

The truck and motorcycle meet when they have covered the same distance: $v_{\text{truck}}t = \frac{1}{2}at^2 \Rightarrow 20t = t^2$, which gives $t = 20$ s. The speed of the motorcycle at this moment is $v = at = (2 \text{ m/s}^2)(20 \text{ s}) = 40 \text{ m/s}$.

11. Which one of the following statements is CORRECT about two dimensional motions? (1)
- A. The acceleration in a uniformly circular motion is constant.
- B. ✓ **In a projectile motion the vertical and horizontal parts of its motion are independent of each other.**
- C. The maximum range of projectiles can be achieved at an angle of 90° .
- D. The velocity of a vertical circular motion is maximum at the top of the vertical circle.

Answer: B

In projectile motion, the horizontal motion (with constant velocity) and vertical motion (with constant acceleration due to gravity) are completely independent of each other except for sharing the same time of flight.

12. A man of mass 80 kg stands on a balance inside an elevator. If the balance reads 900 N, the elevator is (1)
- A. ascending with constant velocity. B. descending with constant velocity.
- C. ✓ **ascending with constant acceleration.** D. descending with constant acceleration.

Answer: C

The actual weight of the man is $W = mg = 800 \text{ N}$. Since the scale reads 900 N, the net force on the man is 100 N upward ($N - W = ma$), meaning he is accelerating upward, which corresponds to ascending with increasing speed (constant upward acceleration).

13. A 32 kg big fish moving with 10 m/s to the east swallows a small 4 kg fish moving with a speed of 5 m/s to the west. The velocity of the big fish after impact is (1)
- A. ✓ **8.3 m/s, east** B. 10 m/s, east
- C. 10 m/s, west D. 8.3 m/s, west

Answer: A

Using the conservation of momentum: $m_1 v_1 + m_2 v_2 = (m_1 + m_2) V_f$. Taking east as positive, $(32)(10) + (4)(-5) = 36 V_f \implies 300 = 36 V_f \implies V_f \approx 8.3 \text{ m/s}$ towards the east.

14. A 10 kg object moving with a velocity of $(6\mathbf{i})$ m/s explodes into two equal fragments. One flies off with a velocity $(2\mathbf{i} - \mathbf{j})$ m/s. What is the velocity of the other fragment? (1)
- A. $(3\mathbf{i} + 5\mathbf{j})$ m/s B. $(-3\mathbf{i} - 5\mathbf{j})$ m/s
- C. ✓ **$(10\mathbf{i} + \mathbf{j})$ m/s** D. $(6\mathbf{i} - 5\mathbf{j})$ m/s

Answer: C

By conservation of momentum, $M\vec{V} = m_1\vec{v}_1 + m_2\vec{v}_2$. Since $m_1 = m_2 = 5 \text{ kg}$, we have $10(6\hat{i}) = 5(2\hat{i} - \hat{j}) + 5\vec{v}_2$, which simplifies to $12\hat{i} = 2\hat{i} - \hat{j} + \vec{v}_2 \implies \vec{v}_2 = 10\hat{i} + \hat{j} \text{ m/s}$.

15. What should be the coefficient of static friction at the pavement of a flat road for a car moving with a maximum speed of 15 m/s in a circle of radius 45 m to make turns safely? (1)
- A. 0.2 B. 0.3
- C. 0.4 D. ✓ **0.5**

Answer: D

For a car turning safely on a flat circular road, the centripetal force is supplied by static friction: $\mu_s g \geq \frac{v^2}{R} \implies \mu_s \geq \frac{15^2}{10 \times 45} = \frac{225}{450} = 0.5$.

16. The dimension of energy is (1)
- A. ✓ ML^2T^{-2} B. MLT^{-2}
C. ML^2T^{-3} D. MLT^{-3}

Answer: A

Energy has the same dimension as work, which is force multiplied by displacement. Since the dimension of force is MLT^{-2} , the dimension of energy is $(MLT^{-2})(L) = ML^2T^{-2}$.

17. A force of $F = (2i + 4k)$ N is exerted on a block to move it with a velocity of $V = (6j + 8k)$ m/s. What is the power exerted on the block? (1)
- A. 12 W B. ✓ 32 W
C. 24 W D. 16 W

Answer: B

Power is the dot product of force and velocity vectors, $P = F \cdot V$. Performing the calculation gives $P = (2i + 0j + 4k) \cdot (0i + 6j + 8k) = 2(0) + 0(6) + 4(8) = 32$ W.

18. A block of mass 2.5 kg is attached to a spring with spring constant 40 N/m. If it is pulled down a displacement of 30 cm and released, what would its speed be as it passes the equilibrium position? (1)
- A. 1.6 m/s B. ✓ 1.2 m/s
C. 1.4 m/s D. 1 m/s

Answer: B

The maximum speed of a mass-spring system occurs at the equilibrium position and is given by $v_{\max} = A \cdot \sqrt{k/m}$. Substituting the values, we get $v_{\max} = 0.3 \text{ m} \cdot \sqrt{40 \text{ N/m} / 2.5 \text{ kg}} = 0.3 \cdot 4 = 1.2 \text{ m/s}$.

19. What is the moment of inertia of a thin rod of mass M and length L about an axis perpendicular to the rod at a distance of $L/4$ from one end? ($I_{\text{cm}} = 1/12 ML^2$) (1)
- A. ✓ $(7/48)ML^2$ B. $(7/12)ML^2$
C. $(5/12)ML^2$ D. $(1/3)ML^2$

Answer: A

Using the parallel-axis theorem, $I = I_{\text{cm}} + Md^2$, where d is the distance from the center of mass ($L/2$) to the new axis ($L/4$), which is $L/4$. This gives $I = (1/12)ML^2 + M(L/4)^2 = (1/12 + 1/16)ML^2 = (7/48)ML^2$.

20. The angular displacement described by a particle is given as $\theta(t) = 10 + 20t - 4t^2$ where θ in radian and t in seconds. What is the value of t when the particle becomes momentarily at rest? (1)
- A. 5 s B. ✓ 2.5 s
C. 2 s D. 1 s

Answer: B

A particle is momentarily at rest when its angular velocity is zero. Taking the derivative of $\theta(t)$ with respect to time gives $\omega(t) = 20 - 8t$; setting this to zero yields $t = 2.5$ s.

21. A solid cylindrical grinding stone ($I = \frac{1}{2}MR^2$) has a radius of 0.4 m and mass of 40 kg. A constant unbalanced torque acting on it changes its angular speed to 40 rad/s from rest in 20 seconds. What is the magnitude of the desired net torque? (1)
- A. ✓ 6.4 Nm B. 16 Nm
C. 3.2 Nm D. 8 Nm

Answer: A

The moment of inertia is $I = 0.5 \cdot 40 \text{ kg} \cdot (0.4 \text{ m})^2 = 3.2 \text{ kg}\cdot\text{m}^2$. The angular acceleration is $\alpha = \Delta\omega/\Delta t = 40/20 = 2 \text{ rad/s}^2$, so the net torque is $\tau = I\alpha = 3.2 \cdot 2 = 6.4 \text{ Nm}$.

22. A ring ($I = MR^2$) is released and rolled down an inclined plane which is 10 m above the horizontal ground. What is the linear velocity of the ring at the bottom of the incline? (1)
- A. $2\sqrt{10}$ m/s
B. $\sqrt{10}$ m/s
C. 100 m/s
D. ✓ 10 m/s

Answer: D

For a rolling ring, the conservation of energy gives $Mgh = \frac{1}{2} Mv^2 + \frac{1}{2} I\omega^2 = \frac{1}{2} Mv^2 + \frac{1}{2} Mv^2 = Mv^2$. Thus, $v = \sqrt{gh} = \sqrt{10 \cdot 10} = 10$ m/s.

23. Real gases behave like an ideal gas at (1)
- A. Low temperature and high pressure.
B. ✓ High temperature and low pressure.
C. Low temperature and low pressure.
D. High temperature and high pressure.

Answer: B

At high temperature, gas molecules move too rapidly for intermolecular forces to affect them, and at low pressure, they are spaced far enough apart that their volume is negligible, thus satisfying the ideal gas assumptions.

24. A Carnot engine working between 27°C and 327°C has a work output of 800 J per cycle. The amount of heat energy supplied to the engine from the source in each cycle is (1)
- A. 800 J
B. ✓ 1600 J
C. 3200 J
D. 6400 J

Answer: B

The efficiency of the Carnot engine is $\eta = 1 - T_C/T_H = 1 - 300\text{ K}/600\text{ K} = 0.5$. Since $\eta = W/Q_H$, the heat supplied from the source is $Q_H = 800\text{ J}/0.5 = 1600\text{ J}$.

25. If one mole of an ideal gas doubles its volume as it undergoes an isothermal expansion, its pressure is (1)
- A. quadrupled
B. doubled
C. ✓ halved
D. quartered

Answer: C

During an isothermal expansion, the temperature of an ideal gas remains constant, so its pressure and volume are inversely proportional ($P_1 V_1 = P_2 V_2$). Doubling the volume results in the pressure being halved.

26. The rms speed of an ideal gas at a temperature of 120 K is V . What would the rms speed be if its temperature becomes 480 K? (1)
- A. $V/4$
B. $V/2$
C. $4V$
D. ✓ $2V$

Answer: D

The root-mean-square speed of gas molecules is directly proportional to the square root of the absolute temperature ($v_{rms} \propto \sqrt{T}$). Since the temperature increases by a factor of 4 (from 120 K to 480 K), the rms speed increases by a factor of $\sqrt{4} = 2$, becoming $2V$.

27. A hollow metal sphere of radius 10 cm is charged to a potential of 100 V. What is the potential at the center of the sphere? (1)
- A. Zero
B. 50 V
C. 200 V
D. ✓ 100 V

Answer: D

Inside a charged hollow conducting sphere, the electric field is zero, which means the electric potential is constant throughout the interior and equal to the potential at the surface (100 V).

28. A body is said to be in neutral equilibrium if (1)
- A. its center of gravity is above the axis of rotation.
 - B. its center of gravity is below the axis of rotation.
 - C. ✓ **its center of gravity coincides (meet at a point) with the axis of rotation.**
 - D. its center of gravity produces net torque about the axis of rotation.

Answer: C

A body is in neutral equilibrium if its center of gravity coincides with the axis of rotation. In this state, any displacement does not alter the height of its center of gravity, and no net restoring or upsetting torque is produced.

29. A body is said to be charged positively if it has (1)
- A. excess of protons.
 - B. deficiency of protons.
 - C. excess of electrons.
 - D. ✓ **deficiency of electrons.**

Answer: D

A body becomes positively charged when it loses electrons (which are negatively charged), resulting in a deficiency of electrons; protons are bound in the nucleus and cannot be easily gained or lost.

30. A 10^{-6} F capacitor is charged with a 10 V battery. What is the energy of the capacitor? (1)
- A. ✓ **50 μ J**
 - B. 100 μ J
 - C. 150 μ J
 - D. 200 μ J

Answer: A

The energy stored in a capacitor is calculated using the formula $U = \frac{1}{2}CV^2$. Substituting $C = 10^{-6}$ F and $V = 10$ V gives $U = \frac{1}{2} \times 10^{-6} \times 100 = 50 \times 10^{-6}$ J = 50 μ J.

31. The intensity level (loudness level) changes from $L_1 = 60$ dB to $L_2 = 90$ dB. What is the ratio of intensities I_2/I_1 ? (1)
- A. 3
 - B. 30
 - C. 300
 - D. ✓ **1000**

Answer: D

The difference in intensity levels is given by $\Delta L = 10 \log_{10}(I_2/I_1)$. Since $\Delta L = 90$ dB $-$ 60 dB = 30 dB, we have $3 = \log_{10}(I_2/I_1)$, which yields $I_2/I_1 = 10^3 = 1000$.

32. A 0.5 kg object attached to a spring undergoes SHM with amplitude of 8 cm and period of 0.2π s. What is the maximum force acting on the object? (1)
- A. 80 N
 - B. 50 N
 - C. 8 N
 - D. ✓ **4 N**

Answer: D

The angular frequency is $\omega = \frac{2\pi}{T} = \frac{2\pi}{0.2\pi} = 10$ rad/s. The maximum force is $F_{\max} = m\omega^2 A = 0.5$ kg $\times$ (10 rad/s)² $\times$ 0.08 m = 4 N.

33. When light travels from one medium to another which is separated by a sharp boundary the characteristic that does not change is (1)
- A. velocity
 - B. wavelength
 - C. ✓ **frequency**
 - D. amplitude

Answer: C

When a wave travels from one medium to another, its frequency remains unchanged because it is determined solely by the source of the wave, while its velocity, wavelength, and amplitude change.

Using Young's modulus formula $Y = (F * L_0) / (A * \Delta L)$, we can solve for $\Delta L = (F * L_0) / (A * Y) = (20 * 0.5) / (10^{-6} * 2 * 10^9) = 10 / 2000 = 0.005 \text{ m}$, which is 5 mm.

40. Which one of the following statements is WRONG?

(1)

- A. Wave fronts of point source of light are concentric spheres.
- B. Light rays and wave fronts intersect at right angles.
- C. ✓ **Light rays and wave fronts are parallel.**
- D. Rays and the radii of spherical wave fronts.

Answer: C

Light rays are defined as lines perpendicular to the wave fronts representing the direction of wave propagation, so stating that they are parallel is incorrect.

41. In a hydraulic brake system a force of 20 N is applied to piston 1 which has a cross-sectional area of 4 cm². What is the force on piston 2 if its cross-sectional area is 60 cm²? (1)

- A. 200 N
- B. ✓ **300 N**
- C. 400 N
- D. 500 N

Answer: B

According to Pascal's principle, pressure is transmitted equally throughout the fluid: $F_1/A_1 = F_2/A_2$. Solving for F_2 gives $F_2 = F_1 * (A_2/A_1) = 20 * (60/4) = 300$ N.

42. Bernoulli's principle is based on

(1)

- A. conservation of momentum
- B. conservation of mass
- C. ✓ **conservation of energy**
- D. mass-energy equivalence

Answer: C

Bernoulli's principle states that for an inviscid, incompressible fluid, an increase in speed occurs simultaneously with a decrease in pressure or potential energy, which is a direct statement of the conservation of energy.

43. The speed of water flowing through a horizontal pipe is 10 m/s at a point where the cross-sectional area of the pipe is 0.1 cm². If there is a point in the pipe where its cross-sectional area is 1 cm², what is the pressure difference between these points? (1)

- A. ✓ **4.95×10^4 Pa**
- B. 5.95×10^4 Pa
- C. 6.95×10^4 Pa
- D. 7.95×10^4 Pa

Answer: A

Using the continuity equation, the speed v_2 at the second point is $v_1 * (A_1/A_2) = 10 * (0.1/1) = 1$ m/s. The pressure difference is then given by Bernoulli's equation: $P_2 - P_1 = 0.5 * \rho * (v_1^2 - v_2^2) = 0.5 * 1000 * (100 - 1) = 4.95 * 10^4$ Pa.

44. The transfer of heat by the direct movement of molecules is called

(1)

- A. conduction
- B. ✓ **convection**
- C. radiation
- D. induction

Answer: B

Convection is the transfer of heat through a fluid (liquid or gas) caused by the actual movement of the heated molecules themselves, unlike conduction where energy is transferred without displacement of the molecules.

45. A window has a glass surface of 2000 cm² and thickness of 4 mm. The temperature inside and outside the glass are 21°C and -3°C, respectively. What is the rate of heat flow through the window? ($K = 0.2$ W/m°C) (1)

- A. 480 W
- B. 48 W
- C. 84 W
- D. ✓ **240 W**

Answer: D

The rate of heat flow is given by the formula $H = KA\Delta T/d$. Converting the area to m² ($A = 0.2$ m²) and thickness to meters ($d = 0.004$ m), we get $H = (0.2 \text{ W/m°C} * 0.2 \text{ m}^2 * 24^\circ\text{C}) / 0.004 \text{ m} = 240$ W.

46. A piece of iron (specific heat = $450 \text{ J/kg}^\circ\text{C}$) is dropped from a height of 900 m above the ground. Assuming all the energy is converted to heat the iron, what will be the rise in temperature of the iron in degree centigrade? (1)
- A. zero
B. 8
C. ✓ 20
D. 24

Answer: C

Assuming all potential energy is converted to heat, we have $mgh = mc\Delta T$, which simplifies to $\Delta T = gh/c$. Using $g = 10 \text{ m/s}^2$, the rise in temperature is $\Delta T = (10 \text{ m/s}^2 * 900 \text{ m}) / 450 \text{ J/kg}^\circ\text{C} = 20^\circ\text{C}$.

END OF THE MARKING KEY

Sit this paper online at temari.et/exam-prep/papers/grade-12-physics-2015.

More exam papers are at temari.et/exam-prep/papers.

Generated on Tikimt 2, 2019 E.C. (October 12, 2026 G.C.) · Temari.et