (c) 0.01 mm
- (d) 0.03 mm

[N.B. None of them can be accurately measured as none of them are simple multiples of least constant.]

Read the stem below and answer questions no. 6 and 7:

$y = 0.6 \sin 0.12x \cos 24t$ is the equation of a standing wave, which is represented by the diagram below. x and y are given in meter units.



6. The velocity of the waves producing the standing wave is —

- (a) $100ms^{-1}$
- (b) $200ms^{-1}$
- (c) $300ms^{-1}$
- (d) $400ms^{-1}$

7. If the wavelength of the wave is λ —

- (a) $PQ = \frac{\lambda}{2}$
- (b) $PQ = \frac{3\lambda}{4}$
- (c) $PQ = \lambda$
- (d) $PQ = \frac{5\lambda}{4}$

8. The Gravitational constant $G = ?$

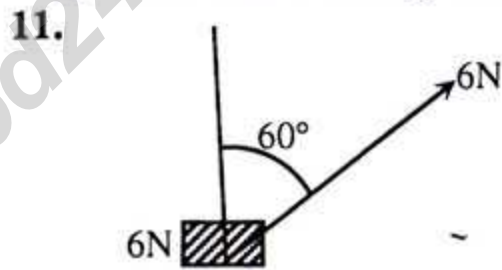
- (a) $66.7 \times 10^{-12}NmKg^{-2}$
- (b) $6.67 \times 10^{-11}Nm^{-2}Kg^{-2}$
- (c) $0.667 \times 10^{-10}Nm^2Kg^{-2}$
- (d) $0.0667 \times 10^{-9}Nm^{-2}Kg^2$

9. Which quantity is conserved in inelastic collisions?

- (a) Kinetic energy
- (b) Potential energy
- (c) Angular momentum
- (d) Momentum

10. Which one below is an example of oscillatory motion?

- (a) Motion of the hand of a clock
- (b) Motion of the earth around the sun
- (c) Motion of an electric fan
- (d) Motion of a tuning fork



A body of weight 6N is being pulled by a force of 6N according to the diagram. The apparent weight of the body is —

- (a) 0.8N
- (b) 3N
- (c) 9N
- (d) 11.2N

12. The area of cross section and breaking mass of a wire are $1mm^2$ and $40kg$ respectively. The breaking stress of the wire is —

- (a) $4 \times 10^{-6}Nm^{-2}$
- (b) $3.92 \times 10^{-4}Nm^{-2}$
- (c) $4 \times 10^7 Nm^{-2}$
- (d) $3.92 \times 10^8 Nm^{-2}$

Read the stem and answer questions no. 13 and 14 :

The length of the second hand of a clock is 3cm.

13. The linear velocity of the edge of the second hand is —

- (a) $3.14ms^{-1}$
- (b) $3.14 \times 10^{-1}ms^{-1}$
- (c) $3.14 \times 10^{-2}ms^{-1}$
- (d) $3.14 \times 10^{-3}ms^{-1}$

14. The second hand's —

- i. time period is 1 minute
- ii. frequency is $1.6 \times 10^{-3} Hz$
- iii. angular velocity is 0.1046 rad/sec

- Which one is correct?
- (a) i and ii
 - (b) ii and iii
 - (c) i and iii
 - (d) i, ii and iii

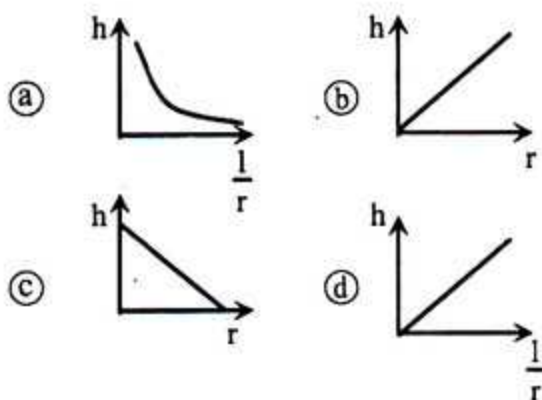
15. **★** Which of the following are always constant within elastic limit?

- i. $\frac{\text{Stress}}{\text{Strain}}$
- ii. $\frac{\text{Lateral strain}}{\text{Longitudinal strain}}$
- iii. $\frac{\text{Force}}{\text{Area}}$

Which one is correct?

- (a) i and ii
- (b) i and iii
- (c) ii and iii
- (d) i, ii and iii

16. Which graph below, drawn between the height of water (h) in the capillary tube and the radius of the tube (r) in a particular place, is correct?



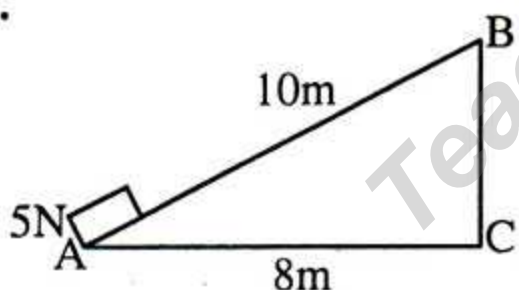
17. In the case of gravitational potential —

- i. it is a scalar quantity
- ii. it is negative at any point in the gravitational field
- iii. its dimension is L^2T^{-2}

Which one is correct?

- (a) i and ii
- (b) ii and iii
- (c) i and iii
- (d) i, ii and iii

18.



According to the diagram the power needed to take a block of weight 5N from A to B in 10 seconds is —

- (a) 3W
- (b) 4W
- (c) 5W
- (d) 6W

19. In the case of unsaturated vapour —

- i. it can be created in any open or closed space
- ii. it can be converted to saturated vapour by increasing the temperature
- iii. it obeys Boyle's and Charles's law

Which one is correct?

- (a) i and ii
- (b) ii and iii
- (c) i and iii
- (d) i, ii and iii

20. The unit vector perpendicular to

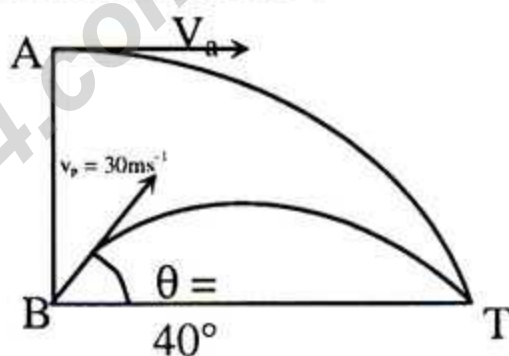
the plane formed by the vectors \vec{M} and \vec{N} is —

- (a) $\frac{\vec{M} \times \vec{N}}{|\vec{M} \times \vec{N}|}$
- (b) $\frac{\vec{M} \cdot \vec{N}}{|\vec{M} \times \vec{N}|}$
- (c) $\frac{\vec{M} \times \vec{N}}{|\vec{M} \cdot \vec{N}|}$
- (d) $\frac{|\vec{M} \times \vec{N}|}{\vec{M} \times \vec{N}}$

21. Which quantity below has the maximum value at the equilibrium position of a simple pendulum?

- (a) Acceleration
- (b) Displacement
- (c) Velocity
- (d) Restoring force

Read the stem below and answer question no. 22 and 23 :



Two objects are thrown from the points A and B, according to the diagram.

22. The vertical component of velocity of the object, after 1 sec of being thrown from B is —

- (a) 9.48 ms^{-1}
- (b) 16.18 ms^{-1}
- (c) 19.28 ms^{-1}
- (d) 25.98 ms^{-1}

23. If the two objects take the same time which hitting the target T then —

- (a) $v_a = v_b \cos\theta$
- (b) $v_b = v_a \sin\theta$
- (c) $v_a = v_b \sin\theta$
- (d) $v_b = v_a \cos\theta$

24. **★** The mean free path of a gas is inversely proportional to —

- (a) the density of the gas
- (b) the atomic diameter of the gas atom
- (c) the square of the number of atoms per unit volume
- (d) the distance travelled by the atom

25. Forced vibration is not resonance if the waves producing the forced vibration do not have the same —

- (a) frequency
- (b) amplitude
- (c) wave velocity
- (d) wavelength

Ans	1	(c)	2	*	3	(d)	4	(d)	5	*	6	(b)	7	(c)	8	(c)	9	(d)	10	(d)	11	(b)	12	(d)	13	(d)
	14	(c)	15	(a)	16	(d)	17	(d)	18	(a)	19	(c)	20	(a)	21	(c)	22	(a)	23	(a)	24	(a)	25	(a)		