110 學年度學士後醫學系招生考試
物理試題

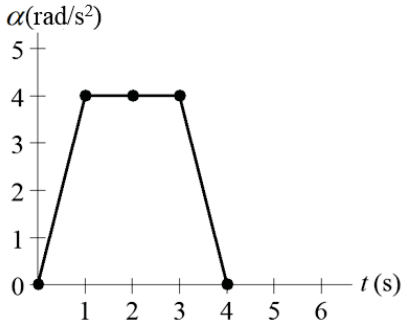
Choose one best answer for the following questions

【單選題】每題 1 分，共計 30 分，答錯 1 題倒扣 0.25 分，倒扣至本大題零分為止，未作答，不給分亦不扣分。1~15 題為物理，16~30 題為化學。

(A) 1. If the diameter of the hydrogen atom is scaling up to the 400 m track playground, what would the size of its nucleus be?
Hint: Radius of hydrogen is 0.053 nano meter. Radius of its nucleus is 0.85 femto meter.
(A) a few-mm sand grain (B) a ping-pong ball (C) a base ball
(D) a bowling ball (E) a basketball

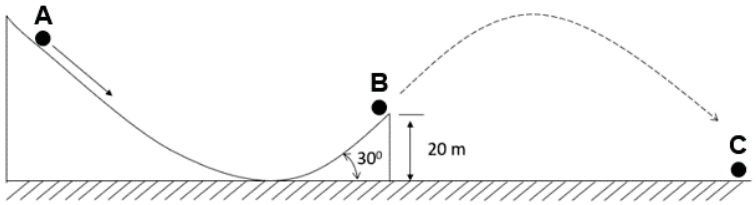
(C) 2. Since 2019, the magnitudes of all SI units have been defined by declaring exact numerical values for *defining constants* when expressed in terms of their SI units. Which one of the following constants is not included?
(A) the speed of light in vacuum, c (B) the Planck constant, h
(C) the Coulomb constant, k_e (or $1/4\pi\varepsilon_0$) (D) the Boltzmann constant, k (or k_B)
(E) the Avogadro constant, N_A

(D) 3. The graph below shows the angular acceleration α of a bicycle tire. During the four-second time interval for which this graph is drawn, we can conclude that _____.



(A) the angular velocity of the wheel did not change
(B) the angular momentum of the wheel about an axis through its center did not change
(C) the angular velocity of the wheel increased by 8 rad/s
(D) the angular velocity of the wheel increased by 12 rad/s
(E) the angular velocity of the wheel increased by 16 rad/s

(B) 4. A ball rolls down and leaves a slope at an angle of 30° above the horizontal direction. The ball hits the ground 10 seconds later at a point 20 meters below the leaving point, as shown below. How far does the ball travel horizontally when it hits the ground (from point B to point C)? (Gravitational acceleration $g = 10\ m/s^2$)



(A) 623 (B) 835 (C) 936 (D) 1019 (E) 2021

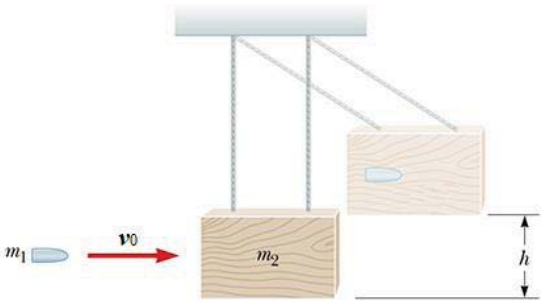
(A) 5. Newton's coefficient of restitution is defined by

$$\text{Coefficient of restitution } (e) = \frac{|\text{Relative velocity after collision}|}{|\text{Relative velocity before collision}|}$$

For a completely inelastic collision in a head-on collision of two objects, what would the value of e would be?

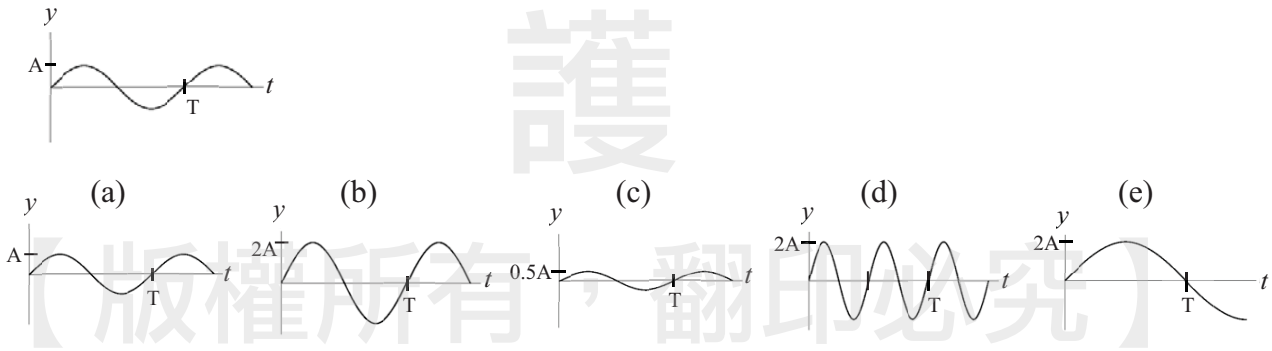
(A) 0 (B) 1/2 (C) 1
(D) 2 (E) Information not enough to determine it.

(B) 6. The ballistic pendulum has mass 10 kg. A bullet of 300 g moves at the speed of v_0 right before hitting the pendulum. How much is the height h that the pendulum can swing upward and rest momentarily? (Gravitational acceleration g = 10 m/s^2)



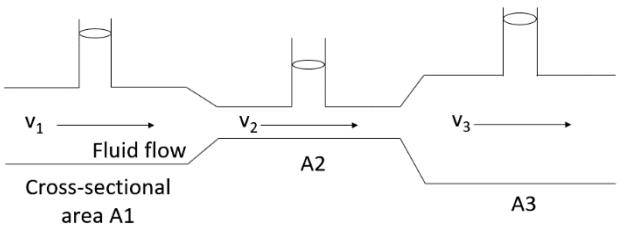
(A) $6.7\times10^{-5}v_0^2$ (B) $4.2\times10^{-5}v_0^2$ (C) $3.3\times10^{-5}v_0^2$
(D) $2.3\times10^{-5}v_0^2$ (E) $5.7\times10^{-5}v_0^2$

(D) 7. Compared to the graph below, which graph in choices shows that the amplitude and the frequency are doubled?



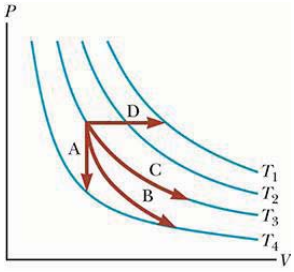
(A) a (B) b (C) c (D) d (E) e

(C) 8. A tube with three openings has three different cross-sectional areas (A1:A2:A3 = 2:1:3), as shown in the figure. The pressure difference is 25 Pa between A1 and A2. If v_1 = 0.125 (m/s), find the density of the fluid (kg/m^3).



(A) 561 (B) 982 (C) 1067 (D) 1534 (E) 1698

(B) 9. Which of the following answers is a correct description of the corresponding process as indicated in the figure?



(A) Isobaric (B) Adiabatic (C) Isovolumetric
(D) Isothermal (E) None of the above is correct.

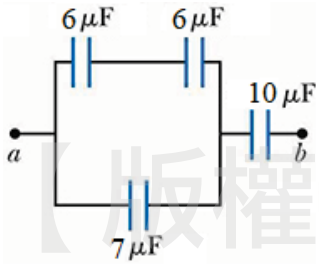
(A) 10. Two waves traveling in opposite directions interfere to produce a standing wave described by $y = 3 \sin(2x) \cos(5t)$ where x is in m and t is in s. What is the wavelength of the interfering waves?

(A) 3.14 m (B) 1.00 m (C) 2.00 m (D) 6.28 m (E) 12.00 m

(B) 11. When the same temperature increase in a system, the change in entropy, ΔS, is the largest in a reversible _____.

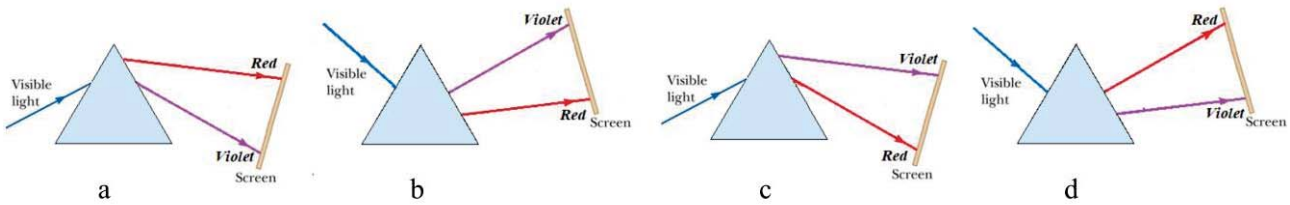
(A) constant-volume process (B) constant-pressure process
(C) adiabatic process (D) process in which no heat is transferred
(E) process in which no work is performed

(D) 12. Four capacitors are connected as shown in the figure. How much is the total charges stored in capacitors if $\Delta V_{ab} = 15$ V.



(A) 30 μC (B) 45 μC (C) 60 μC (D) 75 μC (E) 90 μC

(D) 13. Which of the following is correct for visible light through a prism?



(A) a and d (B) c and b (C) c and d
(D) a and b (E) None of these

(C) 14. In an atom, how many electrons can be contained at most at the 4^{th} orbit?

(A) 9 (B) 18 (C) 32 (D) 162 (E) 324

(D) 15. An energy of 13.6 eV is needed to ionize an electron from the ground state of a hydrogen atom. What is the longest photon wavelength needed to accomplishes this task? (Plank constant = 6.62×10^{-34} m^2·kg/s, speed of light = 3×10^8 m/s, 1 eV = 1.6×10^{-19} J)

(A) 60 nm (B) 70 nm (C) 80 nm (D) 90 nm (E) 100 nm

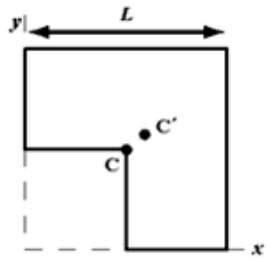
【單選題】每題 2 分，共計 120 分，答錯 1 題倒扣 0.5 分，倒扣至本大題零分為止，未作答，不給分亦不扣分。31~60 題為物理，61~90 題為化學。

(B) 31. Based on an order-of-magnitude estimate, what is the radius of the Earth in the unit of kilometer (km)?

Hint: The meter was originally defined in 1793 as one ten-millionth of the distance from the equator to the North Pole along a great circle.

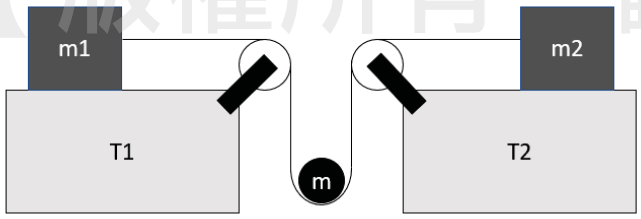
(A) 2 (B) 4 (C) 6 (D) 8 (E) 10

(E) 32. A part of the square that has sides of length L is removed from one corner. The center of mass of the remainder moves from C to C'. The displacement of the x coordinate of the center of mass (from C to C') is _____.



(A) (2/3)L (B) (1/6)L (C) (1/8)L (D) (1/10)L (E) (1/12)L

送分 33. The string and the pulley are massless, and the coefficient of static and kinetic frictions are 0.2 and 0.1, respectively, for both table 1 (T1) and 2 (T2). If m1 = 2 kg, m2 = 3 kg, and m = 1.5 kg, find the acceleration of m. (Gravitational acceleration g = 10 m/s^2)

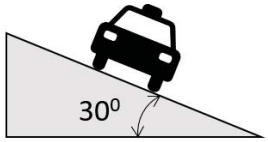


(A) 7.7 m^2/s (B) 8.7 m^2/s (C) 9.7 m^2/s (D) 10.7 m^2/s (E) 11.7 m^2/s

(A) 34. Aluminum Rod #1 has a length L and a diameter d. Aluminum Rod #2 has a length 2L and a diameter 2d. If Rod #1 is under tension T and Rod #2 is under tension 2T, how do the changes in length of the two rods compare?

(A) They are the same.
(B) Rod #1 has double the change in length that Rod #2 has.
(C) Rod #2 has double the change in length that Rod #1 has.
(D) Rod #1 has quadruple the change in length that Rod #2 has.
(E) Rod #2 has quadruple the change in length that Rod #1 has.

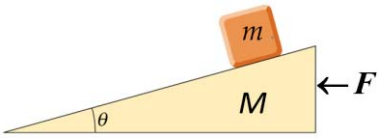
(B) 35. A toy car is running on a banked circular track of radius 10 m, as shown below. If the car weighs 5 kg and on wet ice, find the maximum velocity for the car to keep on the track without skid. (Gravitational acceleration g = 10 m/s^2 , cos30^o = 0.87, cos60^o = 0.5)



(A) 5.4 m/s (B) 7.6 m/s (C) 9.4 m/s (D) 12.6 m/s (E) 15.7 m/s

(C) 36. A small block of mass m rests on the sloping side of a triangular block of mass M which itself rests on a horizontal table as shown in the figure below**.** Assuming all surfaces are frictionless, determine the magnitude of the force **F** that must be applied to M so that m remains in a fixed position relative to M.

Hint: 1. Take *x* and *y* axes horizontal and vertical. 2. Focus at the object m.

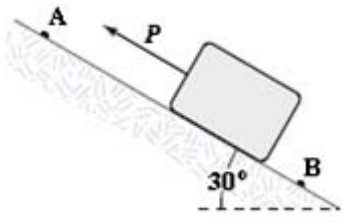


(A) mg sinθ (B) mg tanθ (C) (m+M)g tanθ
(D) (m+M)g sinθ (E) None of these

(B) 37. The four tires of an automobile are inflated to a gauge pressure of 2.0 × 10^5 N/m^2 (29 psi). Each of the four tires has an area of 0.024 m^2 that is in contact with the ground. Determine the weight of the auto.

(A) 4.80 × 10^3 N (B) 1.92 × 10^4 N (C) 7.68 × 10^4 N
(D) 8.33 × 10^6 N (E) 2.08 × 10^7 N

(C) 38. A 2-kg block slides down a frictionless incline from point A to point B. A force (magnitude P = 3 N) acts on the block between A and B, as shown in the figure Points A and B are 2 m apart. If the kinetic energy of the block at A is 10 J, what is the kinetic energy of the block at B? (Gravitational acceleration g = 10 m/s^2)



(A) 17 J (B) 20 J (C) 24 J (D) 27 J (E) 37 J

(E) 39. On a bridge, a man (weight = 70 kg) plays bungee jumping by tying himself to one end of an elastic rope. The rope has a length of 100 m, and the height of the bridge is 500 m. After jumping, the man begins to bounce back 10 seconds later. What is the effective weight of the man at the bouncing point? (Gravitational acceleration g = 10 m/s^2)

(A) 83 kg (B) 95 kg (C) 102 kg (D) 117 kg (E) 127 kg

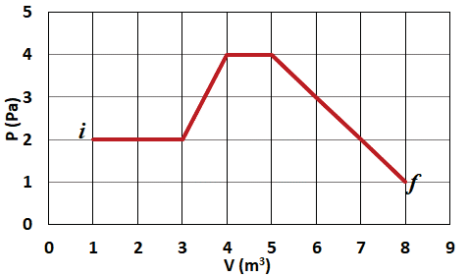
(D) 40. How much energy is required to move a mass *m* object from the Earth's surface to an altitude twice the Earth's radius R_E?

(A) $(-1/2)mgR_E$ (B) $(1/2)mgR_E$ (C) $(-2/3)mgR_E$ (D) $(2/3)mgR_E$ (E) $(1/4)mgR_E$

(A) 41. A styrofoam container used as a picnic cooler contains a block of ice at 0°C. If 225 g of ice melts in 1 hour, how much heat energy (Joule) per second is passing through the walls of the container? (The heat of fusion of ice is 3.33×10^5 J/kg).

(A) 20.8 (B) 124.8 (C) 1800.0 (D) 7492.5 (E) 749250.0

(D) 42. How much is the internal energy change of a gas that expands from *i* to *f* as indicated in the figure if there is also a frictional heat loss of 10 J?



(A) -34.5 J (B) 22.5 J (C) -18.5 J (D) -28.5 J (E) 36.5 J

(D) 43. A solid melt at 100°C by absorbing 2450 kJ heat. How much is the entropy change in this melting process?

(A) 8.23 kJ/K (B) 4.32 kJ/K (C) 7.43 kJ/K (D) 6.57 kJ/K (E) 5.69 kJ/K

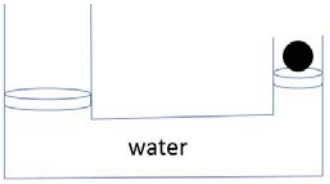
(C) 44. What is the efficiency if a Carnot engine transfers 9.5×10^3 J of energy from a hot reservoir during a cycle and dumps 2×10^3 J heat to a cold reservoir?

(A) 0.69 (B) 0.84 (C) 0.79 (D) 0.65 (E) 0.72

(A) 45. Water pressurized to 3.5×10^5 Pa is flowing at 5.0 m/s in a horizontal pipe which contracts to 1/3 its former area. What are the pressure and flow speed of the water after the contraction?

(A) 2.5×10^5 Pa, 15 m/s (B) 3.0×10^5 Pa, 10 m/s (C) 3.0×10^5 Pa, 15 m/s
(D) 4.5×10^5 Pa, 1.5 m/s (E) 5.5×10^5 Pa, 1.5 m/s

(A) 46. A hydraulic jack with two pistons is shown in the figure. The radii are 10 cm and 5 cm, and the weights are 40 kg and 1 kg for the left and right piston, respectively. A ball weighs 9 kg is placed on the right piston. Find the height difference between two pistons in equilibrium status. (Gravitational acceleration g = 10 m/s^2)

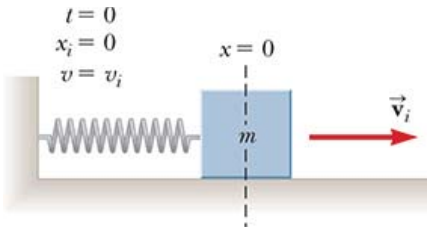


(A) 0 cm (B) 10 cm (C) 1 m (D) 10 m (E) 20 m

(E) 47. A car approaches a stationary police car at 36 m/s. The frequency of the siren (relative to the police car) is 500 Hz. What is the frequency (in Hz) heard by an observer in the moving car as he approaches the police car? (Assume the velocity of sound in air is 343 m/s.)

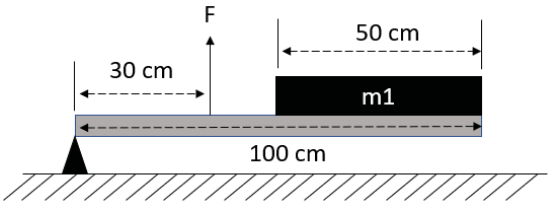
(A) 220 (B) 383 (C) 448 (D) 526 (E) 552

(B) 48. A mass-spring system is shown in the figure where the spring constant k = 100 N/m and the mass is 4 kg. Assuming the initial velocity is 3.5 m/s, what is the amplitude of the motion?



(A) 0.5 m (B) 0.7 m (C) 0.8 m (D) 0.9 m (E) 1.2 m

(C) 49. A block (m1) with a weight of 10 kg was placed on a wooden bar with a weight of 2 kg. The left end of the bar was attached firmly to a triangle. How much force (F) does it take to keep the system in horizontal equilibrium? (Gravitational acceleration g = 10 m/s^2)

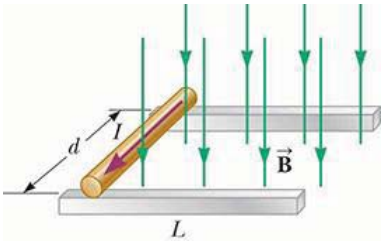


(A) 165 N (B) 224 N (C) 283 N (D) 318 N (E) 361 N

(B) 50. Halley's comet moves about the Sun in an elliptical orbit with its closest approach to the Sun being 0.59 A.U. and its farthest distance being 35 A.U. If the comet's speed at closest approach is 54 km/s, what is its speed when it is farthest from the Sun? [1 Astronomical Unit (A.U.) is the Earth-Sun distance.]

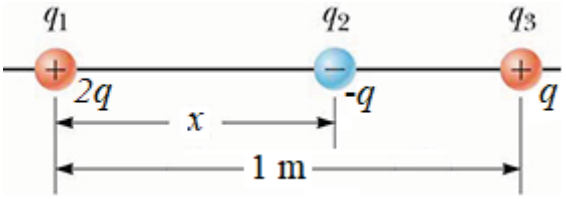
(A) 3203 m/s (B) 910 m/s (C) 15 m/s (D) 13 m/s (E) 7011 m/s

(A)(D) 51. A rod of 0.3 m carries a current of I = 48.0 A in the direction shown in the figure and rolls along the rails with a constant speed. A uniform magnetic field of magnitude 0.25 T is directed perpendicular to the rod and the rails. What is the force acting on the rod?



(A) 3.6 N (→) (B) 2.4 N (←) (C) 1.2 N (←) (D) 3.6 N (←) (E) 1.2 N (→)

(E) 52. Three point charges align along the x-axis as shown in the figure. What is the equilibrium position x of the charge q_2. (The electrical constant is k_e).



(A) 0.45 m (B) 0.62 m (C) 0.36 m (D) 0.78 m (E) 0.59 m

(D) 53. Two parallel thin planes of charge electrical charge density 2.5×10^{8} C/m^2. What is the electric field in the region between the two planes? Assume that the vacuum electric permittivity is $\varepsilon_0 = 8.9\times10^{-12}$ C^2/N·m^2.

(A) 2.8×10^{18} N/C (B) 5.6×10^{19} N/C (C) 1.4×10^{18} N/C
(D) 2.8×10^{19} N/C (E) 4.2×10^{19} N/C

(D) 54. The voltage across a parallel-plate capacitor is measured to be 92.5 V. When a dielectric is inserted between the plates, the voltage drops to 23.4 V. What is the dielectric constant of the inserted material? Assume that the vacuum electric permittivity is $\varepsilon_0 = 8.9\times10^{-12}$ C^2/N·m^2.

(A) 0.26 (B) 2.64 (C) 0.62 (D) 3.95 (E) 1.82

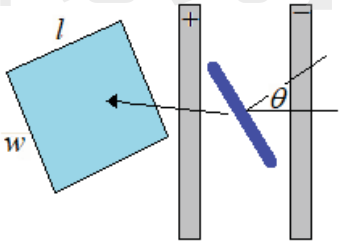
(E) 55. An AC generator consists of 6 turns of a wire. Each turn has an area of 0.040 m^2. The loop rotates in a uniform field (B = 0.20 T) at a constant frequency of 50 Hz. What is the maximum induced emf?

(A) 2.4 V (B) 3.0 V (C) 4.8 V (D) 13 V (E) 15 V

(E) 56. It is known that the magnetic field of 0.17 T can cause an O_2^+ ion to move in a circular orbit of radius 2 m. Find the radius of circular orbit of a Na^{2+} ion with identical velocity in the same magnetic field. (Ion moves in direction perpendicular to the magnetic field.)

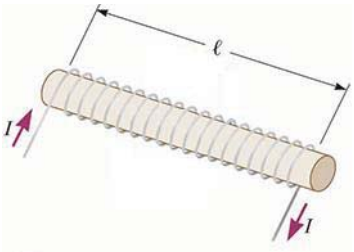
(A) 0.12 m (B) 0.25 m (C) 0.34 m (D) 0.52 m (E) 0.72 m

(D) 57. What is the electric flux through a surface in between two parallel planes shown in the figure if w = 2 cm, l = 5 cm, E = 500 N/C and θ = 30°?



(A) 0.52 N·m^2/C (B) 0.26 N·m^2/C (C) 0.81 N·m^2/C
(D) 0.43 N·m^2/C (E) 0.36 N·m^2/C

(A) 58. A solenoid with 200 turns of copper wires is operated by a 1000 V power supply and must be 25 cm long. What is the magnitude of magnetic field that is created in the solenoid? (The resistance of Cu wire is 0.2 Ω and the permeability $\mu_0 = 4\pi\times10^{-7}$ T·m/A)



(A) 5.03 T (B) 3.21 T (C) 7.84 T (D) 4.58 T (E) 4.36 T

(E) 59. For a convex mirror with radius of curvature R = 10 cm, if an object is placed 15 cm in front the mirror, what is the magnification of the image and is it a real or virtual? Upright or inverted? (mirror's equation: $1/p+1/q = 2/R$)

(A) 3.75 cm (virtual behind mirror) and M = 0.25, inverted
(B) 7.50 cm (virtual behind mirror) and M = 0.5, upright
(C) 3.75 cm (real in front mirror) and M = 0.5, inverted
(D) 7.50 cm (real in front mirror) and M = 0.25, inverted
(E) 3.75 cm (virtual behind mirror) and M = 0.25, upright

送分 60. For a bi-concave thin lens, the radii of curvature are 10 and 20 cm. If an object is placed 15 cm in front of the mirror, what is the magnification of the image and is it a real or virtual? Upright or inverted? (thin lens' equation: $1/p+1/q = (n-1)(1/R_1-1/R_2)$, the refractive index of glass is 1.5).

(A) 9.72 cm (virtual behind mirror) and M = 0.64, inverted
(B) 11.64 cm (virtual behind mirror) and M = 0.58, inverted
(C) 10.91 cm (virtual in front mirror) and M = 0.73, upright
(D) 8.69 cm (real in front mirror) and M = 0.25, inverted
(E) 12.45 cm (virtual behind mirror) and M = 0.53, upright

物　理

程量子(陳宗德)老師提供

考情分析

以下針對110年學士後西醫物理考科之分析：

1. 在難易度方面，相較於109年物理考卷而言，今年的試題較為新穎，僅有極少數出自於原文題庫，多數題出自於108年台綜大轉學考考題(已收錄於高點出版的物理解題制霸一書)。本次試題乍看之下，可能會覺得很難，但是仔細看過後，非常簡單，若物理觀念了解，皆可以直接作答，完全不需要計算。有些題目計算稍微複雜，三位數的加、減、乘、除，若估算方式熟悉的話，皆可以快速作答。大部分95%以上的題目，於先修、正課、特訓班課堂中、作業練習中及七百題題庫皆教授過，且做過多次練習，只是題目換句話說，若物理觀念不錯，可直接作答。

2. 在考題命中度方面，此次試卷內容與上課教材、平時作業、複習卷、七百題題庫、總複習課程題庫、實戰解析課程之題庫及高點建國所提供的模擬考有90%以上的命中度，若將來同學們平時訓練足夠，提升運算速度，則分數可以提升許多，並可增加上榜的機率。

3. 在命題範圍方面，相較於109年物理考卷而言，今年物理試題，考題較為新穎，值得注意的是，考題來自於大學轉學考試題之比重也增加。此次考試光學部分，皆為上課內容，故應可拿分。此次試題，可以感覺到出題老師的用心，物理觀念清楚，即可作答。

4. 猜測預估物理考科平均分數，滿分75分，60分以上則算不錯，平均應會落在55分上下。

以上供參閱，感恩。

程量子筆

試題詳解

【單選題】每題 1 分

1. If the diameter of the hydrogen atom is scaling up to the 400 m track playground, what would the size of its nucleus be?
Hint: Radius of hydrogen is 0.053 nano meter. Radius of its nucleus is 0.85 femto meter.
(A) a few-mm sand grain (B) a ping-pong ball (C) a base ball
(D) a bowling ball (E) a basketball

1. 解：(A)

Radius of hydrogen is 0.053 nano meter. Radius of its nucleus is 0.85 femto meter.

$0.053[nm] = 5.3 \times 10^{-11}[m]$

$0.85[fm] = 8.5 \times 10^{-16}[m]$ 相差 $\approx 10^{-5}[m]$

$\Rightarrow 400[m] = 4 \times 10^{2}[m]$

要相差 $\approx 10^{-5}[m]$

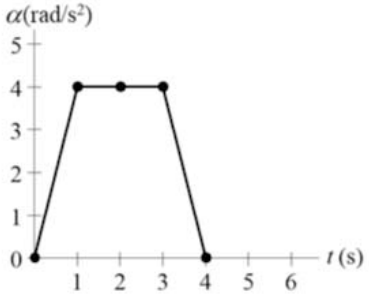
$\Rightarrow 10^{-3}[m] = [mm]$

2. Since 2019, the magnitudes of all SI units have been defined by declaring exact numerical values for *defining constants* when expressed in terms of their SI units. Which one of the following constants is not included?
(A) the speed of light in vacuum, c (B) the Planck constant, h
(C) the Coulomb constant, k_e (or $1/4\pi\varepsilon_0$) (D) the Boltzmann constant, k (or k_B)
(E) the Avogadro constant, N_A

2. 解：(C)

hyperfine transition frequency of Cs	$\Delta\nu_{Cs}$
speed of light in vacuum	c
Planck constant	h
elementary charge	e
Boltzmann constant	k
Avogadro constant	N_A
luminous efficacy	K_{cd}

3. The graph below shows the angular acceleration α of a bicycle tire. During the four-second time interval for which this graph is drawn, we can conclude that _____.

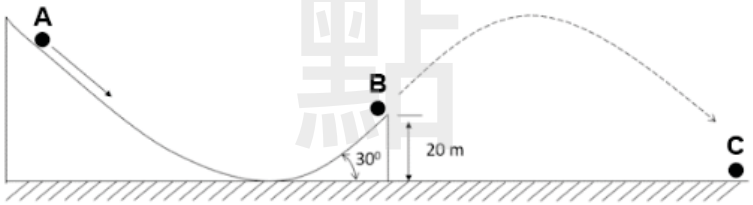


(A) the angular velocity of the wheel did not change
(B) the angular momentum of the wheel about an axis through its center did not change
(C) the angular velocity of the wheel increased by 8 rad/s
(D) the angular velocity of the wheel increased by 12 rad/s
(E) the angular velocity of the wheel increased by 16 rad/s

3. 解：(D)

$$\omega = \frac{(2+4)4}{2} = +12[rad/s]$$

4. A ball rolls down and leaves a slope at an angle of 30° above the horizontal direction. The ball hits the ground 10 seconds later at a point 20 meters below the leaving point, as shown below. How far does the ball travel horizontally when it hits the ground (from point B to point C)? (Gravitational acceleration g = 10 m/s^2)



(A) 623 (B) 835 (C) 936 (D) 1019 (E) 2021

4. 解：(B)

$$y = (v_0 \sin\theta)t - \frac{1}{2}gt^2$$

$$\Rightarrow -20 = (v_0 \sin 30°) \times 10 - \frac{1}{2} \times 10 \times 10^2$$

$$\Rightarrow v_0 = 96[m/s]$$

$$x = (v_0 \cos\theta)t = (96\cos 30°) \times 10 = 831.4[m]$$

5. Newton's coefficient of restitution is defined by

$$\text{Coefficient of restitution } (e) = \frac{|\text{Relative velocity after collision}|}{|\text{Relative velocity before collision}|}$$

For a completely inelastic collision in a head-on collision of two objects, what would the value of e would be?

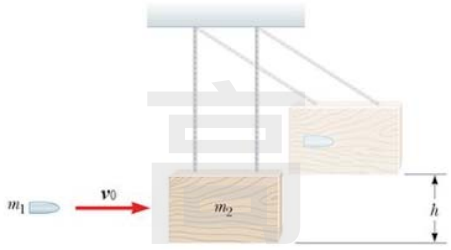
(A) 0 (B) 1/2 (C) 1
(D) 2 (E) Information not enough to determine it.

5. 解：(A)

$$e = \frac{|v_{1f} - v_{2f}|}{|v_{1i} - v_{2i}|}$$

$e = 1$ 彈性碰撞，$0 \le e < 1$ 非彈性碰撞

6. The ballistic pendulum has mass 10 kg. A bullet of 300 g moves at the speed of v_0 right before hitting the pendulum. How much is the height h that the pendulum can swing upward and rest momentarily? (Gravitational acceleration g = 10 m/s^2)



(A) $6.7\times10^{-5}v_0^2$ (B) $4.2\times10^{-5}v_0^2$ (C) $3.3\times10^{-5}v_0^2$
(D) $2.3\times10^{-5}v_0^2$ (E) $5.7\times10^{-5}v_0^2$

6. 解：(B)

由動量守恆

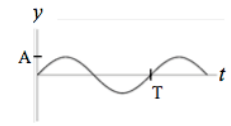
$$0.3\times v_0=(10+0.3)v_{cm}\Rightarrow v_{cm}=0.029v_0$$

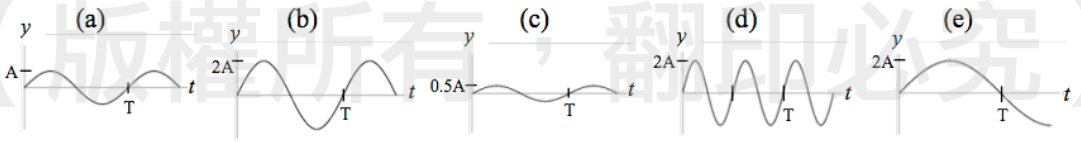
由機械能守恆

$$\frac{1}{2}(10+0.3)(0.029v_0)^2+0=0+(10+0.3)(10)h$$

$$\Rightarrow h=4.24\times10^{-5}v_0^2$$

7. Compared to the graph below, which graph in choices shows that the amplitude and the frequency are doubled?





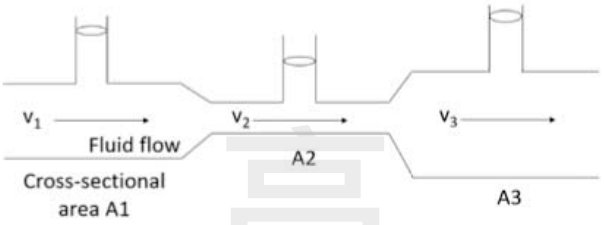
(A) a (B) b (C) c (D) d (E) e

7. 解：(D)

$$A'=2A$$

$$f'=2f=2\cdot\frac{1}{T}$$

8. A tube with three openings has three different cross-sectional areas (A1:A2:A3 = 2:1:3), as shown in the figure. The pressure difference is 25 Pa between A1 and A2. If $v_1 = 0.125$ (m/s), find the density of the fluid (kg/m^3).



(A) 561 (B) 982 (C) 1067 (D) 1534 (E) 1698

8. 解：(C)

由連續性方程式

$$A_1v_1 = A_2v_2 \Rightarrow 2\times 0.125 = 1\times v_2 \Rightarrow v_2 = 0.25[m/s]$$

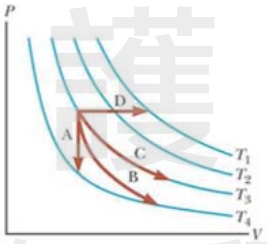
由伯努利方程式

$$P_1 + \frac{1}{2}\rho v_1^2 = P_2 + \frac{1}{2}\rho v_2^2 \Rightarrow P_1 - P_2 = \frac{1}{2}\rho(v_2^2 - v_1^2)$$

$$\Rightarrow 25 = \frac{1}{2}\rho(0.25^2 - 0.125^2)$$

$$\Rightarrow \rho = 1068[kg/m^3]$$

9. Which of the following answers is a correct description of the corresponding process as indicated in the figure?



(A) Isobaric (B) Adiabatic (C) Isovolumetric
(D) Isothermal (E) None of the above is correct.

9. 解：(B)

Adiabatic process

10. Two waves traveling in opposite directions interfere to produce a standing wave described by $y = 3\sin(2x)\cos(5t)$ where x is in m and t is in s. What is the wavelength of the interfering waves?

(A) 3.14m (B) 1.00m (C) 2.00m (D) 6.28m (E) 12.00m

10. 解：(A)

$$k = \frac{2\pi}{\lambda} \Rightarrow 2 = \frac{2\pi}{\lambda} \Rightarrow \lambda = 3.14[m]$$

11. When the same temperature increase in a system, the change in entropy, ΔS, is the largest in a reversible _____.
(A) constant-volume process (B) constant-pressure process
(C) adiabatic process (D) process in which no heat is transferred
(E) process in which no work is performed

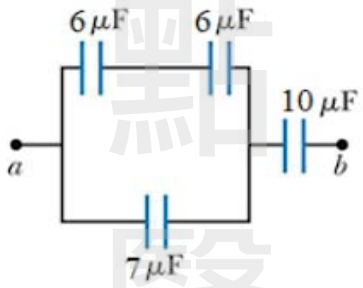
11. 解：(B)

(A)(E) $\Delta S = nC_v \ln\left|\frac{T_f}{T_i}\right|$

(B) $\Delta S = nC_p \ln\left|\frac{T_f}{T_i}\right|$

(C)(D) $\Delta S = 0$ (reversible)

12. Four capacitors are connected as shown in the figure. How much is the total charges stored in capacitors if $\Delta V_{ab} = 15$ V.

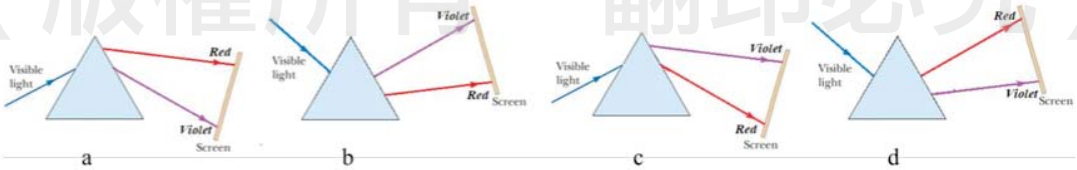


(A) 30μC (B) 45μC (C) 60μC (D) 75μC (E) 90μC

12. 解：(D)

$$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} = \frac{1}{6} + \frac{1}{6} \Rightarrow C = 3$$
$$C = C_1 + C_2 = 3 + 7 = 10$$
$$\frac{1}{C_{ab}} = \frac{1}{C_1} + \frac{1}{C_2} = \frac{1}{10} + \frac{1}{10} \Rightarrow C_{ab} = 5$$
$$Q = C_{ab}V_{ab} = 5 \times 15 = 75$$

13. Which of the following is correct for visible light through a prism?



(A) a and d (B) c and b (C) c and d
(D) a and b (E) None of these

13. 解：(D)

紅光偏向角比較小，紫光偏向角比較大

14. In an atom, how many electrons can be contained at most at the 4^{th} orbit?
(A) 9 (B) 18 (C) 32 (D) 162 (E) 324

14. 解：(C)

number of electron $2n^2 = 2 \times 4^2 = 32$

15. An energy of 13.6 eV is needed to ionize an electron from the ground state of a hydrogen atom. What is the longest photon wavelength needed to accomplishes this task? (Plank constant = 6.62×10^{-34} $m^2\cdot kg/s$, speed of light = 3×10^8 m/s, 1 eV = 1.6×10^{-19} J)

(A) 60 nm (B) 70 nm (C) 80 nm (D) 90 nm (E) 100 nm

15. 解：(D)

$$E=\frac{hc}{\lambda}$$

$$\Rightarrow 13.6=\frac{1240}{\lambda}\Rightarrow \lambda=91.17[nm]$$

【單選題】每題 2 分

31. Based on an order-of-magnitude estimate, what is the radius of the Earth in the unit of kilometer (km)?

Hint: The meter was originally defined in 1793 as one ten-millionth of the distance from the equator to the North Pole along a great circle.

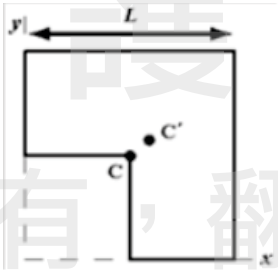
(A) 2 (B) 4 (C) 6 (D) 8 (E) 10

31. 解：(B)

$$R=6400km=0.6\times10^4\,km$$

估計數量級為 4

32. A part of the square that has sides of length L is removed from one corner. The center of mass of the remainder moves from C to C'. The displacement of the x coordinate of the center of mass (from C to C') is _____.



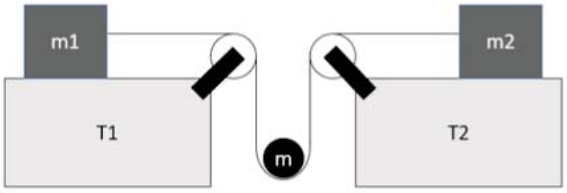
(A) (2/3)L (B) (1/6)L (C) (1/8)L (D) (1/10)L (E) (1/12)L

32. 解：(E)

由質心定義 $\sum_i m_i\vec{x}_i=M\vec{X}_{cm}$

$$m(-\frac{1}{4}L)+m(\frac{1}{4}L)+m(\frac{1}{4}L)=(3m)X_{cm}\Rightarrow X_{cm}=\frac{1}{12}L$$

33. The string and the pulley are massless, and the coefficient of static and kinetic frictions are 0.2 and 0.1, respectively, for both table 1 (T1) and 2 (T2). If m1 = 2 kg, m2 = 3 kg, and m = 1.5 kg, find the acceleration of m. (Gravitational acceleration g = 10 m/s^2)



(A) 7.7 m^2/s (B) 8.7 m^2/s (C) 9.7 m^2/s (D) 10.7 m^2/s (E) 11.7 m^2/s

33. 解：(C) (無正確答案)

對於m1而言

$T-\mu_k m_1 g = m_1 a_1 \Rightarrow T-0.1\times 2\times 10 = 2a_1 \Rightarrow T = 2+2a_1$--------(1)

對於m2而言

$T-\mu_k m_2 g = m_2 a_2 \Rightarrow T-0.1\times 3\times 10 = 3a_2 \Rightarrow T = 3+3a_2$-------(2)

對於m而言

$2T-mg = -ma \Rightarrow 2T-1.5\times 10 = -1.5a$----------(3)

由繩子的總長度固定不變

$a_1+a_2 = -2a$----------(4)

由(1)(2)(3)(4)解得 $a_1 = 2.14\left[m/s^2\right]$、$a_2 = 1.09\left[m/s^2\right]$、$a = 1.62\left[m/s^2\right]$

34. Aluminum Rod #1 has a length L and a diameter d. Aluminum Rod #2 has a length 2L and a diameter 2d. If Rod #1 is under tension T and Rod #2 is under tension 2T, how do the changes in length of the two rods compare?
(A) They are the same.
(B) Rod #1 has double the change in length that Rod #2 has.
(C) Rod #2 has double the change in length that Rod #1 has.
(D) Rod #1 has quadruple the change in length that Rod #2 has.
(E) Rod #2 has quadruple the change in length that Rod #1 has.

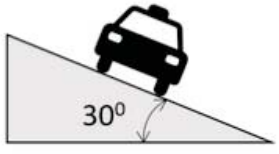
34. 解：(A)

由 $\frac{F}{A} = Y\frac{\Delta l}{l}$

Aluminum Rod #1 $\frac{T}{\pi(\frac{d}{2})^2} = Y\frac{\Delta l}{L} \Rightarrow \Delta l = \frac{4TL}{\pi d^2 Y}$

Aluminum Rod #2 $\frac{2T}{\pi(\frac{2d}{2})^2} = Y\frac{\Delta l}{2L} \Rightarrow \Delta l = \frac{4TL}{\pi d^2 Y}$

35. A toy car is running on a banked circular track of radius 10 m, as shown below. If the car weighs 5 kg and on wet ice, find the maximum velocity for the car to keep on the track without skid. (Gravitational acceleration g = 10 m/s^2, cos30^o = 0.87, cos60^o = 0.5)



(A) 5.4 m/s (B) 7.6 m/s (C) 9.4 m/s (D) 12.6 m/s (E) 15.7 m/s

35. 解：(B)

$$N\sin\theta = m\frac{v^2}{R}$$
$$N\cos\theta = mg$$
$$\Rightarrow \tan\theta = \frac{v^2}{Rg}$$
$$\Rightarrow v = \sqrt{Rg\tan\theta} = \sqrt{10\times 10\tan 30^\circ} = 7.59[m/s]$$

36. A small block of mass m rests on the sloping side of a triangular block of mass M which itself rests on a horizontal table as shown in the figure below**.** Assuming all surfaces are frictionless, determine the magnitude of the force **F** that must be applied to M so that m remains in a fixed position relative to M.
Hint: 1. Take *x* and *y* axes horizontal and vertical. 2. Focus at the object m.

(A) mg sinθ (B) mg tanθ (C) (m+M)g tanθ (D) (m+M)g sinθ (E) None of these

36. 解：(C)

對m而言，由 $\vec{F} = m\vec{a}$
$N\cos\theta - mg = 0 \Rightarrow N\cos\theta = mg$
$N\sin\theta = ma$
$\Rightarrow a = g\tan\theta$
對系統而言
$F = (M+m)a = (M+m)g\tan\theta$

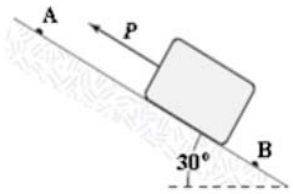
37. The four tires of an automobile are inflated to a gauge pressure of 2.0×10^5 N/m^2 (29 psi). Each of the four tires has an area of 0.024 m^2 that is in contact with the ground. Determine the weight of the auto.

(A) 4.80×10^3N (B) 1.92×10^4N (C) 7.68×10^4N
(D) 8.33×10^6N (E) 2.08×10^7N

37. 解：(B)

$$A = 0.024\times 4 = 0.096[m^2]$$
$$P = \frac{F}{A} \Rightarrow F = PA = 2\times10^5\times0.096 = 1.92\times10^4[N]$$

38. A 2-kg block slides down a frictionless incline from point A to point B. A force (magnitude P = 3 N) acts on the block between A and B, as shown in the figure Points A and B are 2 m apart. If the kinetic energy of the block at A is 10 J, what is the kinetic energy of the block at B? (Gravitational acceleration g = 10 m/s^2)



(A) 17 J (B) 20 J (C) 24 J (D) 27J (E) 37J

38. 解：(C)

由機械能守恆 $E = K + U$
$10 + 2\times9.8\times2\sin30 = K_B + 0 + 3\times2 \Rightarrow K_B = 23.6[J]$

39. On a bridge, a man (weight = 70 kg) plays bungee jumping by tying himself to one end of an elastic rope. The rope has a length of 100 m, and the height of the bridge is 500 m. After jumping, the man begins to bounce back 10 seconds later. What is the effective weight of the man at the bouncing point? (Gravitational acceleration g = 10 m/s^2)
(A) 83 kg (B) 95 kg (C) 102 kg (D) 117 kg (E) 127 kg

39. 解：(E)

男孩向下100公尺時之速度

$$v^2 = v_0^2 + 2gy = 0 + 2 \times 10 \times 100 = 2000$$
$$\Rightarrow v = 44.72[m/s]$$

男孩向下100公尺所花的時間

$$v = v_0 + gt \Rightarrow 44.72 = 0 + 10t \Rightarrow t = 4.472[s]$$

因為繩子具有彈性，故男孩仍然會向下運動，但會越來越慢

$$v = v_0 + at \Rightarrow 0 = 44.72 + a \times 5.528 \Rightarrow a = -8.09[m/s^2]$$

The effective weight of the man at the bouncing point

$$T - mg = ma \Rightarrow T = mg + ma = m(g + a) = M_{eff}g$$
$$\Rightarrow M_{eff} = m(\frac{g+a}{g}) = 70(1 + \frac{8.09}{10}) = 126.6[kg]$$

40. How much energy is required to move a mass *m* object from the Earth's surface to an altitude twice the Earth's radius R_E?
(A) (-1/2)mgR_E (B) (1/2)mgR_E (C) (-2/3)mgR_E (D) (2/3)mgR_E (E) (1/4)mgR_E

40. 解：(D)

重力所作的功

$$W = GMm(\frac{1}{r_f} - \frac{1}{r_i}) = GMm(\frac{1}{3R} - \frac{1}{R}) = -\frac{2GMm}{3R}$$

克服重力所作的功

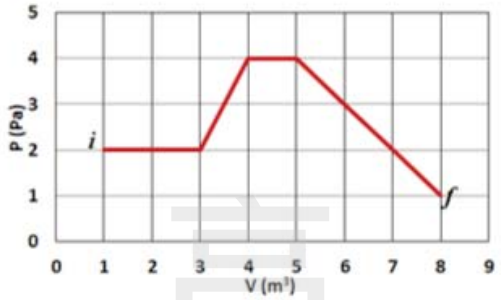
$$\Rightarrow W = \frac{2GMm}{3R} = \frac{2GMm}{3R^2}R = \frac{2}{3}mgR$$

41. A styrofoam container used as a picnic cooler contains a block of ice at 0°C. If 225 g of ice melts in 1 hour, how much heat energy (Joule) per second is passing through the walls of the container? (The heat of fusion of ice is 3.33 × 10^5 J/kg).
(A) 20.8 (B) 124.8 (C) 1800.0 (D) 7492.5 (E) 749250.0

41. 解：(A)

$$\frac{\Delta Q}{\Delta t} = \frac{0.225 \times 3.33 \times 10^5}{3600} = 20.8[J/s]$$

42. How much is the internal energy change of a gas that expands from *i* to *f* as indicated in the figure if there is also a frictional heat loss of 10 J?



(A) -34.5 J (B) 22.5 J (C) -18.5 J (D) -28.5 J (E) 36.5 J

42. 解：(D)

由能量守恆定律 $\Delta U = \Delta Q - \Delta W$

$\Delta U = -10 - 18.5 = -28.5$

43. A solid melt at 100°C by absorbing 2450 kJ heat. How much is the entropy change in this melting process?

(A) 8.23 kJ/K (B) 4.32 kJ/K (C) 7.43 kJ/K (D) 6.57 kJ/K (E) 5.69 kJ/K

43. 解：(D)

$$\Delta S = \frac{\Delta Q}{T} = \frac{2450}{100+273} = 6.57[kJ/K]$$

44. What is the efficiency if a Carnot engine transfers 9.5×10^3 J of energy from a hot reservoir during a cycle and dumps 2×10^3 J heat to a cold reservoir?

(A) 0.69 (B) 0.84 (C) 0.79 (D) 0.65 (E) 0.72

44. 解：(C)

卡諾熱機效率 $e = 1 - \frac{Q_c}{Q_h} = 1 - \frac{2\times10^3}{9.5\times10^3} = 0.79$

45. Water pressurized to 3.5×10^5 Pa is flowing at 5.0 m/s in a horizontal pipe which contracts to 1/3 its former area. What are the pressure and flow speed of the water after the contraction?

(A) 2.5×10^5 Pa, 15 m/s (B) 3.0×10^5 Pa, 10 m/s (C) 3.0×10^5 Pa, 15 m/s

(D) 4.5×10^5 Pa, 1.5 m/s (E) 5.5×10^5 Pa, 1.5 m/s

45. 解：(A)

由 $A_1v_1 = A_2v_2$

$A_1(5) = (\frac{1}{3}A_1)v_2 \Rightarrow v_2 = 15[m/s]$

由 $P_1 + \frac{1}{2}\rho v_1^2 + \rho g y_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho g y_2$

$3.5\times10^5 + \frac{1}{2}\times1000\times5^2 = P_2 + \frac{1}{2}\times1000\times15^2$

$\Rightarrow 3.5\times10^5 = P_2 + 100000$

$\Rightarrow P_2 = 2.5\times10^5[Pa]$

46. A hydraulic jack with two pistons is shown in the figure. The radii are 10 cm and 5 cm, and the weights are 40 kg and 1 kg for the left and right piston, respectively. A ball weighs 9 kg is placed on the right piston. Find the height difference between two pistons in equilibrium status. (Gravitational acceleration g = 10 m/s^2)

(A) 0 cm (B) 10 cm (C) 1 m (D) 10 m (E) 20 m

46. 解：(A)

因 $P_1 = P_2$，故高度差為零

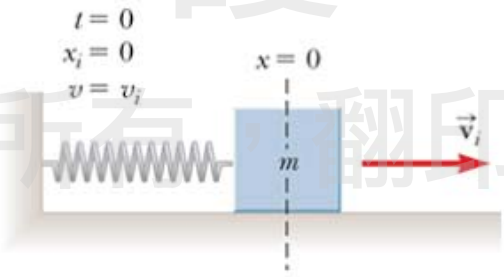
47. A car approaches a stationary police car at 36 m/s. The frequency of the siren (relative to the police car) is 500 Hz. What is the frequency (in Hz) heard by an observer in the moving car as he approaches the police car? (Assume the velocity of sound in air is 343 m/s.)

(A) 220 (B) 383 (C) 448 (D) 526 (E) 552

47. 解：(E)

$$f' = \frac{343+36}{343} \times 500 = 552[Hz]$$

48. A mass-spring system is shown in the figure where the spring constant k = 100 N/m and the mass is 4 kg. Assuming the initial velocity is 3.5 m/s, what is the amplitude of the motion?



(A) 0.5 m (B) 0.7 m (C) 0.8 m (D) 0.9 m (E) 1.2 m

48. 解：(B)

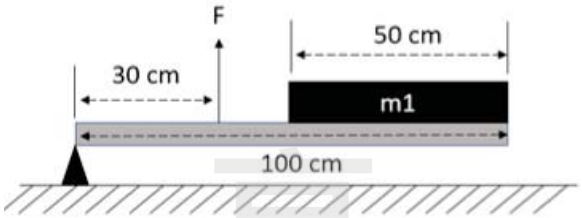
由機械能守恆

$$\frac{1}{2}mv_m^2 + 0 = 0 + \frac{1}{2}kA^2$$

$$\Rightarrow 4 \times 3.5^2 = 100 \times A^2$$

$$\Rightarrow A = 0.7[m]$$

49. A block (m1) with a weight of 10 kg was placed on a wooden bar with a weight of 2 kg. The left end of the bar was attached firmly to a triangle. How much force (F) does it take to keep the system in horizontal equilibrium? (Gravitational acceleration g = 10 m/s^2)



(A) 165 N (B) 224 N (C) 283 N (D) 318 N (E) 361 N

49. 解：(C)

順時針力矩等於逆時針力矩

$$0.3 \times F = 0.5 \times 2 \times 10 + 0.75 \times 10 \times 10$$
$$\Rightarrow F = 283.3[N]$$

50. Halley's comet moves about the Sun in an elliptical orbit with its closest approach to the Sun being 0.59 A.U. and its farthest distance being 35 A.U. If the comet's speed at closest approach is 54 km/s, what is its speed when it is farthest from the Sun? [1 Astronomical Unit (A.U.) is the Earth-Sun distance.]

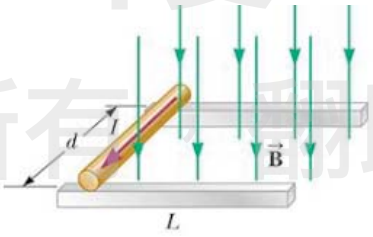
(A) 3203 m/s (B) 910 m/s (C) 15 m/s (D) 13 m/s (E) 7011 m/s

50. 解：(B)

由角動量守恆

$$0.59 \times m \times 54 \times 10^3 = 35 \times m \times v$$
$$\Rightarrow v = 910[m/s]$$

51. A rod of 0.3 m carries a current of I = 48.0 A in the direction shown in the figure and rolls along the rails with a constant speed. A uniform magnetic field of magnitude 0.25 T is directed perpendicular to the rod and the rails. What is the force acting on the rod?



(A) 3.6 N (→) (B) 2.4 N (←) (C) 1.2 N (←) (D) 3.6 N (←) (E) 1.2 N (→)

51. 解：(A) (D)

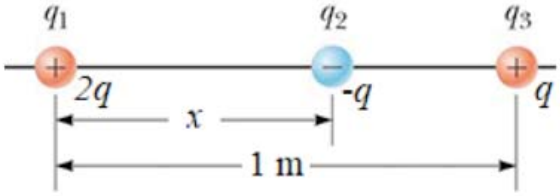
$$F_m = ilB = 48 \times 0.3 \times 0.25 = 3.6[N] \ (\rightarrow)$$

rolls along the rails with a constant speed

$$F_{ext} = F_m = 3.6[N] (\leftarrow)$$

題意沒說何種外力作用在棒子上，若是磁力，則 $F_m = 3.6[N]$ (→)，若是若是外力，則 $F_{ext} = 3.6[N] (\leftarrow)$

52. Three point charges align along the *x*-axis as shown in the figure. What is the equilibrium position *x* of the charge q_2. (The electrical constant is k_e).



(A) 0.45 m (B) 0.62 m (C) 0.36 m (D) 0.78 m (E) 0.59 m

52. 解：(E)

由庫侖定律

$$\frac{k_e 2q^2}{x^2} = \frac{k_e q^2}{(1-x)^2} \Rightarrow x = 0.586[m]$$

53. Two parallel thin planes of charge electrical charge density 2.5×10^{8} C/m^2. What is the electric field in the region between the two planes? Assume that the vacuum electric permittivity is $\varepsilon_0 = 8.9\times10^{-12}$ C^2/N·m^2.

(A) 2.8×10^{18} N/C (B) 5.6×10^{19} N/C (C) 1.4×10^{18} N/C
(D) 2.8×10^{19} N/C (E) 4.2×10^{19} N/C

53. 解：(D)

$$E = \frac{\sigma}{\varepsilon_0} = \frac{2.5\times10^{8}}{8.9\times10^{-12}} = 2.8\times10^{19}[N/C]$$

54. The voltage across a parallel-plate capacitor is measured to be 92.5 V. When a dielectric is inserted between the plates, the voltage drops to 23.4 V. What is the dielectric constant of the inserted material? Assume that the vacuum electric permittivity is $\varepsilon_0 = 8.9\times10^{-12}$ C^2/N·m^2.

(A) 0.26 (B) 2.64 (C) 0.62 (D) 3.95 (E) 1.82

54. 解：(D)

$$V_i = E_i d = \frac{\sigma}{\varepsilon_0} d$$

$$V_f = E_f d = \frac{\sigma}{k\varepsilon_0} d$$

$$\Rightarrow \frac{V_i}{V_f} = k = \frac{92.5}{23.4} = 3.95$$

55. An AC generator consists of 6 turns of a wire. Each turn has an area of 0.040 m^2. The loop rotates in a uniform field (B = 0.20 T) at a constant frequency of 50 Hz. What is the maximum induced emf?

(A) 2.4V (B) 3.0V (C) 4.8V (D) 13V (E) 15V

55. 解：(E)

$$\varepsilon_m = NBA\omega = NBA2\pi f$$
$$= 6\times0.2\times0.04\times2\pi\times50$$
$$= 15.07[V]$$

56. It is known that the magnetic field of 0.17 T can cause an O_2^+ ion to move in a circular orbit of radius 2 m. Find the radius of circular orbit of a Na^{2+} ion with identical velocity in the same magnetic field. (Ion moves in direction perpendicular to the magnetic field.)

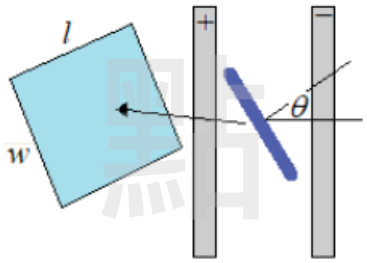
(A) 0.12m (B) 0.25m (C) 0.34m (D) 0.52m (E) 0.72m

56. 解：(E)

$$qvB = m\frac{v^2}{R} \Rightarrow \frac{v}{B} = \frac{qR}{m}$$

$$\frac{1\cdot q\cdot 2}{32} = \frac{2\cdot q\cdot R}{23} \Rightarrow R = 0.72[m]$$

57. What is the electric flux through a surface in between two parallel planes shown in the figure if $w = 2$ cm, $l = 5$ cm, $E = 500$ N/C and $\theta = 30°$?



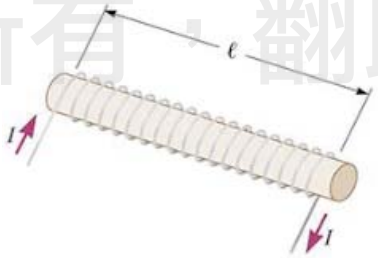
(A) 0.52 N·m^2/C (B) 0.26 N·m^2/C (C) 0.81 N·m^2/C

(D) 0.43 N·m^2/C (E) 0.36 N·m^2/C

57. 解：(D)

$$\phi_E = 500 \times (2\times10^{-2} \times 5\times10^{-2}) \times \cos 30°$$
$$= 0.433[N\cdot m^2/C]$$

58. A solenoid with 200 turns of copper wires is operated by a 1000 V power supply and must be 25 cm long. What is the magnitude of magnetic field that is created in the solenoid? (The resistance of Cu wire is 0.2 Ω and the permeability $\mu_0 = 4\pi\times10^{-7}$ T·m/A)



(A) 5.03T (B) 3.21T (C) 7.84T (D) 4.58T (E) 4.36T

58. 解：(A)

$$V = iR \Rightarrow 1000 = i\times0.2 \Rightarrow i = 5000$$

$$B = n\mu_0 i = \frac{N}{l}\mu_0 i = \frac{200}{0.25}\times4\pi\times10^{-7}\times5000 = 5.024[T]$$

59. For a convex mirror with radius of curvature R = 10 cm, if an object is placed 15 cm in front the mirror, what is the magnification of the image and is it a real or virtual? Upright or inverted? (mirror's equation: $1/p+1/q = 2/R$)
(A) 3.75 cm (virtual behind mirror) and M = 0.25, inverted
(B) 7.50 cm (virtual behind mirror) and M = 0.5, upright
(C) 3.75 cm (real in front mirror) and M = 0.5, inverted
(D) 7.50 cm (real in front mirror) and M = 0.25, inverted
(E) 3.75 cm (virtual behind mirror) and M = 0.25, upright

59. 解：(E)

$$\frac{1}{p}+\frac{1}{q}=\frac{2}{R}\Rightarrow\frac{1}{15}+\frac{1}{q}=\frac{2}{-10}\Rightarrow q=-3.75[cm]<0\text{(虛像)}$$

放大率 $M=-\frac{q}{p}=-\frac{-3.75}{15}=+0.25$ (正立縮小)

60. For a bi-concave thin lens, the radii of curvature are 10 and 20 cm. If an object is placed 15 cm in front of the mirror, what is the magnification of the image and is it a real or virtual? Upright or inverted? (thin lens' equation: $1/p+1/q = (n-1)(1/R_1-1/R_2)$, the refractive index of glass is 1.5).
(A) 9.72 cm (virtual behind mirror) and M = 0.64, inverted
(B) 11.64 cm (virtual behind mirror) and M = 0.58, inverted
(C) 10.91 cm (virtual in front mirror) and M = 0.73, upright
(D) 8.69 cm (real in front mirror) and M = 0.25, inverted
(E) 12.45 cm (virtual behind mirror) and M = 0.53, upright

60. 解：(無正確答案)

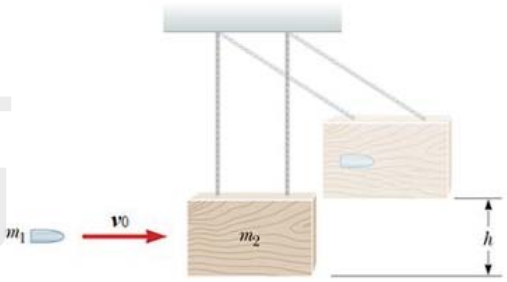
$$\frac{1}{p}+\frac{1}{q}=(n-1)(\frac{1}{R_1}-\frac{1}{R_2})$$

命中事實

高醫後西醫物理110年第六題

100% 命中

6. The ballistic pendulum has mass 10 kg. A bullet of 300 g moves at the speed of v_0 right before hitting the pendulum. How much is the height h that the pendulum can swing upward and rest momentarily? (Gravitational acceleration g = 10 m/s^2)



(A) $6.7\times10^{-5}v_0^2$ (B) $4.2\times10^{-5}v_0^2$ (C) $3.3\times10^{-5}v_0^2$
(D) $2.3\times10^{-5}v_0^2$ (E) $5.7\times10^{-5}v_0^2$

高點程量子物理（上課講義）第五章第二十題

5-20 In the ballistic pendulum, a bullet of mass m is fired into a very large wooden block of mass M suspended by a light wire. The bullet is stopped by the block, and the entire system swing go through a height h. Calculate the velocity of the bullet right before the collision.

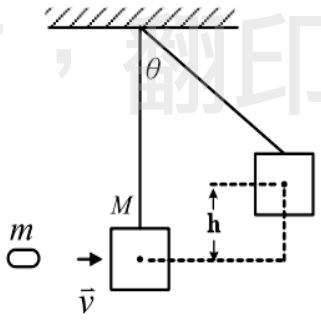
解

碰撞前後那一剎那，系統在水平方向未受外力，故水平方向之動量守恆

$$\Rightarrow mv+0=(m+M)V_{cm}\Rightarrow V_{cm}=\frac{m}{m+M}v \text{----------(1)}$$

往後系統(子彈＋木頭)被視為一個點，它的速度為V_{cm}，利用功與能中之動能變成重力位能

$$\Rightarrow\frac{1}{2}(m+M)V_{cm}^2=(m+M)gh \text{---------(2)}$$



(1) 代入(2)得

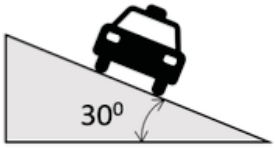
$$\Rightarrow\frac{1}{2}(m+M)(\frac{m}{m+M}v)^2=(m+M)gh$$

$$\Rightarrow v=\sqrt{\frac{m+M}{m}2gh}$$

高醫後西醫物理110年第三十五題

100% 命中

35. A toy car is running on a banked circular track of radius 10 m, as shown below. If the car weighs 5 kg and on wet ice, find the maximum velocity for the car to keep on the track without skid. (Gravitational acceleration g = 10 m/s^2 , cos30° = 0.87, cos60° = 0.5)



(A) 5.4 m/s (B) 7.6 m/s (C) 9.4 m/s (D) 12.6 m/s (E) 15.7 m/s

高點程量子物理（上課講義）第三章第三十五題

3-35一汽車行駛於轉彎的公路上，若路面的傾斜角為θ，曲率半徑為R，求行車速度與傾斜角的關係。

解

汽車是在作圓周運動，故座標軸

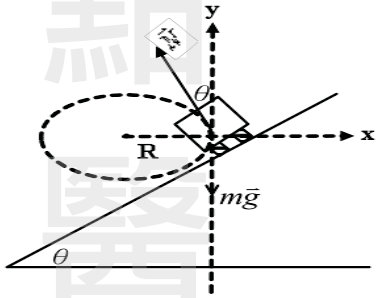
由運動定律

$$\sum F_x = -N\sin\theta = -ma_x = -m\frac{v^2}{R}$$

$$\sum F_y = N\cos\theta - mg = ma_y = 0$$

由以上兩式消去 N 得

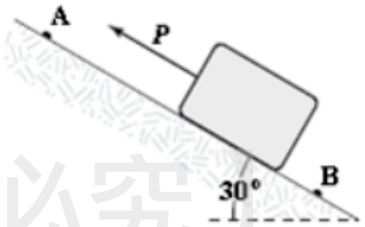
$$v = (Rg\tan\theta)^{1/2}$$



高醫後西醫物理110年第三十八題

100% 命中

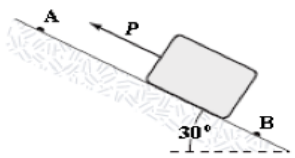
38. A 2-kg block slides down a frictionless incline from point A to point B. A force (magnitude P = 3 N) acts on the block between A and B, as shown in the figure Points A and B are 2 m apart. If the kinetic energy of the block at A is 10 J, what is the kinetic energy of the block at B? (Gravitational acceleration g = 10 m/s^2)



(A) 17 J (B) 20 J (C) 24 J (D) 27 J (E) 37 J

高點程量子物理（七百題題庫）

7. A 2.0-kg block slides down a frictionless incline from point A to point B. A force (magnitude $P = 3.0$ N) acts on the block between A and B, as shown. Points A and B are 2.0 m apart. If the kinetic energy of the block at A is 10 J, what is the kinetic energy of the block at B?



(A) 27 J (B) 20 J (C) 24 J (D) 17 J (E) 37 J

7. 解：(C)

由機械能守恆 $E = K + U$

$$10 + 2\times 9.8\times 2\sin 30 = K + 3\times 2 \Rightarrow K = 23.6[J]$$

高醫後西醫物理110年第四十五題　100% 命中

45. Water pressurized to 3.5×10^5 Pa is flowing at 5.0 m/s in a horizontal pipe which contracts to 1/3 its former area. What are the pressure and flow speed of the water after the contraction?

(A) 2.5×10^5 Pa, 15 m/s　(B) 3.0×10^5 Pa, 10 m/s　(C) 3.0×10^5 Pa, 15 m/s
(D) 4.5×10^5 Pa, 1.5 m/s　(E) 5.5×10^5 Pa, 1.5 m/s

高點程量子物理（上課作業）

6. Water pressurized to 3.5×10^5 Pa is flowing at 5.0 m/s in a horizontal pipe which contracts to 1/3 its former area. What are the pressure and velocity of the water after the contraction?

(A) 2.5×10^5 Pa, 15 m/s　(B) 3.0×10^5 Pa, 10 m/s　(C) 3.0×10^5 Pa, 15 m/s
(D) 4.5×10^5 Pa, 1.5 m/s　(E) 5.5×10^5 Pa, 1.5 m/s

6. 解：(A)

由 $A_1v_1 = A_2v_2$

$$A_1(5) = (\frac{1}{3}A_1)v_2 \Rightarrow v_2 = 15[m/s]$$

由 $P_1 + \frac{1}{2}\rho v_1^2 + \rho g y_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho g y_2$

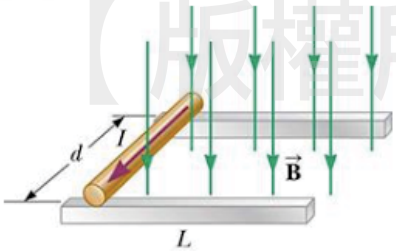
$$3.5\times10^5 + \frac{1}{2}\times1000\times5^2 = P_2 + \frac{1}{2}\times1000\times15^2$$

$$\Rightarrow 3.5\times10^5 = P_2 + 100000$$

$$\Rightarrow P_2 = 2.5\times10^5[Pa]$$

高醫後西醫物理110年第五十一題　100% 命中

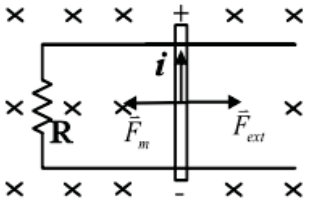
51. A rod of 0.3 m carries a current of $I = 48.0$ A in the direction shown in the figure and rolls along the rails with a constant speed. A uniform magnetic field of magnitude 0.25 T is directed perpendicular to the rod and the rails. What is the force acting on the rod?



(A) 3.6 N (→)　(B) 2.4 N (←)　(C) 1.2 N (←)　(D) 3.6 N (←)　(E) 1.2 N (→)

高點程量子物理（上課講義）磁學第三章

在外力 $\vec{F}_{ext}$ 作用於磁場中的金屬棒時，棒上會產生感應電流 i，見圖。此載流金屬棒又因存在於磁場 $\vec{B}$ 內，它受磁場力 $\vec{F}_m$。當此棒向右等速運動時，$|\vec{F}_{ext}| = |\vec{F}_m|$，單位時間外力 $\vec{F}_{ext}$ 對金屬棒



高醫後西醫物理110年第五十五題 100% 命中

55. An AC generator consists of 6 turns of a wire. Each turn has an area of 0.040 m^2. The loop rotates in a uniform field (B = 0.20 T) at a constant frequency of 50 Hz. What is the maximum induced emf?

(A) 2.4 V (B) 3.0 V (C) 4.8 V (D) 13 V (E) 15 V

高點程量子物理（上課作業）

6. A 10 turn conducting loop with a radius of 3.0 cm spins at 60 revolutions per second in a magnetic field of 0.50 T. The maximum emf generated is:

(A) 0.014 V (B) 0.085 V (C) 0.53 V (D) 0.85 V (E) 5.3 V

6. 解：(E)

$$\varepsilon = -N\frac{d\phi_B}{dt}$$

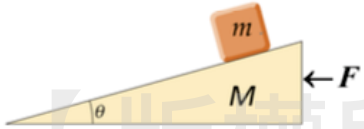
$$= -N\frac{d}{dt}BA\cos(\omega t) = NBA\omega\sin(\omega t) = \varepsilon_{\max}\sin(\omega t)$$

$$\varepsilon_{\max} = NBA\omega = 10\times 0.5\times\pi(3\times10^{-2})^2\times 60\times 2\pi = 5.32[V]$$

高醫後西醫物理110年第三十六題 100% 命中

36. A small block of mass m rests on the sloping side of a triangular block of mass M which itself rests on a horizontal table as shown in the figure below. Assuming all surfaces are frictionless, determine the magnitude of the force **F** that must be applied to M so that m remains in a fixed position relative to M.

Hint: 1. Take x and y axes horizontal and vertical. 2. Focus at the object m.

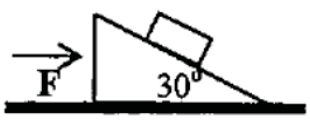


(A) mg sinθ (B) mg tanθ (C) (m+M)g tanθ
(D) (m+M)g sinθ (E) None of these

高點程量子物理（總複習）

3. A rectangular block of mass 1 kg rests on a 30°-wedge-shaped block of mass 3 kg, as shown in the figure. Neglecting all the frictions between the contact surfaces, find the magnitude of horizontal force F that must applied to the wedge in order that the rectangular block does not slide along the wedge:

(A) 19.60 N (B) 22.63 N
(C) 27.72 N (D) 33.95 N.



Problem 3

3. 解：(B)

由 $\bar{F} = m\bar{a}$

$F = (m_1 + m_3)a$ ----------(1)

$N - m_1 g\cos\theta - m_1 a\sin\theta = 0$ ------(2)

$m_1 g\sin\theta - m_1 a\cos\theta = 0$ ----------(3)

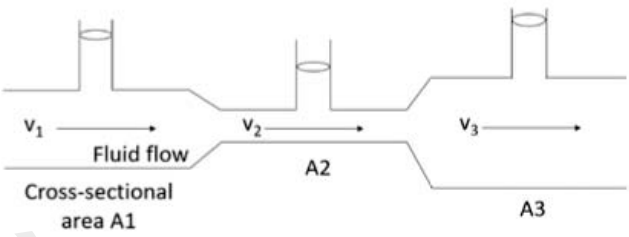
由(3)得 $\tan\theta = \frac{a}{g} \Rightarrow a = \frac{1}{\sqrt{3}}g$

代入(1)得 $F = (1+3)\frac{1}{\sqrt{3}}\times 9.8 = 22.62[N]$

高醫後西醫物理110年第八題

90% 命中

8. A tube with three openings has three different cross-sectional areas (A1:A2:A3 = 2:1:3), as shown in the figure. The pressure difference is 25 Pa between A1 and A2. If $v_1 = 0.125$ (m/s), find the density of the fluid (kg/m^3).



(A) 561 (B) 982 (C) 1067 (D) 1534 (E) 1698

高點程量子物理（七百題題庫）

10. Water pressurized to 3.5×10^5 Pa is flowing at 5.0 m/s in a horizontal pipe which contracts to 1/3 its former area. What are the pressure and velocity of the water after the contraction?

(A) 2.5×10^5 Pa, 15 m/s (B) 3.0×10^5 Pa, 10 m/s (C) 3.0×10^5 Pa, 15 m/s
(D) 4.5×10^5 Pa, 1.5 m/s (E) 5.5×10^5 Pa, 1.5 m/s

10. 解：(A)

由 $A_1v_1 = A_2v_2$

$A_1(5) = (\frac{1}{3}A_1)v_2 \Rightarrow v_2 = 15[m/s]$

由 $P_1 + \frac{1}{2}\rho v_1^2 + \rho g y_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho g y_2$

$3.5\times10^5 + \frac{1}{2}\times1000\times5^2 = P_2 + \frac{1}{2}\times1000\times15^2$

$\Rightarrow 3.5\times10^5 = P_2 + 100000$

$\Rightarrow P_2 = 2.5\times10^5[Pa]$

高醫後西醫物理110年第十題

90% 命中

10. Two waves traveling in opposite directions interfere to produce a standing wave described by $y = 3\sin(2x)\cos(5t)$ where x is in m and t is in s. What is the wavelength of the interfering waves?

(A) 3.14 m (B) 1.00 m (C) 2.00 m (D) 6.28 m (E) 12.00 m

高點程量子物理（總複習）複習題庫

41. The transverse displacement of a standing wave on a string is given by

$$y(x,t) = 4\sin(0.5x)\cos(30t),$$

where x and y are in centimeters (cm). What is the wave speed of component waves?

(A) 10 cm/s (B) 15 cm/s (C) 30 cm/s (D) 60 cm/s (E) 120 cm/s.

41. 解：(D)

$$v = \frac{\omega}{k} = \frac{30}{0.5} = 60[cm/s]$$

高醫後西醫物理110年第五十八題 90% 命中

58. A solenoid with 200 turns of copper wires is operated by a 1000 V power supply and must be 25 cm long. What is the magnitude of magnetic field that is created in the solenoid? (The resistance of Cu wire is 0.2 Ω and the permeability $\mu_0 = 4\pi\times10^{-7}$ T·m/A)

(A) 5.03 T (B) 3.21 T (C) 7.84 T (D) 4.58 T (E) 4.36 T

高點程量子物理（上課作業）

7. A 0.50-m long solenoid consists of 1 000 turns of copper wire wound with a 4.0 cm radius. When the current in the solenoid is 18 A, the magnetic field at a point 1.0 cm from the central axis of the solenoid is
(A) 0.090 mT (B) 0.36 mT (C) 23 mT (D) 36 mT (E) 45 mT

7. 解：(E)

$$B = n\mu_0 i = \frac{N}{l}\mu_0 i = \frac{1000}{0.5}(4\pi\times10^{-7})(18) = 0.0452 = 45.2[mT]$$

高醫後西醫物理110年第五十三題 90% 命中

53. Two parallel thin planes of charge electrical charge density 2.5×10^{8} C/m^2. What is the electric field in the region between the two planes? Assume that the vacuum electric permittivity is $\varepsilon_0 = 8.9\times10^{-12}$ C^2/N·m^2.

(A) 2.8×10^{18} N/C (B) 5.6×10^{19} N/C (C) 1.4×10^{18} N/C
(D) 2.8×10^{19} N/C (E) 4.2×10^{19} N/C

高點程量子物理（上課作業）

3. Two infinite parallel surfaces carry uniform charge densities of 0.20 nC/m^2 and −0.60 nC/m^2. What is the magnitude of the electric field at a point between the two surfaces?
(A) 34 N/C (B) 23 N/C (C) 45 N/C (D) 17 N/C (E) 90 N/C