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2011 Biomedical Engineering Master Entrance Exam — Physics (可用計算機)

選擇題 (總共50題，每題2分，共100分，不倒扣)

1 The coordinate of a particle in meters is given by $x(t) = 16t - 3.0t^3$, where the time t is in seconds. The particle is momentarily at rest at t =
A. 0.75 s B. 1.3 s C. 5.3 s
D. 7.3 s

2 A ball is in free fall. Its acceleration is:
A. downward during both ascent and descent
B. downward during ascent and upward during descent
C. upward during ascent and downward during descent
D. upward during both ascent and descent
E. downward at all times except at the very top, when it is zero

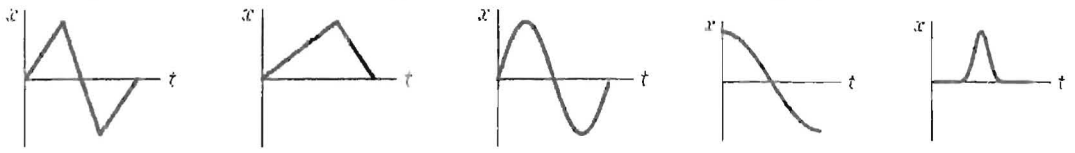
3 Displacement can be obtained from:
A. the slope of an acceleration-time graph
B. the slope of a velocity-time graph
C. the area under an acceleration-time graph
D. the area under a velocity-time graph
E. the slope of an acceleration-time graph

4 A certain vector in the xy plane has an x component of 4m and a y component of 10m. It is then rotated in the xy plane so its x component is doubled. Its new y component is about:
A. 20m B. 7.2m C. 5.0m D. 4.5m E. 2.2m

5 A jet plane in straight horizontal flight passes over your head. When it is directly above you, the sound seems to come from a point behind the plane in a direction 30° from the vertical. The speed of the plane is: A. the same as the speed of sound B. half the speed of sound C. three-fifths the speed of sound D. 0.866 times the speed of sound E. twice the speed of sound

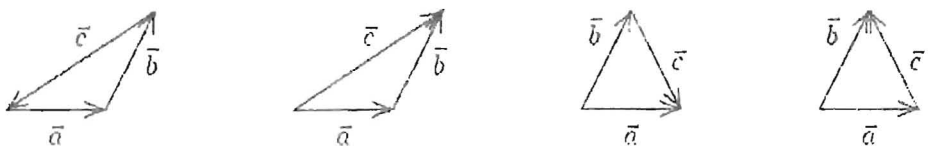
6 For a biological sample in a 1.0-m radius centrifuge to have a centripetal acceleration of 25g its speed must be: A. 11m/s B. 16m/s C. 50m/s D. 122m/s E. 245m/s

7 A car accelerates from rest on a straight road. A short time later, the car decelerates to a stop and then returns to its original position in a similar manner, by speeding up and then slowing to a stop. Which of the following five coordinate versus time graphs best describes the motion?



A　B　C　D　E

8 The vectors $\vec{a}$, $\vec{b}$, and $\vec{c}$ are related by $\vec{c} = \vec{b} - \vec{a}$. Which diagram below illustrates this relationship?



A　B　C　D

E. None of these

(背面仍有題目,請繼續作答)

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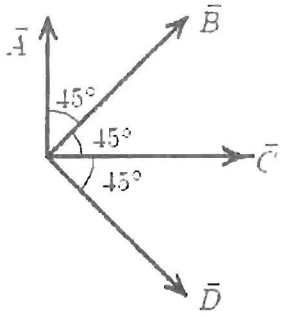
9 Four vectors $\{\vec{A}, \vec{B}, \vec{C}, \vec{D}\}$ all have the same magnitude. The angle θ between adjacent vectors is 45° as shown. The correct vector equation is:

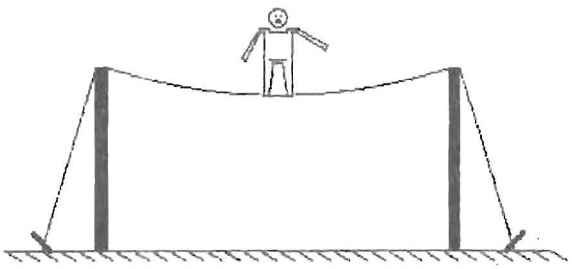


A. $\vec{A}-\vec{B}-\vec{C}+\vec{D}=0$
B. $\vec{B}+\vec{D}-\sqrt{2}\vec{C}=0$
C. $\vec{A}-\vec{B}=\vec{B}+\vec{D}$
D. $\vec{A}-\vec{B}-\vec{C}+\vec{D}=0$
E. $(\vec{A}+\vec{C})/\sqrt{2}=-\vec{B}$

10 A boy on the edge of a vertical cliff 20m high throws a stone horizontally outward with a speed of 20m/s. It strikes the ground at what horizontal distance from the foot of the cliff? Use g = 10m/s2. A. 10m B. 40m C. 50m D. 50√5m E. none of these

11 An object placed on an equal-arm balance requires 12 kg to balance it. When placed on a spring scale, the scale reads 12 kg. Everything (balance, scale, set of weights and object) is now transported to the Moon where the free-fall acceleration is one-sixth that on Earth. The new readings of the balance and spring scale (respectively) are: A. 12 kg, 12 kg B. 2kg, 2kg C. 12 kg, 2 kg D. 2 kg, 12 kg E. 12 kg, 72 kg

12 A circus performer of weight W is walking along a "high wire" as shown. The tension in the wire:



A. is approximately W B. is approximately W/2 C. is much less than W D. is much more than W E. depends on whether he stands on one foot or two feet

13 A 24-N horizontal force is applied to a 40-N block initially at rest on a rough horizontal surface. If the coefficients of friction are $\mu_s = 0.5$ and $\mu_k = 0.4$, the magnitude of the frictional force on the block is: A. 8N B. 12N C. 16N D. 20N E. 400N

14 A line drive to the shortstop is caught at the same height as it was originally hit. Over its entire flight the work done by gravity and the work done by air resistance, respectively, are: A. zero; positive B. zero; negative C. positive; negative D. negative; positive E. negative; negative

15 A force of 10N holds an ideal spring with a 20-N/m spring constant in compression. The potential energy stored in the spring is: A. 0.5J B. 2.5J C. 5 J D. 10 J E. 200 J

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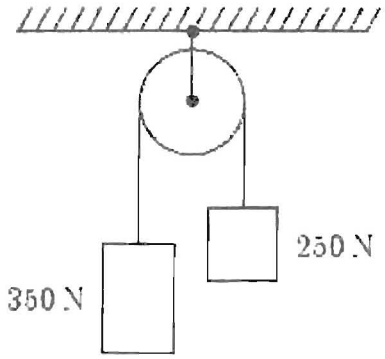
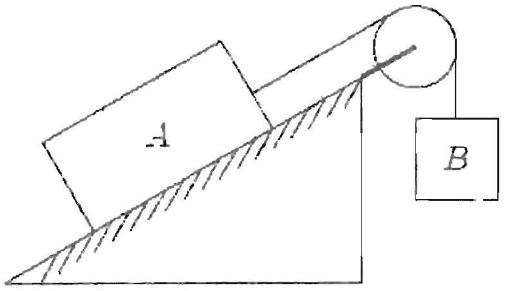
16 Two blocks, weighing 250N and 350 N, respectively, are connected by a string that passes over a massless pulley as shown. The tension in the string is: A. 250N B. 290N C. 350N D. 500N E. 700N



17 Block A, with a mass of 10 kg, rests on a 30° incline. The coefficient of kinetic friction is 0.20. The attached string is parallel to the incline and passes over a massless, frictionless pulley at the top. Block B, with a mass of 8.0 kg, is attached to the dangling end of the string. The acceleration of B is:



A. $0.69\,m/s^2$, up the plane
B. $0.69\,m/s^2$, down the plane
C. $2.6\,m/s^2$, up the plane
D. $2.6\,m/s^2$, down the plane
E. 0

18 The magnitude of the force required to cause a 0.04-kg object to move at 0.6m/s in a circle of radius 1.0m is: A. $2.4 \times 10\text{-}_2$ N B. $1.4 \times 10\text{-}_2$ N C. $1.4\pi \times 10\text{-}_2$ N D. $2.4\pi_2 \times 10\text{-}_2$ N E. 3.13N

19 Camping equipment weighing 6000N is pulled across a frozen lake by means of a horizontal rope. The coefficient of kinetic friction is 0.05. How much work is done by the campers in pulling the equipment 1000m if its speed is increasing at the constant rate of 0.20m/s2? A. $=1.2 \times 10^6$ J B. 1.8×10^5 J C. 3.0×10^5 J D. 4.2×10^5 J E. 1.2×10^6 J

20 Which of the following five quantities is NOT an expression for energy? Here m is a mass, g is the acceleration due to gravity, h and d are distances, F is a force, v is a speed, a is an acceleration, P is power, and t is time. A. mgh B. Fd C. $1/2mv^2$ D. Ma E. Pt

21 A golf ball is struck by a golf club and falls on a green three meters above the tee. The potential energy of the Earth-ball system is greatest: A. just before the ball is struck B. just after the ball is struck C. just after the ball lands on the green D. when the ball comes to rest on the green E. when the ball reaches the highest point in its flight

22 The potential energy of a body of mass m is given by $U = -mgx + 1/2kx^2$. The corresponding force is: A. $-mgx^2/2 + kx^3/6$ B. $mgx^2/2 - kx^3/6$ C. $-mg + kx/2$ D. $-mg + kx$ E. $mg - kx$

(背面仍有題目,請繼續作答)

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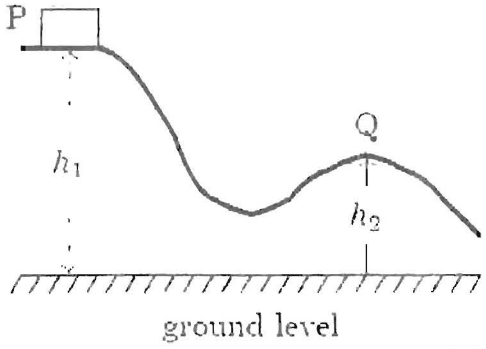
23 A 640-N hunter gets a rope around a 3200-N polar bear. They are stationary, 20m apart, on frictionless level ice. When the hunter pulls the polar bear to him, the polar bear will move:
A. 1.0m B. 3.3m C. 10m D. 12m E. 17m

24 A block is released from rest at point P and slides along the frictionless track shown. At point Q, its speed is:



A. $2g\sqrt{h_1 - h_2}$
B. $2g(h_1 - h_2)$
C. $(h_1 - h_2)/2g$
D. $\sqrt{2g(h_1 - h_2)}$
E. $(h_1 - h_2)^2/2g$

25 A student's life was saved in an automobile accident because an airbag expanded in front of his head. If the car had not been equipped with an airbag, the windshield would have stopped the motion of his head in a much shorter time. Compared to the windshield, the airbag: A. causes a much smaller change in momentum B. exerts a much smaller impulse C. causes a much smaller change in kinetic energy D. exerts a much smaller force E. does much more work

26 Wrapping paper is being from a 5.0-cm radius tube, free to rotate on its axis. If it is pulled at the constant rate of 10 cm/s and does not slip on the tube, the angular velocity of the tube is:
A. 2.0 rad/s B. 5.0 rad/s C. 10 rad/s D. 25 rad/s E. 50 rad/s

27 A 5.0-kg ball rolls without sliding from rest down an inclined plane. A 4.0-kg block, mounted on roller bearings totaling 100 g, rolls from rest down the same plane. At the bottom, the block has: A. greater speed than the ball B. less speed than the ball C. the same speed as the ball D. greater or less speed than the ball,depending on the angle of inclination
E. greater or less speed than the ball, depending on the radius of the ball

28 An airtight box, having a lid of area 80 cm^2, is partially evacuated. Atmospheric pressure is 1.01×10^5 Pa. A force of 600N is required to pull the lid off the box. The pressure in the box was: A. 2.60×10^4 Pa B. 6.35×10^4 Pa C. 7.50×10^4 Pa D. 1.38×10^5 Pa E. 1.76×10^5 Pa

29 A 210-g object apparently loses 30 g when suspended in a liquid of density 2.0g/cm^3. The density of the object is: A. 7.0g/cm^3 B. 3.5g/cm^3 C. 1.4g/cm^3 D. 14 g/cm^3 E. none of these

30 A 0.20-kg object attached to a spring whose spring constant is 500N/m executes simple harmonic motion. If its maximum speed is 5.0m/s, the amplitude of its oscillation is: A. 0.0020m B. 0.10m C. 0.20m D. 25m E. 250m

31 The principle of equipartition of energy states that the internal energy of a gas is shared equally: A. among the molecules B. between kinetic and potential energy C. among the relevant degrees of freedom D. between translational and vibrational kinetic energy E. between temperature and pressure

32 One mole of an ideal gas expands reversibly and isothermally at temperature T until its volume is doubled. The change of entropy of this gas for this process is: A. Rln 2 B. (ln 2)/T C. 0 D. RT ln 2 E. 2R

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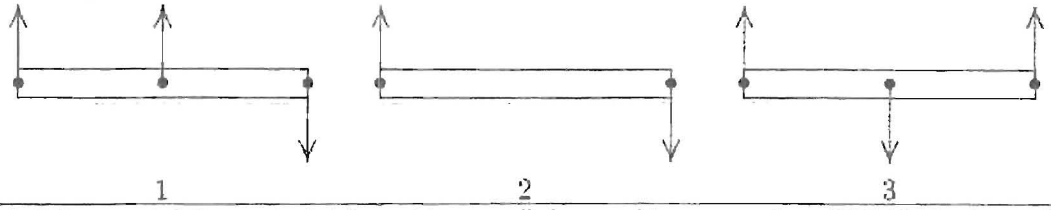
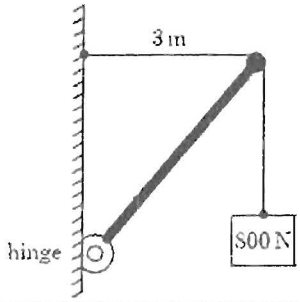
33 Three identical uniform rods are each acted on by two or more forces, all perpendicular to the rods and all equal in magnitude. Which of the rods could be in static equilibrium if an additional force is applied at the center of mass of the rod? A. Only 1 B. Only 2 C. Only 3 D. Only 1 and 2 E. All three

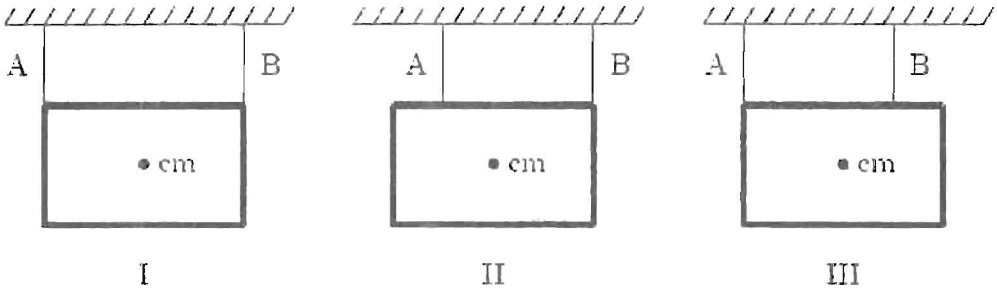


34 A 5.0-m weightless strut, hinged to a wall, is used to support an 800-N block as shown. The horizontal and vertical components of the force of the hinge on the strut are:



A. $F_H = 800\,\text{N},\ F_V = 800\,\text{N}$
B. $F_H = 600\,\text{N},\ F_V = 800\,\text{N}$
C. $F_H = 800\,\text{N},\ F_V = 600\,\text{N}$
D. $F_H = 1200\,\text{N},\ F_V = 800\,\text{N}$
E. $F_H = 0,\ F_V = 800\,\text{N}$

35 A picture is to be hung from the ceiling by means of two wires. Order the following arrangements of the wires according to the tension force of wire B, from least to greatest. A. I, II, III B. III, II, I C. I and II tie, then III D. II, I, III E. all tie



I II III

36 The displacement of a string is given by $y(x, t) = y_m \sin(kx + \omega t)$.
The speed of the wave is: A. $2\pi k/\omega$ B. ω/k C. ωk D. $2\pi/k$ E. $k/2\pi$

37 When the temperature of a copper penny is increased by 100◦C, its diameter increases by 0.17%. The area of one of its faces increases by: A. 0.17% B. 0.34% C. 0.51% D. 0.13% E. 0.27%

38 A negatively charged rubber rod is brought near the knob of a positively charged electroscope. The result is that: A. the electroscope leaves will move farther apart B. the rod will lose its charge C. the electroscope leaves will tend to collapse D. the electroscope will become discharged E. nothing noticeable will happen

39 An isolated charged point particle produces an electric field with magnitude E at a point 2m away from the charge. A point at which the field magnitude is E/4 is: A. 1m away from the particle B. 0.5m away from the particle C. 2m away from the particle D. 4m away from the particle E. 8m away from the particle

(背面仍有題目,請繼續作答)

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40 A charged point particle is placed at the center of a spherical Gaussian surface. The electric flux Φ_E is changed if: A. the sphere is replaced by a cube of the same volume
B. the sphere is replaced by a cube of one-tenth the volume
C. the point charge is moved off center (but still inside the original sphere)
D. the point charge is moved to just outside the sphere
E. a second point charge is placed just outside the sphere

41 Three particles lie on the x axis: particle 1, with a charge of 1×10^{-8} C is at x = 1 cm, particle 2, with a charge of 2×10^{-8} C, is at x = 2 cm, and particle 3, with a charge of -3×10^{-8} C, is at x = 3 cm. The potential energy of this arrangement, relative to the potential energy for infinite separation, is: A. $+4.9 \times 10^{-4}$ J B. -4.9×10^{-4} J C. $+8.5 \times 10^{-4}$ J D. -8.5×10^{-4} J E. zero

42 A battery is used to charge a series combination of two identical capacitors. If the potential difference across the battery terminals is V and total charge Q flows through the battery during the charging process then the charge on the positive plate of each capacitor and the potential difference across each capacitor are: A. Q/2 and V/2, respectively B. Q and V , respectively C. Q/2 and V , respectively D. Q and V/2, respectively E. Q and 2V , respectively

43 A wire with a length of 150m and a radius of 0.15mm carries a current with a uniform current density of 2.8×10^7 A/m^2. The current is: A. 0.63A^2 B. 2.0A C. 5.9A^2 D. 296A E. 400A^2

44 Four 20-Ω resistors are connected in parallel and the combination is connected to a 20-V emf device. The current in the device is: A. 0.25A B. 1.0A C. 4.0A D. 5.0A E. 100A

45 At one instant an electron (charge = -1.6×10^{-19} C) is moving in the xy plane, the components of its velocity being $v_x = 5\times10^5$ m/s and $v_y = 3\times 10^5$ m/s. A magnetic field of 0.8T is in the positive x direction. At that instant the magnitude of the magnetic force on the electron is: A. 0 B. 2.6×10^{-14} N C. 3.8×10^{-14} N D. 6.4×10^{-14} N E. 1.0×10^{-13} N

46 Two long parallel straight wires carry equal currents in opposite directions. At a point midway between the wires, the magnetic field they produce is: A. zero B. non-zero and along a line connecting the wires C. non-zero and parallel to the wires D. non-zero and perpendicular to the plane of the two wires E. none of the above

47 A car travels northward at 75km/h along a straight road in a region where Earth's magnetic field has a vertical component of $0.50 \times 10\text{-}_4$ T. The emf induced between the left and right side, separated by 1.7m, is: A. 0 B. 1.8mV C. 3.6mV D. 6.4mV E. 13mV

48 A capacitor in an LC oscillator has a maximum potential difference of 15V and a maximum energy of 360 μJ. At a certain instant the energy in the capacitor is 40 μJ. At that instant what is the potential difference across the capacitor? A. Zero B. 5V C. 10V D. 15V E. 20V

49 Visible light has a frequency of about: A. 5×10^{18} Hz B. 5×10^{16} Hz C. 5×10^{14} Hz D. 5×10^{12} Hz E. 5×10^{10} Hz

50 Two events occur simultaneously at separated points on the y axis of reference frame S. According to an observer moving in the positive x direction: A. the event with the greater y coordinate occurs first B. the event with the greater y coordinate occurs last
C. either event might occur first, depending on the observer's speed
D. the events are simultaneous E. none of the above