



**PHYSICS
HIGHER LEVEL
PAPER 1**

Tuesday 4 May 2004 (afternoon)

1 hour

INSTRUCTIONS TO CANDIDATES

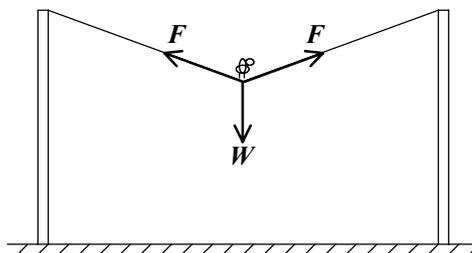
- Do not open this examination paper until instructed to do so.
- Answer all the questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.

1. The number of heartbeats of a person at rest in one hour, to the nearest order of magnitude is
 - A. 10^1 .
 - B. 10^2 .
 - C. 10^3 .
 - D. 10^5 .

2. When a force F of (10.0 ± 0.2) N is applied to a mass m of (2.0 ± 0.1) kg, the percentage uncertainty attached to the value of the calculated acceleration $\frac{F}{m}$ is
 - A. 2 %.
 - B. 5 %.
 - C. 7 %.
 - D. 10 %.

3. The coefficient of dynamic friction between two objects that are in contact depends on
 - A. the relative speed between the two surfaces.
 - B. the area of the surfaces in contact.
 - C. the nature of the two surfaces in contact.
 - D. the density of material of the two objects.

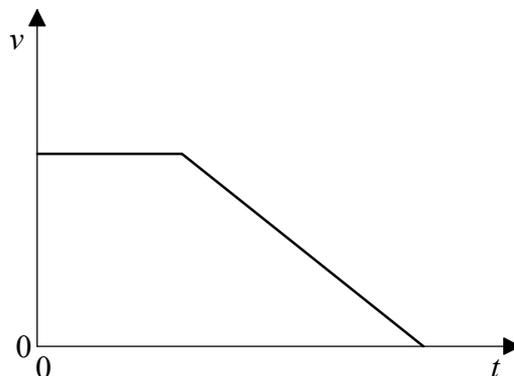
4. A bird of weight W lands at the midpoint of a horizontal wire stretched between two poles. The magnitude of the force exerted by each pole on the wire is F .



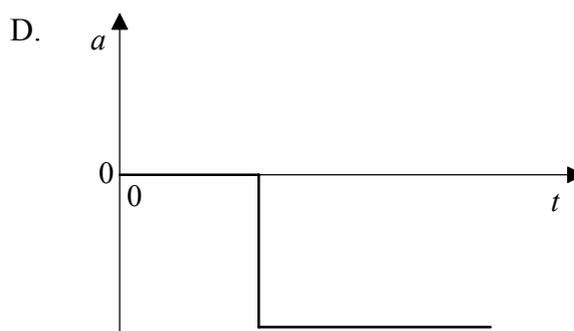
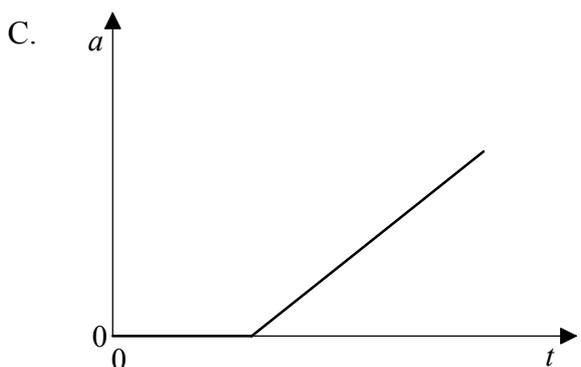
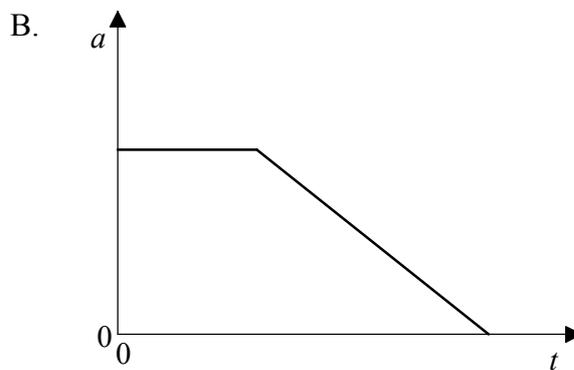
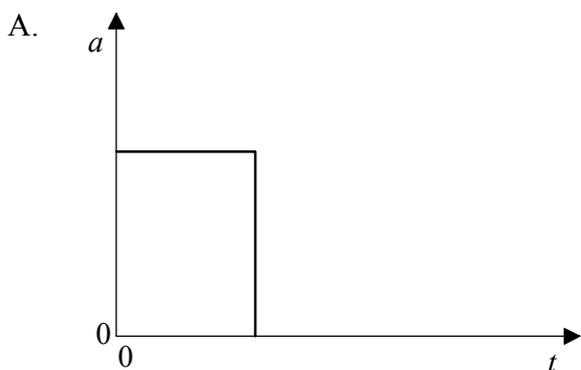
The bird will be in equilibrium if

- A. $2F > W$.
 - B. $2F = W$.
 - C. $2F < W$.
 - D. $F = W$.
5. An ammeter has a zero offset error. This fault will affect
- A. neither the precision nor the accuracy of the readings.
 - B. only the precision of the readings.
 - C. only the accuracy of the readings.
 - D. both the precision and the accuracy of the readings.

The diagram below refers to questions 6 and 7. It shows the variation with time t of the velocity v of an object.



6. The area between the line of the graph and the time-axis represents
- A. the average velocity of the object.
 - B. the displacement of the object.
 - C. the impulse acting on the object.
 - D. the work done on the object.
7. Which **one** of the following graphs shows the variation with time t of the acceleration a of the object?



8. An astronaut in outer space is holding a hammer and drifting at constant velocity. The astronaut throws the hammer in the opposite direction to that in which she is drifting.

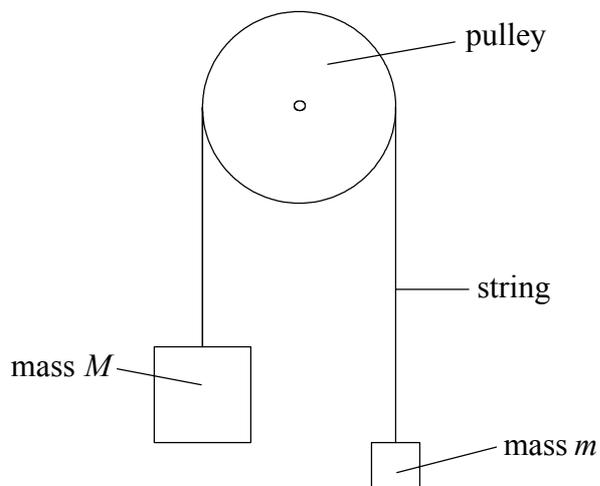
What change, if any, occurs in the total kinetic energy and the total momentum of the astronaut and hammer?

	Total kinetic energy	Total momentum
A.	unchanged	increased
B.	unchanged	unchanged
C.	increased	increased
D.	increased	unchanged

9. A constant force is applied to a ball of mass m . The velocity of the ball changes from v_1 to v_2 . The impulse received by the ball is

- A. $m(v_2 + v_1)$.
- B. $m(v_2 - v_1)$.
- C. $m(v_2^2 + v_1^2)$.
- D. $m(v_2^2 - v_1^2)$.

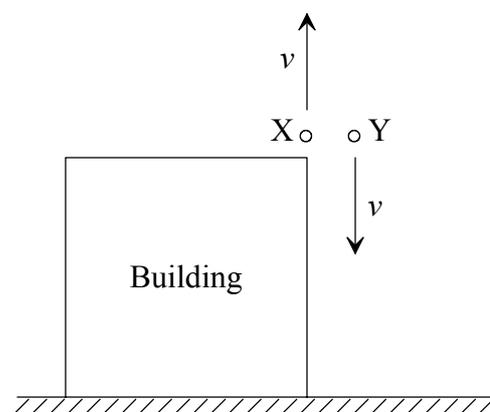
10. A light inextensible string has a mass attached to each end and passes over a frictionless pulley as shown.



The masses are of magnitudes M and m , where $m < M$. The acceleration of free fall is g . The downward acceleration of the mass M is

- A. $\frac{(M - m)g}{(M + m)}$.
- B. $\frac{(M - m)g}{M}$.
- C. $\frac{(M + m)g}{(M - m)}$.
- D. $\frac{Mg}{(M + m)}$.

11. A stone X is thrown vertically upwards with speed v from the top of a building. At the same time, a second stone Y is thrown vertically downwards with the same speed v as shown.

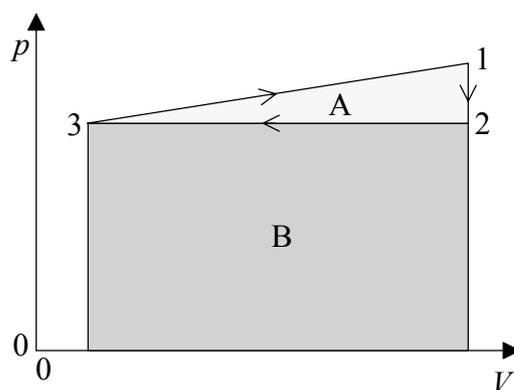


Air resistance is negligible. Which **one** of the following statements is **true** about the speeds with which the stones hit the ground at the base of the building?

- A. The speed of stone X is greater than that of stone Y.
- B. The speed of stone Y is greater than that of stone X.
- C. The speed of stone X is equal to that of stone Y.
- D. Any statement about the speeds depends on the height of the building.
12. The mass of the Moon is m and the mass of the Earth is M . The distance between their centres is R . The torque exerted by the Earth on the Moon is
- A. zero.
- B. $\frac{GMm}{R}$.
- C. $\frac{GMm}{R^2}$.
- D. $\frac{GMm}{R^3}$.

13. The rings of Saturn are made of rocky particles that orbit the planet. The period T of each particle depends on its distance r from the centre of Saturn. The period T is proportional to r^n . Which **one** of the following is n equal to?
- A. 1.0
 - B. 1.5
 - C. 2.0
 - D. 3.0
14. Which **one** of the following statements correctly defines the gravitational potential at a point P in a gravitational field?
- A. The work done per unit mass in moving a small mass from point P to infinity.
 - B. The work done per unit mass in moving a small mass from infinity to point P.
 - C. The work done in moving a small mass from infinity to point P.
 - D. The work done in moving a small mass from point P to infinity.
15. Some liquid is contained in a shallow dish that is open to the atmosphere. The rate of evaporation of the liquid does **not** depend on
- A. the temperature of the liquid.
 - B. the temperature of the atmosphere.
 - C. the depth of the liquid.
 - D. the pressure of the atmosphere.
16. The equation of state for an ideal gas, $pV = nRT$, describes the behaviour of real gases
- A. only at low pressures and large volumes.
 - B. only at high temperatures.
 - C. only at large volumes and large pressures.
 - D. at all pressures and volumes.

17. The temperature of an ideal gas is reduced. Which **one** of the following statements is true?
- A. The molecules collide with the walls of the container less frequently.
 - B. The molecules collide with each other more frequently.
 - C. The time of contact between the molecules and the wall is reduced.
 - D. The time of contact between molecules is increased.
18. In one cycle of a heat engine, 300 J of energy is absorbed and 200 J of energy is ejected. The efficiency of the engine is
- A. $\frac{3}{2}$.
 - B. $\frac{2}{3}$.
 - C. $\frac{1}{2}$.
 - D. $\frac{1}{3}$.
19. The diagram shows the variation with volume V of pressure p during one complete cycle of a heat engine.



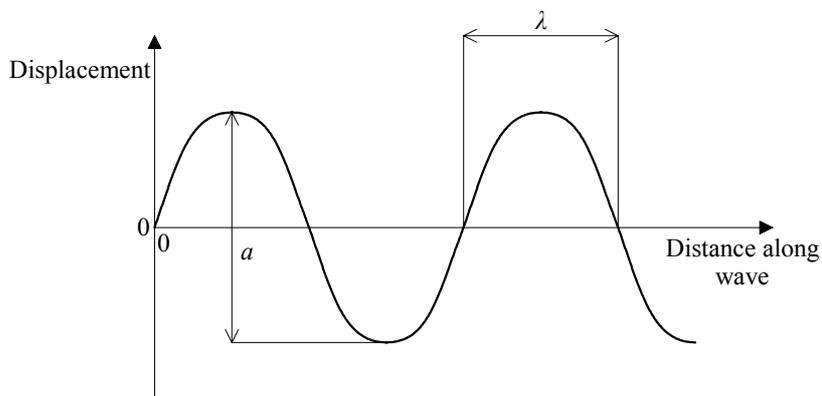
The work done is represented by the area

- A. A.
- B. B.
- C. (B + A).
- D. (B – A).

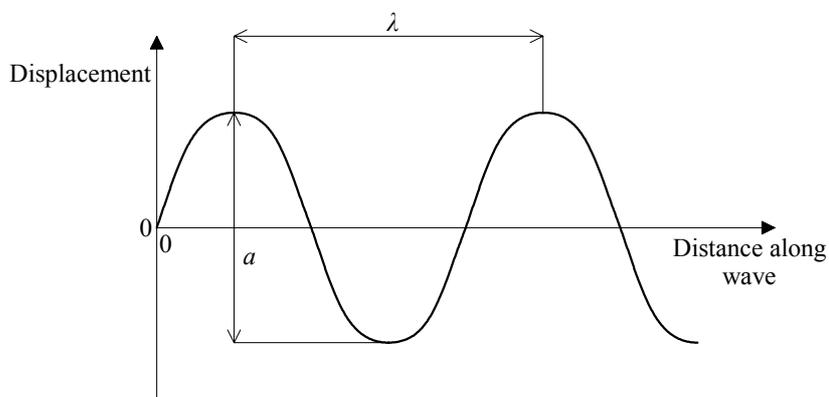
20. A gas expands rapidly. The process is approximately
- A. isobaric.
 - B. isothermal.
 - C. adiabatic.
 - D. isovolumetric.

21. On which **one** of the following graphs is the wavelength λ and the amplitude a of a wave correctly represented?

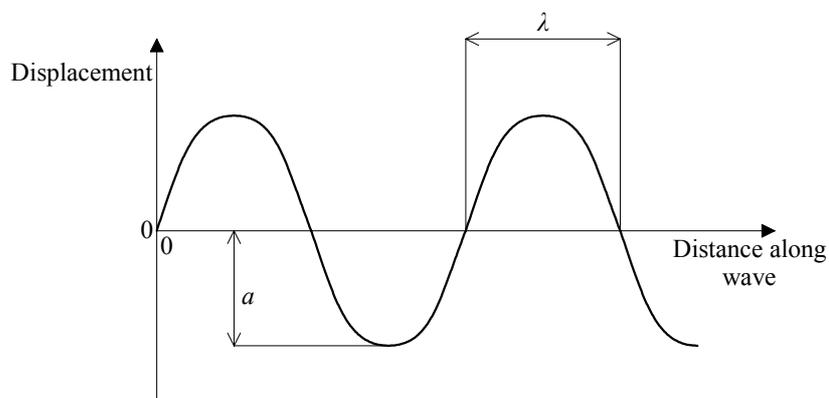
A.



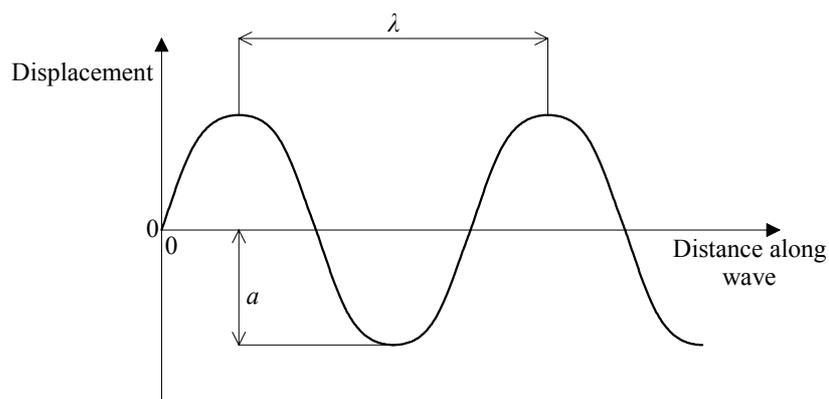
B.



C.



D.



22. The diagram below shows two wave pulses moving towards one another.



Which **one** of the following diagrams shows the resultant pulse when the two pulses are superposed?

- A.
- B.
- C.
- D.

23. Standing waves in an open pipe come about as a result of

- A. reflection and superposition.
- B. reflection and diffraction.
- C. superposition and diffraction.
- D. reflection and refraction.

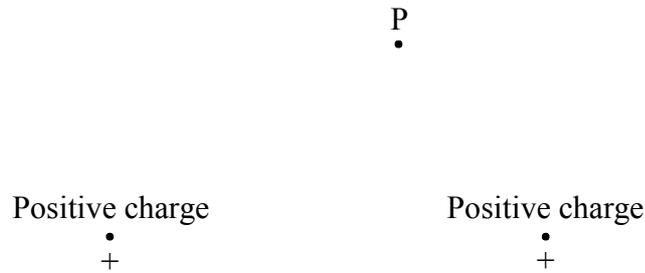
24. The sound from two vibrating strings is heard at the same time. One string produces sound of frequency 350 Hz and the other, 354 Hz. The observer hears a sound of

- A. frequency 350 Hz with a beat frequency of 4 Hz.
- B. frequency 354 Hz with a beat frequency of 2 Hz.
- C. frequency 352 Hz with a beat frequency of 4 Hz.
- D. frequency 352 Hz with a beat frequency of 2 Hz.

25. A source of sound emits waves of wavelength λ , period T and speed v when at rest. The source moves away from a stationary observer at speed V , relative to the observer. The wavelength of the sound waves, as measured by the observer is

- A. $\lambda + vT$.
- B. $\lambda - vT$.
- C. $\lambda + VT$.
- D. $\lambda - VT$.

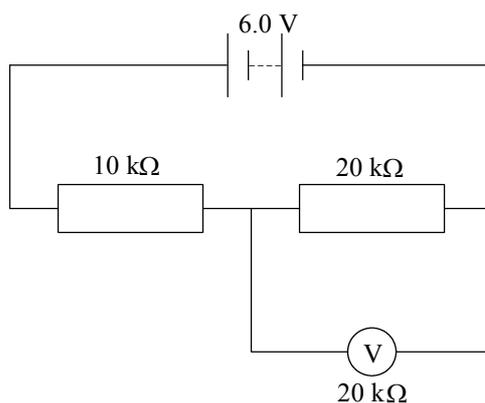
26. The diagram below shows two positive point charges of equal magnitude. A negative point charge is placed at P.



Which **one** of the following diagrams best shows the direction of the resultant force on the negative charge at P?

- A.
- B.
- C.
- D.

27. Which **one** of the following is a fundamental unit?
- A. Coulomb
 - B. Ohm
 - C. Volt
 - D. Ampere
28. A charged particle of mass m and charge q is travelling in a uniform magnetic field with speed v such that the magnetic force on the particle is F . The magnetic force on a particle of mass $2m$, charge q and speed $2v$ travelling in the same direction in the magnetic field is
- A. $4F$.
 - B. $2F$.
 - C. F .
 - D. $\frac{1}{2}F$.
29. In the circuit shown, the voltmeter has a resistance of $20\text{ k}\Omega$ and the battery has an e.m.f. of 6.0 V and negligible internal resistance.



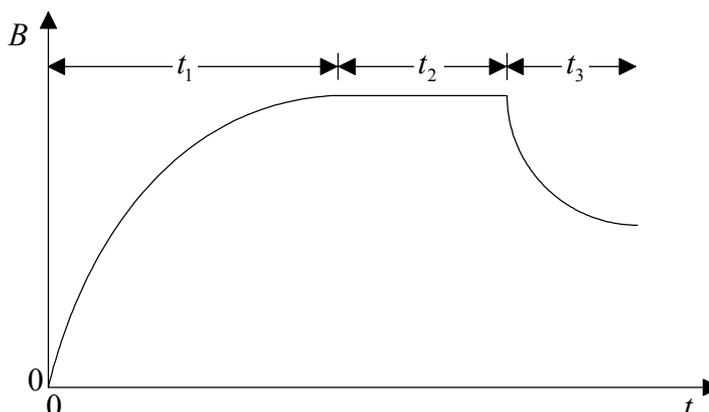
The reading on the voltmeter is

- A. 2.0 V .
- B. 3.0 V .
- C. 4.0 V .
- D. 6.0 V .

30. A battery is connected in series with a resistor R . The battery transfers 2 000 C of charge completely round the circuit. During this process, 2 500 J of energy is dissipated in the resistor R and 1 500 J is expended in the battery.

The e.m.f. of the battery is

- A. 2.00 V.
 - B. 1.25 V.
 - C. 0.75 V.
 - D. 0.50 V.
31. A magnetic field links a closed loop of metal wire. The magnetic field strength B varies with time t as shown.



A current is induced in the loop during the time period

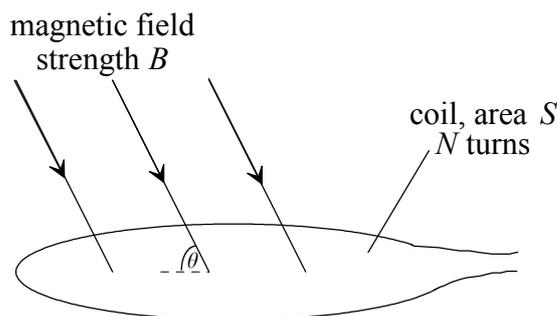
- A. t_1 only.
- B. t_2 only.
- C. t_2 and t_3 only.
- D. t_1 and t_3 only.

32. The rms voltages across the primary and secondary coils in an ideal transformer are V_p and V_s respectively. The currents in the primary and secondary coils are I_p and I_s respectively.

Which **one** of the following statements is always true?

- A. $V_s = V_p$
- B. $I_s = I_p$
- C. $V_s I_s = V_p I_p$
- D. $\frac{V_s}{V_p} = \frac{I_s}{I_p}$.

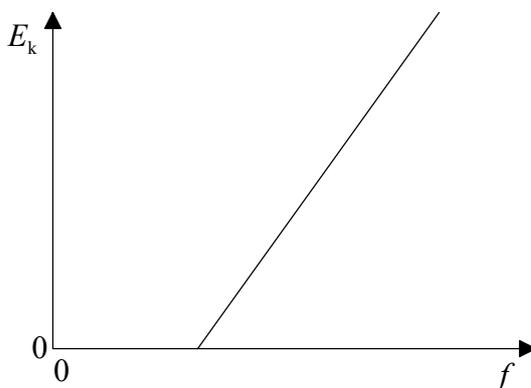
33. A coil of area S has N turns of wire. It is placed in a uniform magnetic field of strength B so that its plane makes an angle θ with the direction of the magnetic field as shown.



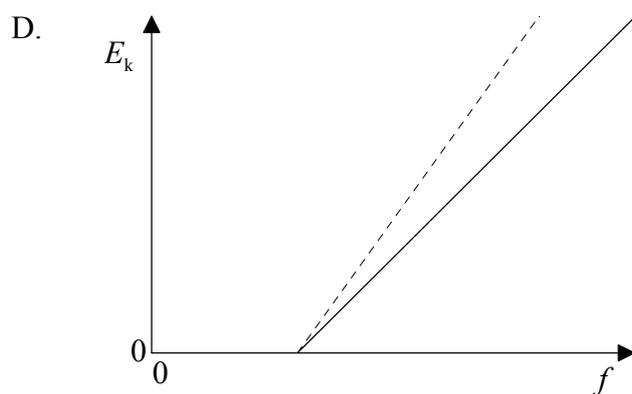
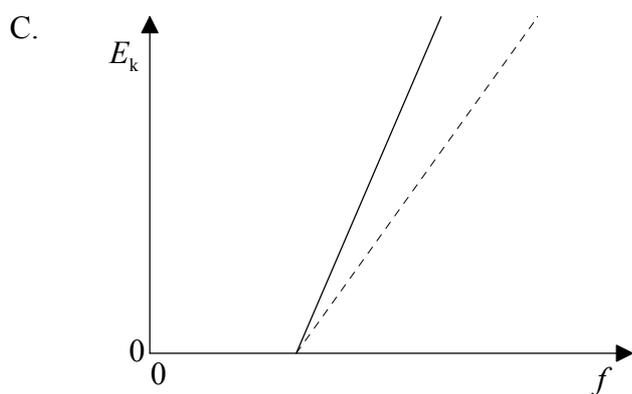
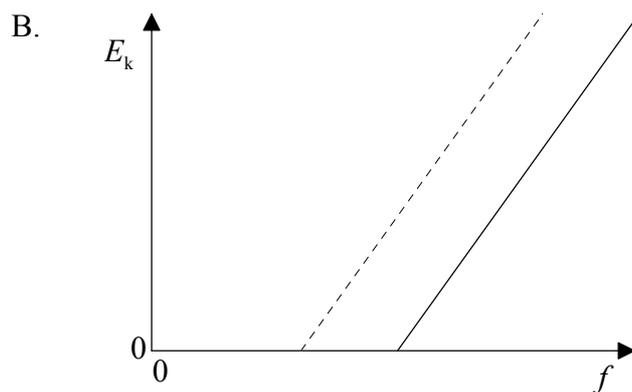
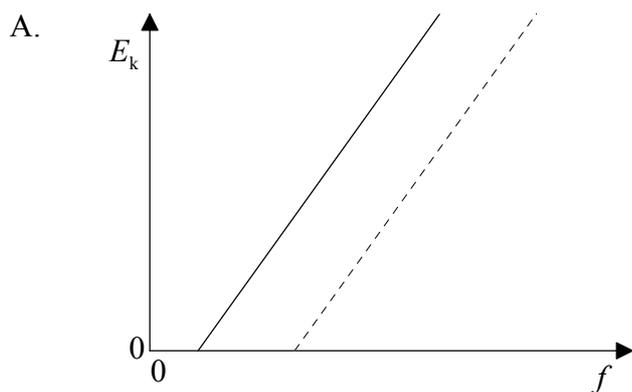
The magnetic flux linkage is

- A. $BSN \sin\theta$.
 - B. $BSN \cos\theta$.
 - C. $BSN \tan\theta$.
 - D. BSN .
34. In an X-ray tube, the accelerating potential difference across the tube determines
- A. the maximum frequency of the X-rays.
 - B. the maximum wavelength of the X-rays.
 - C. the wavelengths of the characteristic spectra.
 - D. the maximum intensity of the X-ray beam.

35. The graph shows the variation with frequency f of the maximum kinetic energy E_k of photoelectrons emitted from a metal surface S.



Which **one** of the following graphs shows the corresponding variation for a metal surface with a higher work function? The dotted line on each graph shows the variation for metal S.



36. A particle has kinetic energy E and its associated de Broglie wavelength is λ . The energy E is proportional to
- A. λ^2 .
 - B. λ .
 - C. λ^{-1} .
 - D. λ^{-2} .
37. Which **one** of the following statements is true for the decay of a radioactive isotope?
- A. The activity at any particular time is proportional to the original number of nuclei present.
 - B. The activity at any particular time is proportional to the number of nuclei of the isotope present at that time.
 - C. The activity at any particular time is proportional to the half-life of the isotope.
 - D. The activity at any particular time is proportional to the decay constant of the isotope.
38. An isotope of radium has a half-life of 4 days. A freshly prepared sample of this isotope contains N atoms. The time taken for $\frac{7N}{8}$ of the atoms of this isotope to decay is
- A. 32 days.
 - B. 16 days.
 - C. 12 days.
 - D. 8 days.
39. Which particles among the following are leptons?
- A. Protons and neutrons
 - B. Electrons and photons
 - C. Electrons and neutrinos
 - D. Quarks and bosons

40. Which **one** of the following gives evidence for the existence of nuclear energy levels?

- A. Gamma ray spectra
 - B. Visible line spectra
 - C. Absorption spectra
 - D. X-ray spectra
-