22096507

International Baccalaureate®
Baccalauréat International
Bachillerato Internacional

PHYSICS
HIGHER LEVEL
PAPER 1

Tuesday 12 May 2009 (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.

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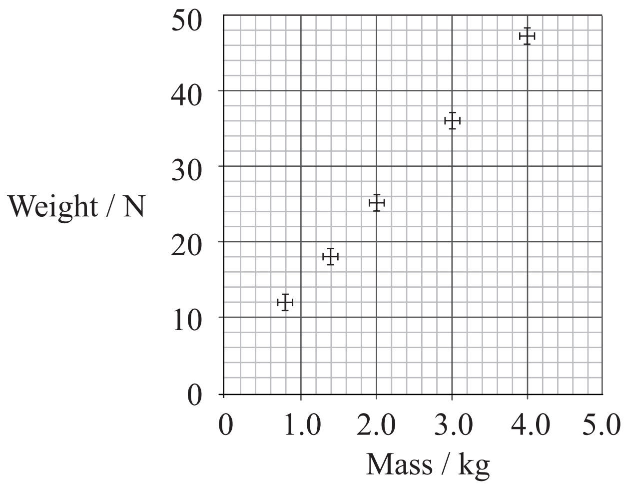
1. The masses and weights of different objects are independently measured. The graph is a plot of weight versus mass that includes error bars.



These experimental results suggest that

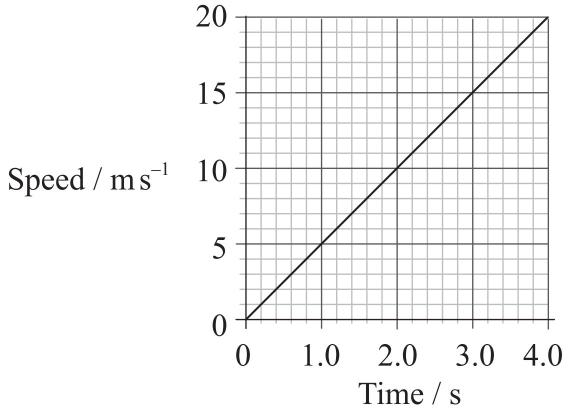
A. the measurements show a significant systematic error but small random error.

B. the measurements show a significant random error but small systematic error.

C. the measurements are precise but not accurate.

D. the weight of an object is proportional to its mass.

2. The graph is a speed versus time graph for an object that is moving in a straight line.



The distance travelled by the object during the first 4.0 seconds is

A. 80 m.

B. 40 m.

C. 20 m.

D. 5 m.

3. A lift (elevator) is operated by an electric motor. It moves between the 10th floor and the 2nd floor at a constant speed. One main energy transformation during this journey is

A. gravitational potential energy $\rightarrow$ kinetic energy.

B. electrical energy $\rightarrow$ kinetic energy.

C. kinetic energy $\rightarrow$ thermal energy.

D. electrical energy $\rightarrow$ thermal energy.

4. A communications satellite is moving at a constant speed in a circular orbit around Earth. At any given instant in time, the resultant force on the satellite is

A. zero.

B. equal to the gravitational force on the satellite.

C. equal to the vector sum of the gravitational force on the satellite and the centripetal force.

D. equal to the force exerted by the satellite's rockets.

5. A student is sitting on a chair. One force that is acting on the student is the pull of gravity. According to Newton's third law, there must be another force which is

A. the upward push of the chair on the student.

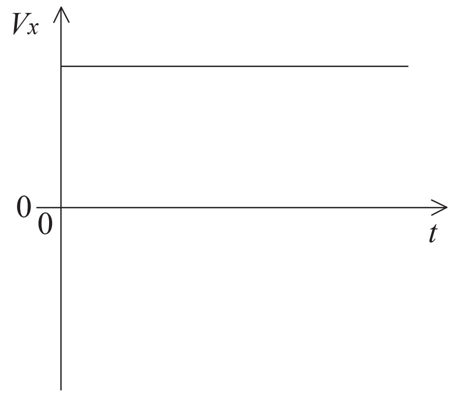
B. the downward force on the student.

C. the downward push of the chair on Earth.

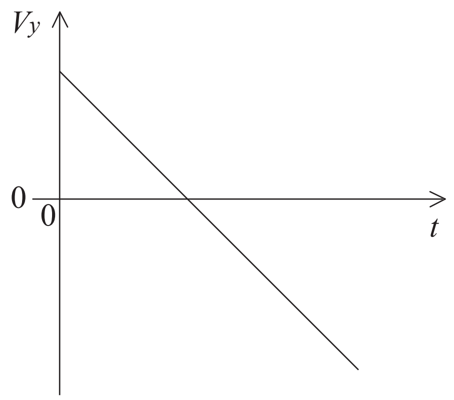
D. the upward force on Earth.

6. An object moves in the *x*-*y* plane. The graphs below show how the component of its velocity V_x in the *x*-direction and the component of its velocity V_y in the *y*-direction, vary with time *t*.

x-direction component



y-direction component



The particle is moving

A. in a parabola.

B. with simple harmonic motion.

C. with constant velocity in a straight line.

D. in a circle.

7. The mass of a planet is M and its radius is R. In order for a body of mass m to escape the gravitational attraction of the planet, its kinetic energy at the surface of the planet must be at least

A. $\dfrac{GMm}{R}$

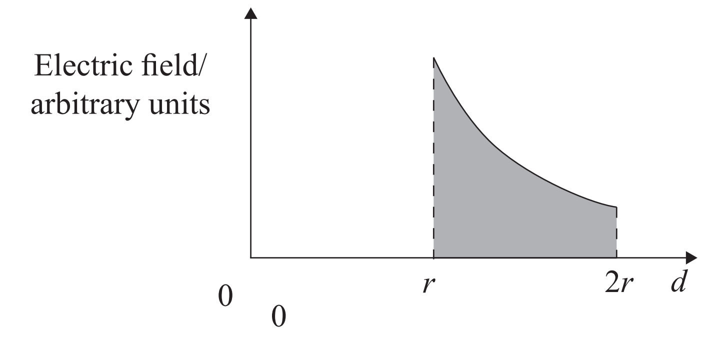
B. $\dfrac{GMm}{R^2}$

C. $\dfrac{GM}{R}$

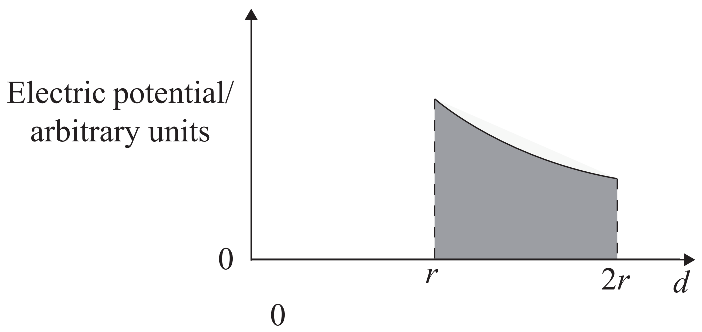
D. $\dfrac{GM}{R^2}$

8. The two graphs below represent the variation with distance, d, for $d = r$ to $d = 2r$ of the electric field and the electric potential around an isolated point charge.

Graph 1:



Graph 2:



The work done by an external force in moving a test charge $+q$ from $d = 2r$ to $d = r$ is equal to q multiplied by the

A. shaded area under graph 1.

B. shaded area under graph 2.

C. average value of the electric field.

D. average value of the electric potential.

9. The ratio

$$\frac{\text{thermal capacity of a sample of copper}}{\text{specific heat capacity of copper}}$$

A. does not have any unit.

B. has unit $\text{J kg}^{-1}\ \text{K}^{-1}$.

C. has unit J kg^{-1}.

D. has unit kg.

10. In the kinetic model of an ideal gas, it is assumed that

A. the forces between the molecules of the gas and the container are always zero.

B. the intermolecular potential energy of the molecules of the gas is constant.

C. the kinetic energy of a given molecule of the gas is constant.

D. the momentum of a given molecule of the gas is constant.

11. A positive amount of thermal energy Q is transferred to an ideal gas from its surroundings. The internal energy of the gas increases and the gas does a positive amount of work W on its surroundings. The change of state of the gas is

A. isochoric (isovolumetic).

B. isobaric.

C. isothermal.

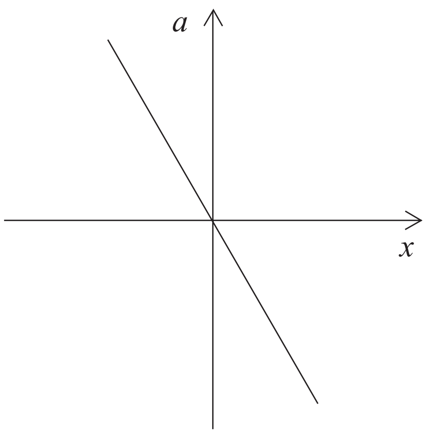
D. adiabatic.

12. Which of the following correctly describes the entropy changes of the water molecules and the universe when a sample of water freezes?

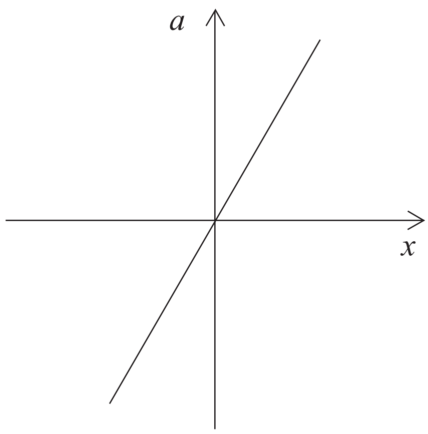
	Water molecules	Universe
A.	increases	increases
B.	decreases	increases
C.	increases	decreases
D.	decreases	decreases

13. Which graph correctly shows how the acceleration a of a particle undergoing SHM varies with its displacement x from its equilibrium position?

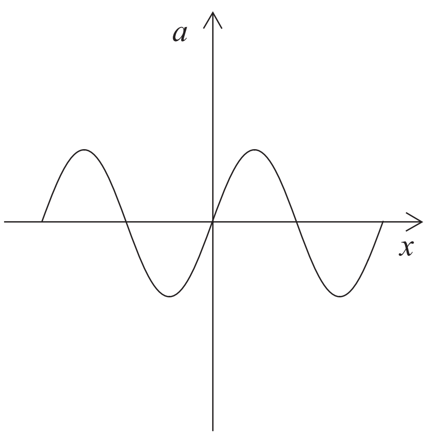
A.



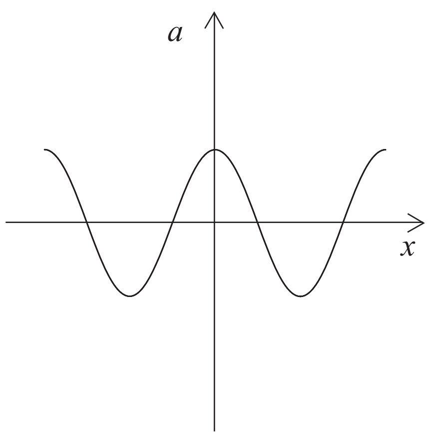
B.



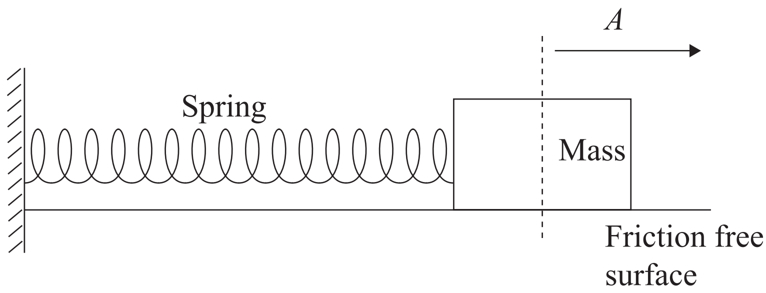
C.



D.



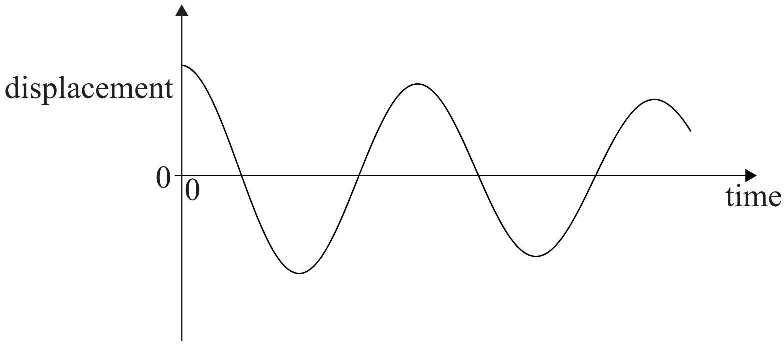
14. A mass on the end of a horizontal spring is displaced from its equilibrium position by a distance A and released. Its subsequent oscillations have total energy E and time period T.



An identical mass is attached to an identical spring. The maximum displacement is $2A$. Assuming this spring obeys Hooke's law, which of the following gives the correct time period and total energy?

	New time period	**New energy**
A.	T	$4E$
B.	T	$2E$
C.	$\sqrt{2}T$	$4E$
D.	$\sqrt{2}T$	$2E$

15. The graph below represents the variation with time of the displacement of an oscillating particle.



The motion of the object is

A. over damped.

B. critically damped.

C. lightly damped.

D. not damped.

16. The wavelength of a standing (stationary) wave is equal to

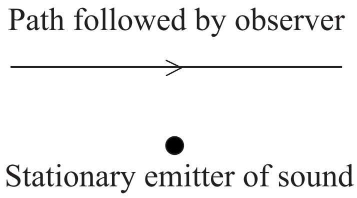
A. the distance between adjacent nodes.

B. twice the distance between adjacent nodes.

C. half the distance between adjacent nodes.

D. the distance between a node and an adjacent antinode.

17. During a journey an observer travels at constant speed towards, and then goes beyond, a stationary emitter of sound.



The frequency of the sound as measured at the emitter is *f*. The frequency according to the observer

A. is always greater than *f*.

B. is always equal to *f*.

C. is always less than *f*.

D. varies during the journey.

18. A parallel beam of monochromatic light of wavelength λ passes through a slit of width *b*. After passing through the slit the light is incident on a distant screen. The angular width of the central maximum is

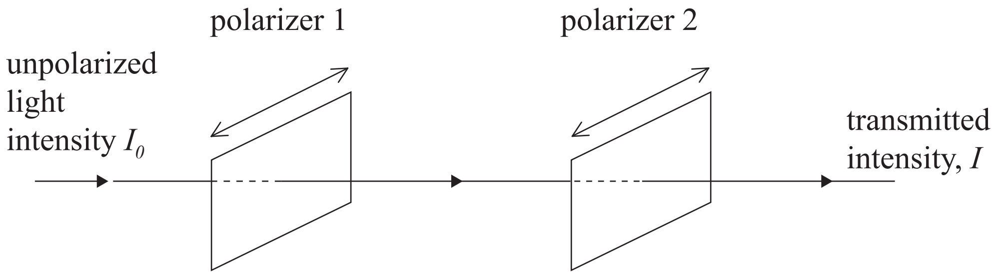
A. $2\dfrac{\lambda}{b}$ radians.

B. $\dfrac{\lambda}{b}$ radians.

C. $2\dfrac{\lambda}{b}$ degrees.

D. $\dfrac{\lambda}{b}$ degrees.

19. Unpolarized light is shone through two identical polarizers whose axes are parallel.



The ratio $\frac{I}{I_0}$ is

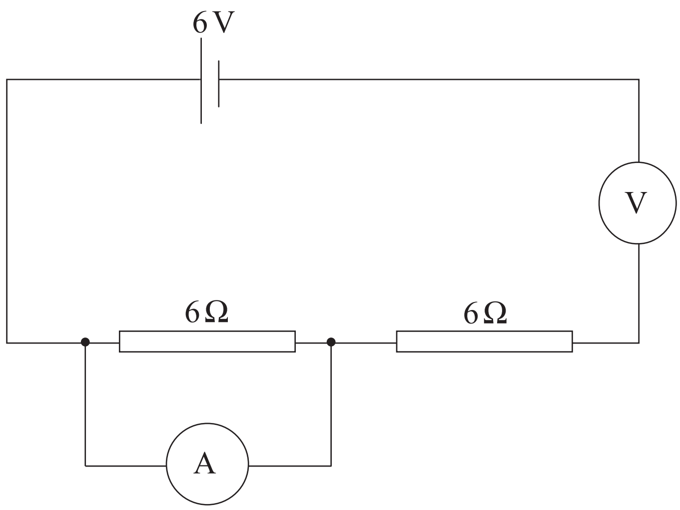
A. 100%.

B. 50%.

C. 25%.

D. 0%.

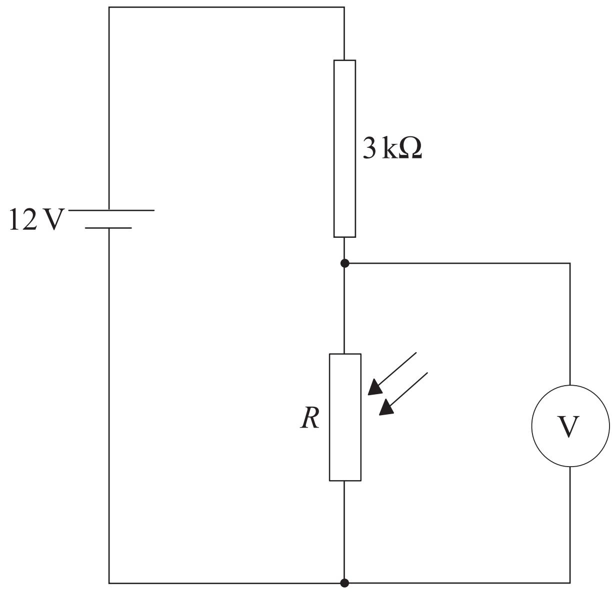
20. Two 6 Ω resistors are connected in series with a 6 V cell. A student **incorrectly** connects an ammeter and a voltmeter as shown below.



The readings on the ammeter and on the voltmeter are

	Ammeter reading / A	Voltmeter reading / V
A.	0.0	0.0
B.	0.0	6.0
C.	1.0	0.0
D.	1.0	6.0

21. The diagram shows a potential divider circuit.



In order to increase the reading on the voltmeter the

A. temperature of *R* should be increased.

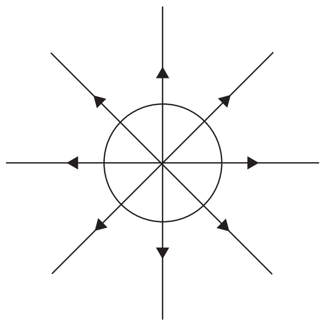
B. temperature of *R* should be decreased.

C. light intensity on *R* should be increased.

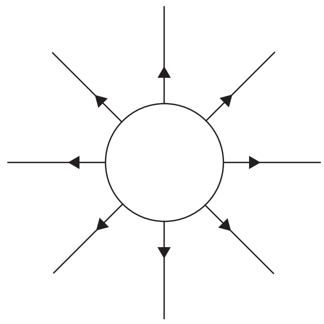
D. light intensity on *R* should be decreased.

22. Which diagram best represents the electric field due to a negatively charged conducting sphere?

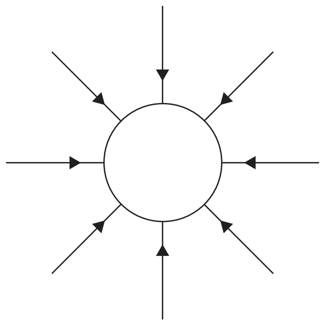
A.



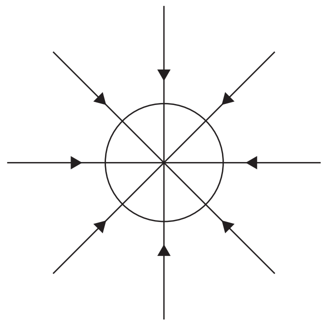
B.



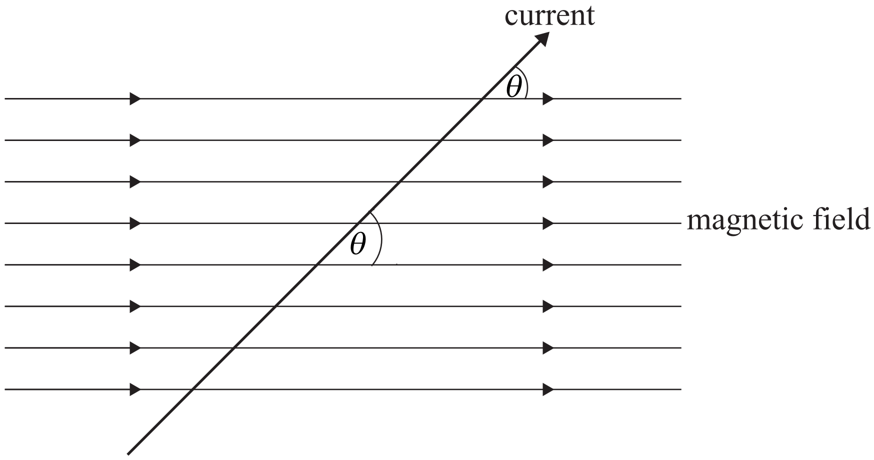
C.



D.



23. A current carrying wire is in the same plane as a uniform magnetic field. The angle between the wire and the magnetic field is θ.



The magnetic force on the current carrying wire is

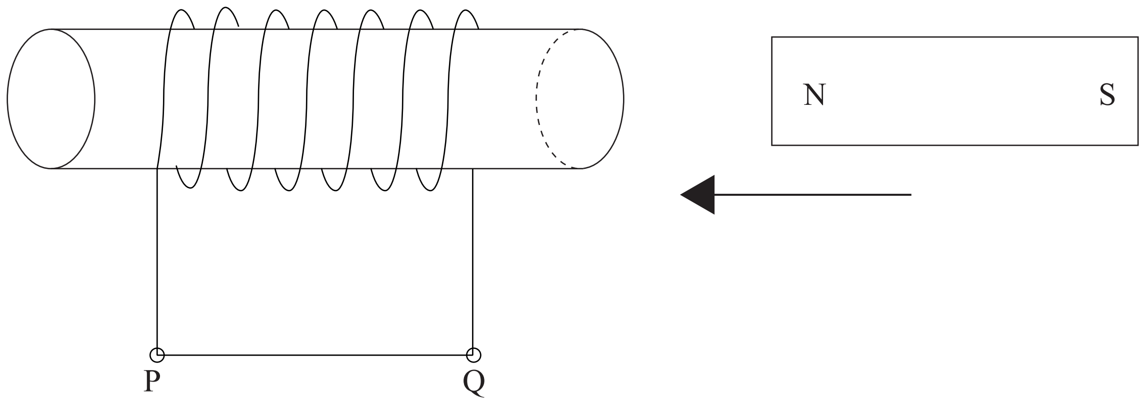
A. zero.

B. into the plane of the paper.

C. out of the plane of the paper.

D. at an angle θ to the direction of the magnetic field.

24. A permanent bar magnet is moved towards a coil of conducting wire wrapped around a non-conducting cylinder. The ends of the coil, P and Q are joined by a straight piece of wire.



The induced current in the **straight piece of wire** is

A. alternating.

B. zero.

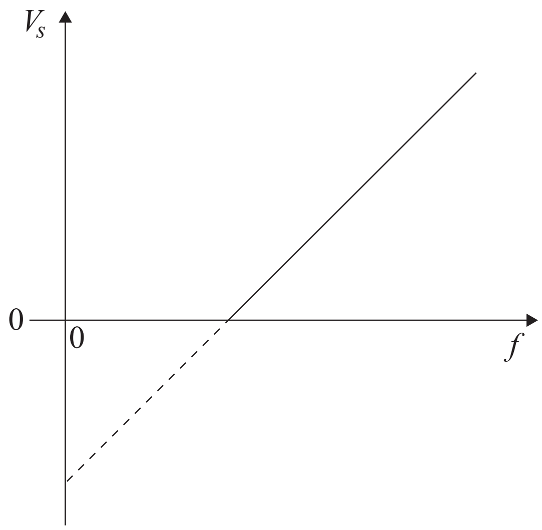
C. from P to Q.

D. from Q to P.

25. In order to reduce power losses in the transmission lines between a power station and a factory, two transformers are used. One is located at the power station and the other at the factory. Which of the following gives the correct types of transformer used?

	Power station	**Factory**
A.	step-up	step-up
B.	step-up	step-down
C.	step-down	step-up
D.	step-down	step-down

26. Ultra-violet light is shone on a zinc surface and photoelectrons are emitted. The sketch graph shows how the stopping potential V_s varies with frequency f.



Planck's constant may be determined from the charge of an electron e multiplied by

A. the x-intercept.

B. the y-intercept.

C. the gradient.

D. the area under the graph.

27. A beam of electrons is accelerated from rest through a potential difference V. The de Broglie wavelength of the electrons is λ. For electrons accelerated through a potential difference of $2V$ the de Broglie wavelength is

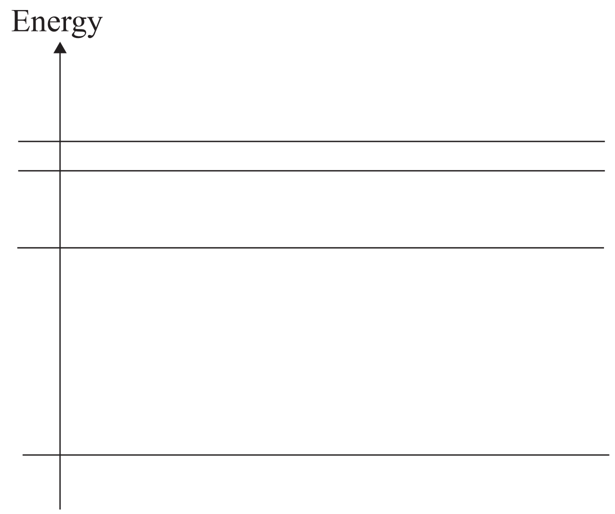
A. 2λ

B. $\sqrt{2\lambda}$

C. $\frac{\lambda}{2}$

D. $\frac{\lambda}{\sqrt{2}}$

28. The diagram shows four possible electron energy levels in the hydrogen atom.



The number of different frequencies in the emission spectrum of atomic hydrogen that arise from electron transitions between these levels is

A. 0.

B. 2.

C. 4.

D. 6.

29. A sample contains an amount of radioactive material with a half-life of 3.5 days. After 2 weeks the fraction of the radioactive material remaining is

A. 94 %.

B. 25 %.

C. 6 %.

D. 0 %.

30. The rest mass of a proton is 938 MeV c^{-2}. The energy of a proton at rest is

A. 9.38 J

B. $9.38\times10^{8}\times(3\times10^{8})^{2}$ J

C. 9.38×10^{8} eV

D. $9.38\times10^{8}\times(3\times10^{8})^{2}$ eV

31. In the Schrödinger model of the hydrogen atom, the probability of finding an electron in a small region of space is calculated from the

A. de Broglie hypothesis.

B. Heisenberg uncertainty principle.

C. (amplitude of the wavefunction)^2.

D. rms value of the wavefunction.

32. The radii of nuclei can be estimated from experiments involving

A. the scattering of charged particles.

B. the Bainbridge mass spectrometer.

C. emission spectra.

D. beta particle spectra.

33. When a nucleus undergoes radioactive β^{+} decay, the change in the number of particles in the universe is

A. 0.

B. 1.

C. 2.

D. 3.

34. In a nuclear power station, uranium is used as the energy source and plutonium-239 is produced Which of the following is true?

A. Plutonium-239 is produced by nuclear fusion.

B. A moderator is used to absorb plutonium-239.

C. Control rods are used to slow down plutonium-239.

D. Plutonium-239 can be used as a fuel in another type of nuclear reactor.

35. Greenhouse gases

A. reflect infrared radiation but absorb ultraviolet radiation.

B. reflect ultraviolet radiation but absorb infrared radiation.

C. transmit infrared radiation but absorb ultraviolet radiation.

D. transmit ultraviolet radiation but absorb infrared radiation.

36. The rate of global warming might be reduced by

A. replacing the use of coal and oil with natural gas.

B. a reduction in the Earth's albedo.

C. a reduction in carbon fixation.

D. an increase in deforestation.

37. The efficiency of a modern natural gas power station is approximately

A. 10 %.

B. 50 %.

C. 75 %.

D. 90 %.

38. In binary, the decimal number 20 is represented as

A. 11101

B. 11000

C. 10100

D. 00010

39. Laser light of wavelength 500 nm is used to read the information on a CD. The approximate depth for a pit on the CD is

A. 1000 nm.

B. 500 nm.

C. 250 nm.

D. 125 nm.

40. Two CCDs are identical in all respects except the pixels of one device have a greater quantum efficiency. This device will

A. have a greater magnification.

B. have a greater resolution.

C. be able to record images at lower light levels.

D. use less energy.