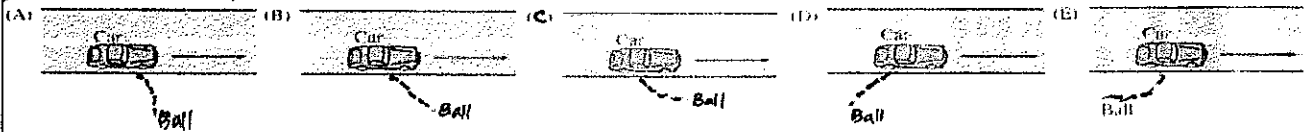


※ 考生請注意: 本試題不可使用計算機。請於答案卷(卡)作答, 於本試題紙上作答者, 不予計分。

單選題: 100 分, 每題 4 分, 答錯倒扣 1 分, 整題不答不給分亦不扣分。

1. One stone is dropped from the side of a bridge, and a second is dropped from the same place a short time later. What is true about the distance between the stones as a function of time after both have been dropped? Ignore air resistance. (A) Always increases. (B) Is constant (C) Increases, finally reaching a constant value. (D) Always decreases. (E) Decreases, and then reaches a constant value.

2. A ball is thrown out of the passenger window of a car moving to the right (ignore air resistance). If the ball is thrown out perpendicular to the velocity of the car, which of the following best depicts the path the ball takes, as viewed from above?



3. In the figure an airport luggage carrying train with a tractor T is pulling three luggage carts, M_1 , M_2 , and M_3 , with constant velocity of 4.5 m/s. If $T = 300.0$ kg, $M_1 = 200.0$ kg, $M_2 = 100.0$ kg, and $M_3 = 100.0$ kg, and the coefficient of kinetic friction for each is 0.4000, what is the force in the connection between the tractor T and cart M_1 ?



(A). 2941 N. (B). 2744 N. (C). 1568 N. (D). 1862 N. (E). 2439 N.

4. The static friction force on an object

- (A). can never be greater than the kinetic friction force on it under the same circumstances.
- (B). can never accelerate the object. (C). can never be greater than the normal force on it.
- (D). can never be greater than the object's weight. (E). None of the choices are correct.

5. A car has a mass of 2,000 kg and travels at 20.0 m/s. If the drag force is 100 N, the power the engines have to provide to keep moving at constant speed is

- (A). 2.0 kW. (B). 2.9 kW. (C). 3.4 kW. (D). 3.9 kW. (E). 4.2 kW.

6. A 4.00 kg solid sphere ($I = 2/5 MR^2$) starts from rest and rolls without slipping down a 30.0 degree incline. The diameter of the sphere is 10.0 cm The acceleration of the center of mass of the solid sphere is (A). 1.50 m/s². (B). 2.00 m/s². (C). 2.50 m/s². (D). 3.00 m/s². (E). 3.50 m/s².

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7. According to Huygens' principle, every point on a wave front acts as a source of a new _____ wave.

(A). transverse. (B). spherical. (C). longitudinal. (D). sinusoidal (E). plane.

8. A baseball (0.145 kg, circumference 229 mm) is held completely under sea water (density, 1017 kg/m^3) by the application of what force? (A). 0.21 N (B). 0.49 N. (C). 0.061 N.

(D). It requires no additional force to remain completely submerged. (E). 0.145 N.

9. A 4.00 kg object is moving at 5.00 m/s SOUTH. It strikes a 3.00 kg object that is moving WEST at 2.00 m/s. The objects have a completely inelastic (stick together) collision. The kinetic energy lost in the collision is (A). 20.2 J. (B). 18.4 J. (C). 10.5 J. (D). 8.33 J. (E). 2.61 J.

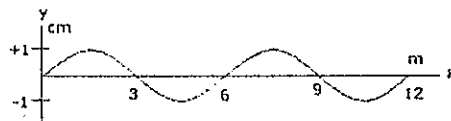
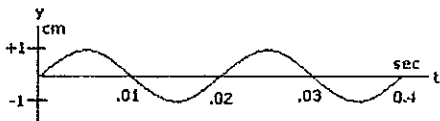
10. A vertical spring system with a bob (mass M) is set into motion with amplitude A . When the bob is pulled instead to move with amplitude $2A$, the following can be concluded:

(A). The period is half as large as before. (B). The period is unaffected.

(C). The period is twice as large as before. (D). The period is 0.7 times as large as before.

(E). The period is 1.4 times as large as before.

11. The following figures are the graphs of a wave at a fixed position and at fixed time.



What is the velocity of the wave in the above figure?

(A). 150 m/s. (B). 200 m/s. (C). 250 m/s. (D). 300 m/s. (E). 450 m/s.

12. The equation of continuity for fluid flow can be derived from the conservation of:

(A). energy. (B). mass. (C). angular momentum. (D). volume. (E). pressure.

13. The coefficient of static friction between a small coin and the surface of a turntable is 0.30. The turntable rotates at 33.3 revolutions per minute. What is the maximum distance (in meters) from the center of the turntable at which the coin will not slide?

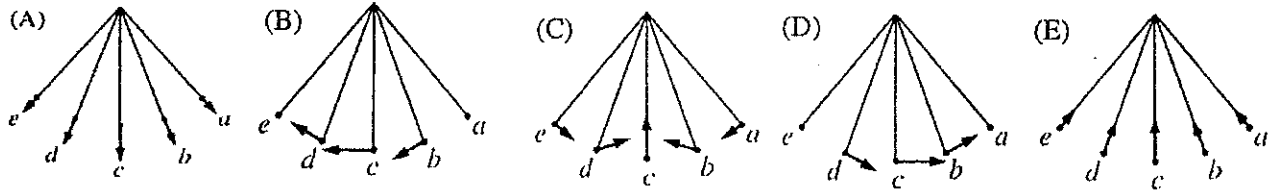
(A). 0.024. (B). 0.048. (C). 0.121. (D). 0.242. (E). 0.484.

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14. During a reversible adiabatic expansion of an ideal gas, which of the following is NOT true?

- (A). $pV^\gamma = \text{constant}$. (B). $pV = nRT$. (C). $TV^{\gamma-1} = \text{constant}$. (D). $|W| = \int pdV$. (E). $pV = \text{constant}$.

15. Which of the following best describes the acceleration of a pendulum bob at points "a" through "e"?



16. A 5.00 gram bullet has a velocity of 300 m/s. It strikes a block of wood and penetrates to a distance of 10.0 cm. The average force of the block of wood on the bullet is

- (A). 1,500 N. (B). 1,750 N. (C). 1,870 N. (D). 2,030 N. (E). 2,250 N.

17. For a system undergoing an isothermal process,

- (A). $Q = -U$. (B). $Q = 0$. (C). $Q = U$. (D). $Q = -W$. (E). $Q = W$.

18. A man (mass m) on an initially stationary boat gets off the boat by leaping to the left in an exactly horizontal direction. Immediately after the leap, the boat (mass M) is seen to be moving to the right at speed v . How much work did the man do during the leap (both on his body and on the boat)?

- (A). $Mv^2/2$. (B). $mv^2/2$. (C). $(M+m)v^2/2$. (D). $(M+M^2/m)v^2/2$. (E). $(Mm/(M+m))v^2/2$.

19. The diagram shows four situations in which a source of sound S with variable frequency and a detector D are either moving or stationary. The arrows indicate the directions of motion. The speeds are all the same. Detector 3 is stationary. The frequency detected is the same. Rank the situations according to the frequency of the source, lowest to highest.



- (A). 1, 2, 3, 4. (B). 4, 3, 2, 1. (C). 1, 3, 4, 2. (D). 2, 1, 4, 3. (E) None of the above.

20. For the typical "household ac voltage" of 120 V, what is the amplitude of the emf?

- (A). 120 V. (B). 240 V. (C). 60.0 V. (D). 170 V. (E). 330 V.

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21. A hollow metal sphere is charged to a potential V . The potential at its center is:

- (A). V . (B). 0 . (C). $-V$. (D). $2V$. (E). πV .

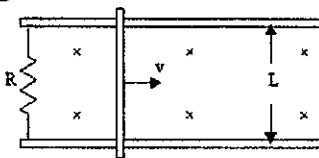
22. When work W is done on an ideal gas of N diatomic molecules in thermal isolation, the temperature increases by: (A). $W/2Nk$. (B). $W/3Nk$. (C). $2W/3Nk$. (D). $2W/5Nk$. (E). W/Nk .

23. Electrons (mass m , charge $-e$) are accelerated from rest through a potential difference V and are then deflected by a magnetic field B that is perpendicular to their velocity. The radius of the resulting electron trajectory is:

- (A). $(\sqrt{2eV/m})/B$. (B). $B\sqrt{2eV}/m$. (C). $(\sqrt{2mV/e})/B$. (D). $B\sqrt{2mV}/e$. (E). none of these.

24. An LR circuit is prepared for an experiment, initially with its switch open. The time constant is that time after switch closure at which the energy stored in the inductor reaches what percentage of its final value: (A). 63%. (B). 14%. (C). 37%. (D). 40%. (E). 100%.

25. A conducting rod slides at 4.0 m/s on metal rails separated by 2.0 m. If a current of 40 mA is generated in the circuit with resistance of 0.36Ω , what is the magnetic field between the rails?



- (A). 0.028 T. (B). 0.11 T. (C). 14 mT. (D). 3.6 mT. (E). 1.8 mT.

Useful constants:

Gravitational acceleration $g=9.8 \text{ m/s}^2$

Vacuum permittivity $\epsilon_0 = 8.85 \times 10^{-12} \text{ Coulomb}^2/(\text{Newton} \cdot \text{meter}^2)$

Vacuum permeability $\mu_0 = 4\pi \times 10^{-7} \text{ Weber}/(\text{Ampere} \cdot \text{meter})$

electron charge $e = -1.6 \times 10^{-19} \text{ Coulomb}$