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2014 Biomedical Engineering Master Entrance Exam — Physics (不可用計算機)

選擇題 (總共40題，每題2.5分，共100分，答錯倒扣 0.5分)

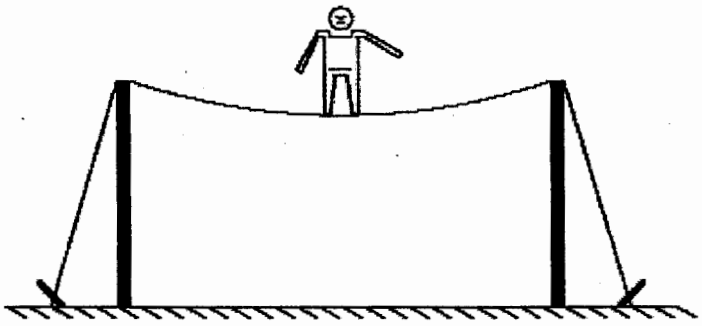
1 Two automobiles are 150 kilometers apart and traveling toward each other. One automobile is moving at 60km/h and the other is moving at 40km/h mph. In how many hours will they meet?
A. 2.5 **B.** 2.0 **C.** 1.75 **D.** 1.5 **E.** 1.25

2 A stone is thrown vertically upward with an initial speed of 19.5 m/s. It will rise to a maximum height of: **A.** 4.9 m **B.** 9.8 m **C.** 19.4 m **D.** 38.8 m **E.** none of these

3 Two vectors have magnitudes of 10m and 15 m. The angle between them when they are drawn with their tails at the same point is 65^0. The component of the longer vector along the line of the shorter is: **A.** 0 **B.** 4.2m **C.** 6.3m **D.** 9.1m **E.** 14m

4 An object is moving on a circular path of radius π meters at a constant speed of 4.0m/s. The time required for one revolution is: **A.** $2/\pi^2$ s **B.** $\pi^2/2$ s **C.** $\pi/2$ s **D.** $\pi^2/4$ **E.** $2/\pi$ s

5 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

6 A 40-N crate rests on a rough horizontal floor. A 12-N horizontal force is then applied to it. If the coefficients of friction are $\mu s = 0.5$ and $\mu k = 0.4$, the magnitude of the frictional force on the crate is: **A.** 8N **B.** 12N **C.** 16N **D.** 20N **E.** 40N

7 A block is placed on a rough wooden plane. It is found that when the plane is tilted 30^0 to the horizontal, the block will slide down at constant speed. The coefficient of kinetic friction of the block with the plane is: **A.** 0.500 **B.** 0.577 **C.** 1.73 **D.** 0.866 **E.** 4.90

8 A 0.50-kg object moves in a horizontal circular track with a radius of 2.5m. An external force of 3.0N, always tangent to the track, causes the object to speed up as it goes around. The work done by the external force as the mass makes one revolution is: **A.** 24 J **B.** 47 J
C. 59 J **D.** 94 J **E.** 120 J

(背面仍有題目，請繼續作答)

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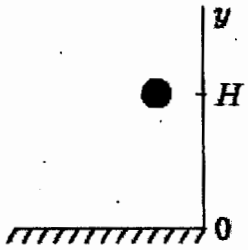
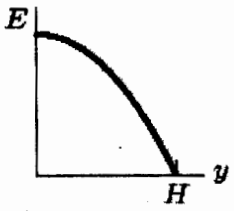
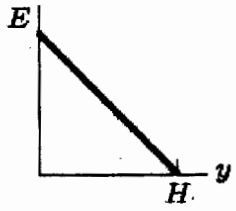
9 A ball is held at a height H above a floor. It is then released and falls to the floor. If air resistance can be ignored, which of the five graphs below correctly gives the mechanical energy E of the Earth-ball system as a function of the altitude y of the ball?

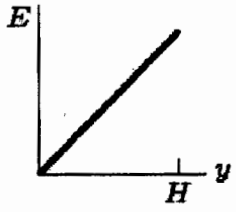




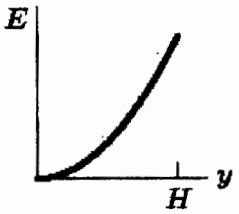
A



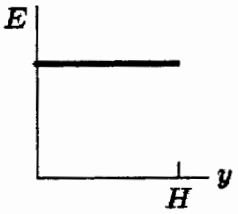
B



C

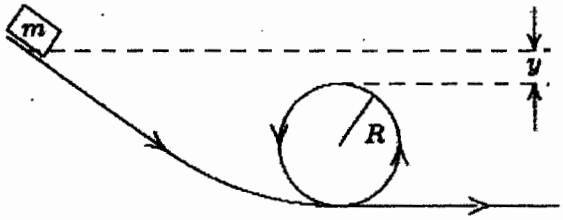


D



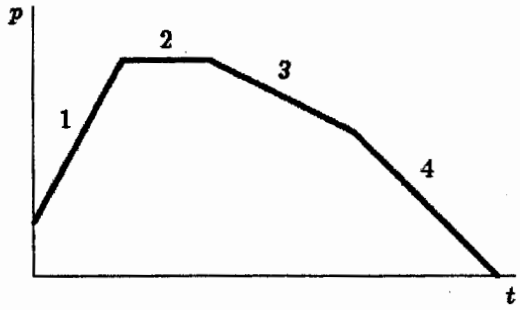
E

10 A small object of mass m starts from rest at the position shown and slides along the frictionless loop-the-loop track of radius R. What is the smallest value of y such that the object will slide without losing contact with the track?



A. R/4 **B.** R/2 **C.** R **D.** 2R **E.** zero

11 A particle moves along the x axis. Its momentum is graphed below as a function of time. Rank the numbered regions according to the magnitude of the force acting on the particle, least to greatest.



A. 1, 2, 3, 4 **B.** 2, 3, 4, 1 **C.** 1, 4, 3, 2 **D.** 1, 3, 4, 2 **E.** 2, 4, 3, 1

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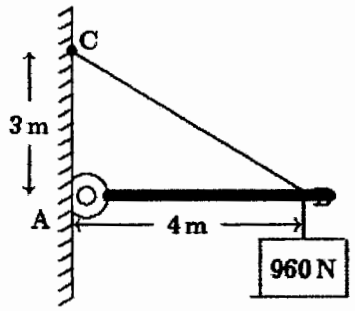
12 A 3.00-g bullet traveling horizontally at 400m/s hits a 3.00-kg wooden block, which is initially at rest on a smooth horizontal table. The bullet buries itself in the block without passing through. The speed of the block after the collision is: **A.** 1.33m/s **B.** 0.40m/s **C.** 12.0m/s **D.** 40.0m/s **E.** 160m/s

13 A flywheel is initially rotating at 20 rad/s and has a constant angular acceleration. After 9.0 s it has rotated through 450 rad. Its angular acceleration is: **A.** 3.3 rad/s **B.** 4.4 rad/s **C.** 5.6 rad/s **D.** 6.7 rad/s **E.** 11 rad/s

14 The coefficient of static friction between a certain cylinder and a horizontal floor is 0.40. If the rotational inertia of the cylinder about its symmetry axis is given by $I = (1/2)MR^2$, then the magnitude of the maximum acceleration the cylinder can have without sliding is:
A. 0.1g **B.** 0.2g **C.** 0.4g **D.** 0.8g **E.** g

15 A 160-N child sits on a light swing and is pulled back and held with a horizontal force of 100 N. The magnitude of the tension force of each of the two supporting ropes is:
A. 60N **B.** 94N **C.** 120N **D.** 190N **E.** 260N

16 A 960-N block is suspended as shown. The beam AB is weightless and is hinged to the wall at



A. The tension force of the cable BC has magnitude:
A. 720N **B.** 1200N **C.** 1280N **D.** 1600N **E.** none of these

17 An object at the surface of Earth (at a distance R from the center of Earth) weighs 90 N. Its weight at a distance 3R from the center of Earth is: **A.** 10N **B.** 30N **C.** 90N **D.** 270N **E.** 810N

18 A bucket resting on the floor of an elevator contains an incompressible fluid of density ρ. When the elevator has a downward acceleration of magnitude a the pressure difference between two points in a fluid, separated by a vertical distance Δh, is given by: **A.** ρaΔh **B.** ρgΔh **C.** ρ(g + a)Δh **D.** ρ(g − a)Δh **E.** ρgaΔh

19 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

（背面仍有題目，請繼續作答）

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20 A cylinder has a radius of 2.1 cm and a length of 8.8 cm. Total charge 6.1×10^{-7} C is distributed uniformly throughout. The volume charge density is: **A.** 5.3×10^{-5} C/m^3 **B.** 5.3×10^{-5} C/m^2 **C.** 8.5×10^{-4} C/m^3 **D.** 5.0×10^{-3} C/m^3 **E.** 6.3×10^{-2} C/m^3

21 A constant-volume gas thermometer is used to measure the temperature of an object. When the thermometer is in contact with water at its triple point (273.16 K) the pressure in the thermometer is 8.500×10^4 Pa. When it is in contact with the object the pressure is 9.650 × 104 Pa. The temperature of the object is:
A. 37.0K **B.** 241K **C.** 310K **D.** 314K **E.** 2020K

22 An automobile tire is pumped up to a gauge pressure of 2.0×10^5 Pa when the temperature is 27^0C. What is its gauge pressure after the car has been running on a hot day so that the tire temperature is 77^0C? Assume that the volume remains fixed and take atmospheric pressure to be 1.013×10^5 Pa.
A. 1.6×10^5 Pa **B.** 2.6×10^5 Pa **C.** 3.6×10^5 Pa **D.** 5.9×10^5 Pa **E.** 7.9×10^5 Pa

23 One mole of an ideal gas expands reversibly and isothermally at temperature T until its volume is double. 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

24 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

25 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

26 Two identical particles, each with charge q, are placed on the x axis, one at the origin and the other at x = 5 cm. A third particle, with charge −q, is placed on the x axis so the potential energy of the three-particle system is the same as the potential energy at infinite separation. Its x coordinate is:
A. 13 cm **B.** 2.5 cm **C.** 7.5 cm **D.** 10 cm **E.** −5 cm

27 A parallel-plate capacitor has a plate area of 0.2m^2 and a plate separation of 0.1mm. To obtain an electric field of 2.0×10^6 V/m between the plates, the magnitude of the charge on each plate should be:
A. 8.9×10^{-7}C **B.** 1.8×10^{-6}C **C.** 3.5×10^{-6}C **D.** 7.1×10^{-6}C **E.** 1.4×10^{-5}C

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28 A certain sample carries a current of 4A when the potential difference is 2V and a current of 10A when the potential difference is 4V. This sample: **A.** obeys Ohm's law **B.** has a resistance of 0.5 Ω at 1V **C.** has a resistance of 2.5 Ω at 1V **D.** has a resistance of 2.5 Ω at 2V **E.** does not have a resistance

29 By using only two resistors, R1 and R2, a student is able to obtain resistances of 3 Ω, 4Ω, 12Ω, and 16 Ω. The values of R1 and R2 (in ohms) are:
A. 3, 4 **B.** 2, 12 **C.** 3, 16 **D.** 4, 12 **E.** 4, 16

30 An electron (charge = -1.6×10^{-19} C) is moving at 3×10^5 m/s in the positive x direction. A magnetic field of 0.8T is in the positive z direction. The magnetic force on the electron is:
A. 0 **B.** 4×10^{-14} N, in the positive z direction **C.** 4×10^{-14} N, in the negative z direction **D.** 4×10^{-14} N, in the positive y direction **E.** 4×10^{-14} N, in the negative y direction

31 The magnetic field a distance 2 cm from a long straight current-carrying wire is 2.0×10^{-5} T. The current in the wire is: **A.** 0.16A **B.** 1.0A **C.** 2.0A **D.** 4.0A **E.** 25A

32 In connection with x-ray emission the symbol Kα refers to:
A. an alpha particle radiation
B. an effect of the dielectric constant on energy levels
C. x-ray radiation from potassium
D. x-ray radiation associated with an electron going from n = ∞ to n = 1
E. x-ray radiation associated with an electron going from n = 2 to n = 1

33 We desire to make an LC circuit that oscillates at 100 Hz using an inductance of 2.5H. We also need a capacitance of: **A.** 1 F **B.** 1mF **C.** 1 μF **D.** 100 μF **E.** 1 pF

34 A bar magnet is broken in half. Each half is broken in half again, etc. The observation is that each piece has both a north and south pole. This is usually explained by:
A. Ampere's theory that all magnetic phenomena result from electric currents
B. our inability to divide the magnet into small enough pieces
C. Coulomb's law **D.** Lenz' law **E.** conservation of charge.

35 If the amplitude of the electric field in a plane electromagnetic wave is 100V/m then the amplitude of the magnetic field is:
A. 3.3×10^{-7} T **B.** 6.7×10^{-7} T **C.** 0.27T **D.** 8.0×10^{7} T **E.** 3.0×10^{9} T

36 A light bulb burns in front of the center of a 40-cm wide plane mirror that is hung vertically on a wall. A man walks in front of the mirror along a line that is parallel to the mirror and twice as far from it as the bulb. The greatest distance he can walk and still see the image of the bulb is:
A. 20 cm **B.** 40 cm **C.** 60 cm **D.** 80 cm **E.** 120 cm

（背面仍有題目，請繼續作答）

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37 In a Young's double-slit experiment, the separation between slits is d and the screen is a distance D from the slits. D is much greater than d and λ is the wavelength of the light. The number of bright fringes per unit width on the screen is:
A. Dd/λ **B.** Dλ/d **C.** D/dλ **D.** λ/Dd **E.** d/Dλ

38 Two stars that are close together are photographed through a telescope. The black and white film is equally sensitive to all colors. Which situation would result in the most clearly separated images of the stars?
A. Small lens, red stars **B.** Small lens, blue stars **C.** Large lens, red stars
D. Large lens, blue stars **E.** Large lens, one star red and the other blue

39 The stopping potential for electrons ejected by 6.8×10^{14}-Hz electromagnetic radiation incident on a certain sample is 1.8V. The kinetic energy of the most energetic electrons ejected and the work function of the sample, respectively, are:
A. 1.8 eV, 2.8 eV **B.** 1.8 eV, 1.0 eV **C.** 1.8 eV, 4.6 eV **D.** 2.8 eV, 1.0 eV **E.** 1.0 eV, 4.6 eV

40 Electrons in a full band do not contribute to the current when an electric field exists in a solid because:
A. the field cannot exert a force on them **B.** the individual contributions cancel each other
C. they are not moving **D.** they make transitions to other bands **E.** they leave the solid