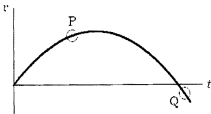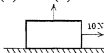※ 考生請注意：本試題 ☑可 □不可 使用計算機

選擇題 (總共80題，每題1.25分，共100分，不倒扣)

1　The diagram shows a velocity-time graph for a car moving in a straight line. At point Q the car must be:

(A) moving with zero acceleration　(B) traveling downhill　(C) traveling below ground-level
(D) reducing speed　(E) traveling in the reverse direction to that at point P

2　A vector has a magnitude of 12. When its tail is at the origin it lies between the positive x axis and the negative y axis and makes an angle of 30º with the x axis. Its y component is:
(A) $6/\sqrt{3}$　(B) $-6\sqrt{3}$　(C) 6　(D) -6　(E) 12

3　A stone is thrown horizontally and follows the path XYZ shown. The direction of the acceleration of the stone at point Y is

horizontal
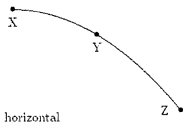
(A) ↓ (B) → (C) ↗ (D) ↘ (E) ↙

4　A 90-kg man stands in an elevator that has a downward acceleration of 1.4m/s². The force exerted by him on the floor is about:　(A) zero　(B) 90N　(C) 760N　(D) 880N　(E) 1010N

5　Acceleration is always in the direction:　(A) of the displacement　(B) of the initial velocity
(C) of the final velocity　(D) of the net force　(E) opposite to the frictional force

6　An object moves around a circle. If the radius is doubled keeping the speed the same then the magnitude of the centripetal force must be:　(A) twice as great　(B) half as great　(C) four times as great　(D) one-fourth as great　(E) the same

7　A crate with a weight of 50N rests on a horizontal surface. A person pulls horizontally on it with a force of 10N and it does not move. To start it moving, a second person pulls vertically upward on the crate. If the coefficient of static friction is 0.4, what is the smallest vertical force for which the crate moves?　(A) 4N　(B) 10N　(C) 14N　(D) 25N　(E) 35N


(背面仍有題目，請繼續作答)

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8 Which of the following bodies has the largest kinetic energy?
(A) Mass 3M and speed V (B) Mass 3M and speed 2V (C) Mass 2M and speed 3V (D) Mass M and speed 4V (E) All four of the above have the same kinetic energy

9 An object moves in a circle at constant speed. The work done by the centripetal force is zero because: (A) the displacement for each revolution is zero (B) the average force for each revolution is zero (C) there is no friction (D) the magnitude of the acceleration is zero (E) the centripetal force is perpendicular to the velocity

10 A 700-N man jumps out of a window into a fire net 10m below. The net stretches 2m before bringing the man to rest and tossing him back into the air. The maximum potential energy of the net, compared to its unstretched potential energy, is:
(A) 300 J (B) 710 J (C) 850 J (D) 7000 J (E) 8400 J

11 A force on a particle is conservative if: (A) its work equals the change in the kinetic energy of the particle (B) it obeys Newton's second law (C) it obeys Newton's third law (D) its work depends on the end points of every motion, not on the path between (E) it is not a frictional force

12 A golf ball of mass m is hit by a golf club so that the ball leaves the tee with speed v. The club is in contact with the ball for time T. The magnitude of the average force on the club on the ball during the time T is: (A) mvT (B) mv/T (C) (1/2)mv^{2}T (D) mv^2/(2T) (E) mT^2/(2v)

13 A 2.5-kg stone is released from rest and falls toward Earth. After 4.0 s, the magnitude of its momentum is: (A) 98 kg · m/s (B) 78 kg · m/s (C) 39 kg · m/s (D) 24 kg · m/s (E) zero

14 The x and y coordinates of the center of mass of the three-particle system shown below are
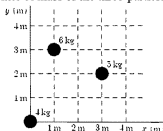
(A) 0, 0 (B) 1.3m, 1.7m (C) 1.4m, 1.9m (D) 1.9m, 2.5m (E) 1.4m, 2.5m

15 A uniform solid cylinder made of lead has the same mass and the same length as a uniform solid cylinder made of wood. The rotational inertia of the lead cylinder compared to the wooden one is:
(A) greater (B) less (C) same (D) unknown unless the radii are given (E) unknown unless both the masses and the radii are given

16 A wheel is spinning at 27 rad/s but is slowing with an angular acceleration that has a magnitude given by (3.0 rad/s^3)t^2. It stops in a time of: (A) 1.7 s (B) 2.6 s (C) 3.0 s (D) 4.4 s (E) 9.0 s

17 The angular speed of the second hand of a watch is: (A) (π/1800) rad/s (B) (π/60)/s (C) (π/30)m/s (D) (2π)m/s (E) (60)m/s

18 A man, with his arms at his sides, is spinning on a light frictionless turntable. When he extends his arms: (A) his angular velocity increases (B) his angular velocity remains the same (C) his rotational inertia decreases (D) his rotational kinetic energy increases (E) his angular momentum remains the same

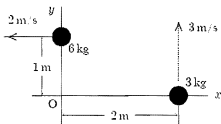19 Two objects are moving in the x, y plane as shown. The magnitude of their total angular

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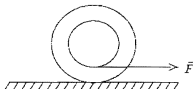
momentum (about the origin O) is:

(A) zero　(B) 6 kg·m²/s　(C) 12 kg·m²/s　(D) 30 kg·m²/s　(E) 78 kg·m²/s

20　A yo-yo, arranged as shown, rests on a frictionless surface. When a force □ F is applied to the string as shown, the yo-yo:

(A) moves to the left and rotates counterclockwise　(B) moves to the right and rotates counterclockwise　(C) moves to the left and rotates clockwise　(D) moves to the right and rotates clockwise　(E) moves to the right and does not rotate

21　When the speed of a rear-drive car is increasing on a horizontal road the direction of the frictional force on the tires is:　(A) forward for all tires　(B) backward for all tires　(C) forward for the front tires and backward for the rear tires　(D) backward for the front tires and forward for the rear tires　(E) zero

22　The ideal mechanical advantage (i.e.) the ratio of the weight W to the pull P for equilibrium of the combination of pulleys shown is:
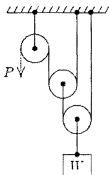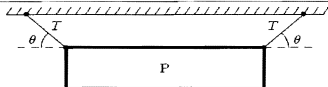

(A) 1　(B) 2　(C) 3　(D) 4　(E) 5

23　A picture P of weight W is hung by two strings as shown. The magnitude of the tension force of each string is T. The total upward pull of the strings on the picture is:

（背面仍有題目,請繼續作答）

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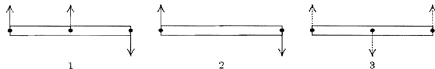

(A) 2W cos θ　(B) T sin θ　(C) T cos θ　(D) 2T sin θ　(E) 2T cos θ

24 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

25 To determine if a rigid body is in equilibrium the vector sum of the gravitational forces acting on the particles of the body can be replaced by a single force acting at:
(A) the center of mass　(B) the geometrical center　(C) the center of gravity　(D) a point on the boundary　(E) none of the above

26 The mass of a hypothetical planet is 1/100 that of Earth and its radius is 1/4 that of Earth. If a person weighs 600N on Earth, what would we weigh on this planet?
(A) 24N　(B) 48N　(C) 96N　(D) 192N　(E) 600N

27 Let M denote the mass of Earth and let R denote its radius. The ratio g/G at Earth's surface is: (A) R^2/M　(B) M/R^2　(C) MR^2　(D) M/R　(E) R/M

28 The two arms of a U-tube are not identical, one having twice the diameter of the other. A cork in the narrow arm requires a force of 16N to remove it. The tube is filled with water and the wide arm is fitted with a piston. The minimum force that must be applied to the piston to push the cork out is: (A) 4N　(B) 8N　(C) 16N　(D) 32N　(E) 64N

29 An airtight box, having a lid of area 80 cm², 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

30 The pressure exerted on the ground by a man is greatest when:
(A) he stands with both feet flat on the ground　(B) he stands flat on one foot　(C) he stands on the toes of one foot　(D) he lies down on the ground　(E) all of the above yield the same pressure

31 A particle oscillating in simple harmonic motion is:
(A) never in equilibrium because it is in motion　(B) never in equilibrium because there is always a force　(C) in equilibrium at the ends of its path because its velocity is zero there
(D) in equilibrium at the center of its path because the acceleration is zero there
(E) in equilibrium at the ends of its path because the acceleration is zero there

32 In simple harmonic motion, the magnitude of the acceleration is:
(A) constant　(B) proportional to the displacement　(C) inversely proportional to the displacement

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(D) greatest when the velocity is greatest　(E) never greater than g

33 Let f be the frequency, v the speed, and T the period of a sinusoidal traveling wave. The correct relationship is:　(A) f = 1/T　(B) f = v + T　(C) f = vT　(D) f = v/T　(E) f = T/v

34 When listening to tuning forks of frequency 256 Hz and 260 Hz, one hears the following number of beats per second:　(A) Zero　(B) 2　(C) 4　(D) 8　(E) 258

35 A balloon is filled with cold air and placed in a warm room. It is NOT in thermal equilibrium with the air of the room until:　(A) it rises to the ceiling　(B) it sinks to the floor　(C) it starts expanding　(D) it starts to contract　(E) none of the above

36 The temperature of a gas is most closely related to:　(A) the kinetic energy of translation of its molecules　(B) its total molecular kinetic energy　(C) the sizes of its molecules　(D) the potential energy of its molecules　(E) the total energy of its molecules

37 273 cm³ of an ideal gas is at 0°C. It is heated at constant pressure to 10°C. It will now occupy:　(A) 263 cm³　(B) 273 cm³　(C) 283 cm³　(D) 278 cm³　(E) 293 cm³

38 The change in entropy is zero for:　(A) reversible adiabatic processes　(B) reversible isothermal processes　(C) reversible processes during which no work is done　(D) reversible isobaric processes　(E) all adiabatic processes

39 A neutral metal ball is suspended by a string. A positively charged insulating rod is placed near the ball, which is observed to be attracted to the rod. This is because:
(A) the ball becomes positively charged by induction
(B) the ball becomes negatively charged by induction
(C) the number of electrons in the ball is more than the number in the rod
(D) the string is not a perfect insulator
(E) there is a rearrangement of the electrons in the ball

40 An electron traveling north enters a region where the electric field is uniform and points north. The electron:　(A) speeds up　(B) slows down　(C) veers east　(D) veers west
(E) continues with the same speed in the same direction

41 The diagram shows the electric field lines in a region of space containing two small charged
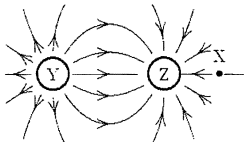
spheres (Y and Z). Then:
(A) Y is negative and Z is positive　(B) the magnitude of the electric field is the same everywhere
(C) the electric field is strongest midway between Y and Z　(D) the electric field is not zero anywhere (except infinitely far from the spheres)　(E) Y and Z must have the same sign

42 A magnetic field CANNOT:　(A) exert a force on a charged particle　(B) change the velocity of a charged particle　(C) change the momentum of a charged particle　(D) change the kinetic energy of a charged particle　(E) change the trajectory of a charged particle

(背面仍有題目，請繼續作答)

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43 The capacitance of a parallel-plate capacitor is: (A) proportional to the plate area (B) proportional to the charge stored (C) independent of any material inserted between the plates (D) proportional to the potential difference of the plates (E) proportional to the plate separation

44 The current is zero in a conductor when no potential difference is applied because: (A) the electrons are not moving (B) the electrons are not moving fast enough (C) for every electron with a given velocity there is another with a velocity of equal magnitude and opposite direction. (D) equal numbers of electrons and protons are moving together (E) otherwise Ohm's law would not be valid

45 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) $400A^2$

46 Which one of the following quantities is correctly matched to its unit? (A) Power – kW·h (B) Energy – kW (C) Potential difference – J/C (D) Current – A/s (E) Resistance – V/C

47 "The sum of the emf's and potential differences around a closed loop equals zero" is a consequence of: (A) Newton's third law (B) Ohm's law (C) Newton's second law (D) conservation of energy (E) conservation of charge

48 A proton (charge e), traveling perpendicular to a magnetic field, experiences the same force as an alpha particle (charge 2e) which is also traveling perpendicular to the same field. The ratio of their speeds, v_{proton}/v_{alpha} is: (A) 0.5 (B) 1 (C) 2 (D) 4 (E) 8

49 An electron moves in the negative x direction, through a uniform magnetic field in the negative y direction. The magnetic force on the electron is:
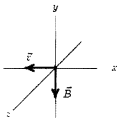
(A) in the negative x direction (B) in the positive y direction (C) in the negative y direction (D) in the positive z direction (E) in the negative z direction

50 Which graph correctly gives the magnitude of the magnetic field outside an infinitely long straight current-carrying wire as a function of the distance r from the wire?
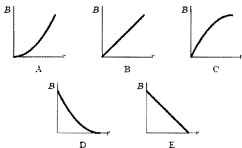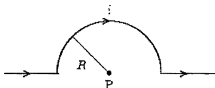
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51 The magnitude of the magnetic field at point P, at the center of the semicircle shown, is given by:

(A) $2\mu_0 i/R$ (B) $\mu_0 i/R$ (C) $\mu_0 i/4\pi R$ (D) $\mu_0 i/2R$ (E) $\mu_0 i/4R$

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52 The emf that appears in Faraday's law is: (A) around a conducting circuit (B) around the boundary of the surface used to compute the magnetic flux (C) throughout the surface used to compute the magnetic flux (D) perpendicular to the surface used to compute the magnetic flux (E) none of the above

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53 1 weber is the same as: (A) 1V/s (B) 1T/s (C) 1T/m (D) 1T $\cdot$ m^2 (E) 1T/m^2

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54 A 150-g block on the end of a spring with a spring constant of 35N/m is pulled aside 25 cm and released from rest. In the electrical analog the initial charge on the capacitor is:
(A) 0.15C (B) 6.67C (C) 0.025C (D) 40C (E) 35C

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55 In the circuit shown, switch S is first pushed up to charge the capacitor. When S is then pushed down, the current in the circuit will oscillate at a frequency of:
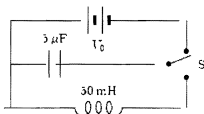
(A) 318 Hz (B) 0.01 Hz (C) 12.500 Hz (D) 2000 Hz (E) depends on V0

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56 A charged capacitor and an inductor are connected in series. At time t = 0 the current is zero, but the capacitor is charged. If T is the period of the resulting oscillations, the next time after t = 0 that the voltage across the inductor is a maximum is:
(A) T (B) T/4 (C) T/2 (D) T (E) 2T

---

57 Two of Maxwell's equations contain a path integral on the left side and an area integral on the right. For them: (A) the path must pierce the area b (B) the path must be well-separated from the area
(C) the path must be along a field line and the area must be perpendicular to the field line
(D) the path must be the boundary of the area (E) the path must lie in the area, away from its boundary

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58 The statement that magnetic field lines form closed loops is a direct consequence of:
(A) Faraday's law (B) Ampere's law (C) Gauss' law for electricity (D) Gauss' law for magnetism (E) the Lorentz force

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59 Which of the following types of electromagnetic radiation travels at the greatest speed in vacuum?
(A) Radio waves (B) Visible light (C) X rays (D) Gamma rays (E) All of these travel at the same speed

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（背面仍有題目，請繼續作答）

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60 Maxwell's equations predict that the speed of electromagnetic waves in free space is given by:
(A) $\mu_0\varepsilon_0$ (B) $(\mu_0\varepsilon_0)^{1/2}$ (C) $1/\mu_0\varepsilon_0$ (D) $1/(\mu_0\varepsilon_0)^{1/2}$ (E) $1/(\mu_0\varepsilon_0)^2$

61 Of the following human eyes are most sensitive to:
(A) red light (B) violet light (C) blue light (D) green light
(E) none of these (they are equally sensitive to all colors)

62 The image produced by a convex mirror of an erect object in front of the mirror is always:
(A) virtual, erect, and larger than the object (B) virtual, erect, and smaller than the object
(C) real, erect, and larger than the object (D) real, erect, and smaller than the object
(E) none of the above

63 A 5.0-ft woman wishes to see a full length image of herself in a plane mirror. The minimum
length mirror required is: (A) 5 ft (B) 10 ft (C) 2.5 ft (D) 3.54 ft
(E) variable: the farther away she stands the smaller the required mirror length

64 In an experiment to measure the wavelength of light using a double slit, it is found that the fringes
are too close together to easily count them. To spread out the fringe pattern, one could:
(A) decrease the slit separation (B) increase the slit separation (C) increase the width of each slit
(D) decrease the width of each slit (E) none of these

65 Interference of light is evidence that: (A) the speed of light is very large (B) light is a transverse
wave (C) light is electromagnetic in character (D) light is a wave phenomenon
(E) light does not obey conservation of energy

66 No fringes are seen in a single-slit diffraction pattern if: (A) the screen is far away
(B) the wavelength is less than the slit width (C) the wavelength is greater than the slit width
(D) the wavelength is less than the distance to the screen (E) the distance to the screen is greater
than the slit width

67 The rainbow seen after a rain shower is caused by:
(A) diffraction (B) Interference (C) Refraction (D) Polarization (E) absorption

68 Diffraction plays an important role in which of the following phenomena?
(A) The sun appears as a disk rather than a point to the naked eye
(B) Light is bent as it passes through a glass prism
(C) A cheerleader yells through a megaphone
(D) A farsighted person uses eyeglasses of positive focal length
(E) A thin soap film exhibits colors when illuminated with white light

69 The proper time between two events is measured by clocks at rest in a reference frame in which the
two events: (A) occur at the same time (B) occur at the same coordinates
(C) are separated by the distance a light signal can travel during the time interval
(D) occur in Boston (E) satisfy none of these

70 A basic postulate of Einstein's theory of relativity is: (A) moving clocks run more slowly than
when they are at rest (B) moving rods are shorter than when they are at rest
(C) light has both wave and particle properties (D) the laws of physics must be the same for
observers moving with uniform velocity relative to each other (E) everything is relative

71 Which of the following electromagnetic radiations has photons with the greatest energy?
(A) blue light (B) yellow light (C) x rays (D) radio waves (E) microwaves

72 The units of the Planck constant h are those of:
(A) energy (B) power (C) momentum (D) angular momentum (E) frequency

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73 Take the potential energy of a hydrogen atom to be zero for infinite separation of the electron and proton. Then, according to quantum theory the energy En of a state with principal quantum number n is proportional to:
(A) n (B) n^2 (C) $1/n$ (D) $1/n^2$ (E) none of the above

74 A particle is confined by finite potential energy walls to a one-dimensional trap from x = 0 to x = L. Its wave function in the region x > L has the form:
(A) $\psi(x) = A\sin(kx)$ (B) $\psi(x) = Ae^{kx}$ (C) $\psi(x) = Ae^{-kx}$ (D) $\psi(x) = Ae^{ikx}$ (E) $\psi(x) = 0$

75 The number of states in a shell with principal quantum number n = 3 is:
(A) 3 (B) 9 (C) 15 (D) 18 (E) 25

76 The density of states for a metal depends primarily on: (A) the temperature (B) the energy (C) the density of the metal (D) the volume of the sample (E) none of these

77 The atomic number of an element is: (A) the whole number nearest to its mass
(B) the number of protons in its nucleus (C) the nearest whole number of hydrogen atoms having the same mass as a single atom of the given element (D) the number of neutrons in its nucleus (E) its order of discovery

78 The mass of a hydrogen atom, in kilograms, is approximately:
(A) 10^{-27} (B) 10^{-31} (C) 10^{-24} (D) 10^{-13} (E) 10^{-8}

79 The binding energy per nucleon: (A) increases for all fission events (B) increases for some, but not all, fission events (C) decreases for all fission events (D) decreases for some, but not all, fission events (E) remains the same for all fission events

80 A particle with spin angular momentum $\hbar$ is called a:
(A) lepton (B) hadron (C) fermion (D) boson (E) electron