IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
PROGRAMA DEL DIPLOMA DEL BI

N03/430/S(1)+

PHYSICS
STANDARD LEVEL
PAPER 1

Tuesday 11 November 2003 (afternoon)

45 minutes

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 ratio $\dfrac{\text{diameter of a nucleus}}{\text{diameter of an atom}}$ is approximately equal to

A. 10^{-15}.

B. 10^{-8}.

C. 10^{-5}.

D. 10^{-2}.

2. Which **one** of the following lists a fundamental unit and a derived unit?

A.	ampere	second
B.	coulomb	kilogram
C.	coulomb	newton
D.	metre	kilogram

3. A student measures the current in a resistor as 677 mA for a potential difference of 3.6 V. A calculator shows the resistance of the resistor to be 5.3175775 Ω. Which **one** of the following gives the resistance to an appropriate number of significant figures?

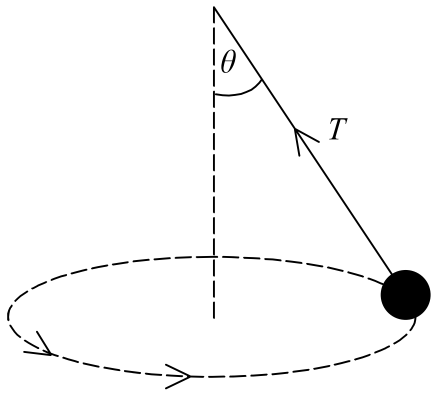
A. 5.3 Ω

B. 5.32 Ω

C. 5.318 Ω

D. 5.31765775 Ω

4. An object on the end of a light flexible string rotates in a circle as shown below.



The tension in the string is T when the string is at angle θ to the vertical. Which of the following is true?

	State	Resultant force
A.	not in equilibrium	T
B.	not in equilibrium	$T \sin\theta$
C.	in equilibrium	T
D.	in equilibrium	$T \sin\theta$

5. Two forces of magnitudes 7 N and 5 N act at a point. Which **one** of the following is **not** a possible value for the magnitude of the resultant force?

A. 1 N

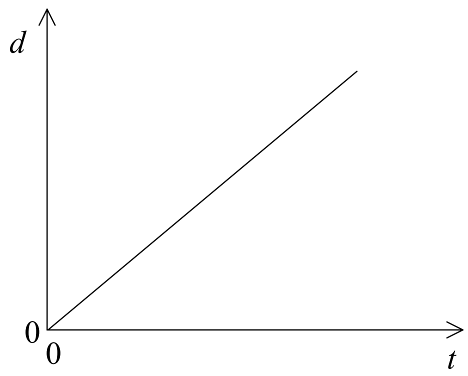
B. 3 N

C. 5 N

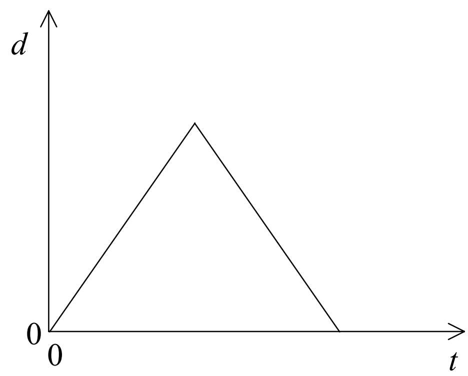
D. 7 N

6. An athlete runs round a circular track at constant speed. Which **one** of the following graphs best represents the variation with time t of the magnitude d of the **displacement** of the athlete from the starting position during one lap of the track?

A.



B.



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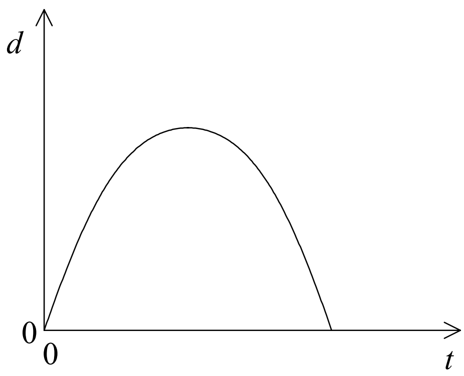

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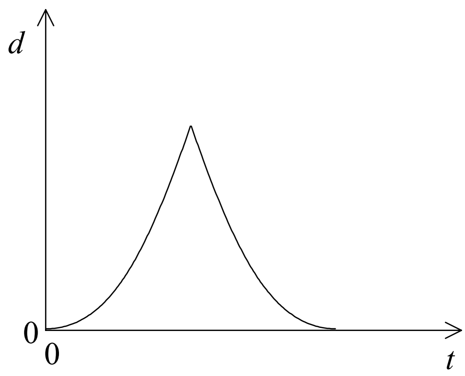


7. A ball is released from rest near the surface of the Moon. Which **one** of the following quantities increases at a constant rate?

A. Only distance fallen

B. Only speed

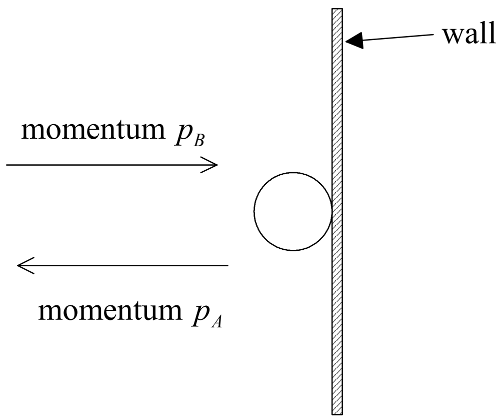
C. Only speed and distance fallen

D. Only speed and acceleration

8. A stone is thrown horizontally from the top of a high cliff. Assuming air resistance is negligible, what is the effect of gravitational force on the horizontal and on the vertical components of the velocity of the stone?

	Vertical component of velocity	Horizontal component of velocity
A.	increases to a constant value	stays constant
B.	increases continuously	stays constant
C.	increases to a constant value	decreases to zero
D.	increases continuously	decreases to zero

9. A sphere of mass *m* strikes a vertical wall and bounces off it, as shown below.



The magnitude of the momentum of the sphere just before impact is p_B and just after impact is p_A. The sphere is in contact with the wall for time *t*. The magnitude of the average force exerted by the wall on the sphere is

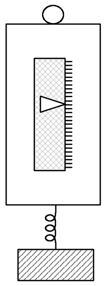
A. $\frac{(p_B - p_A)}{t}$.

B. $\frac{(p_B + p_A)}{t}$.

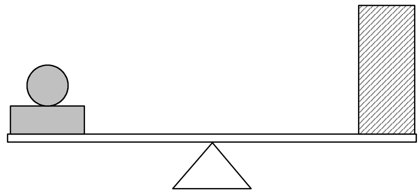
C. $\frac{(p_B - p_A)}{mt}$.

D. $\frac{(p_B + p_A)}{mt}$.

10. The weight of a mass is measured on Earth using a spring balance and a lever balance, as shown below.



spring balance



lever balance

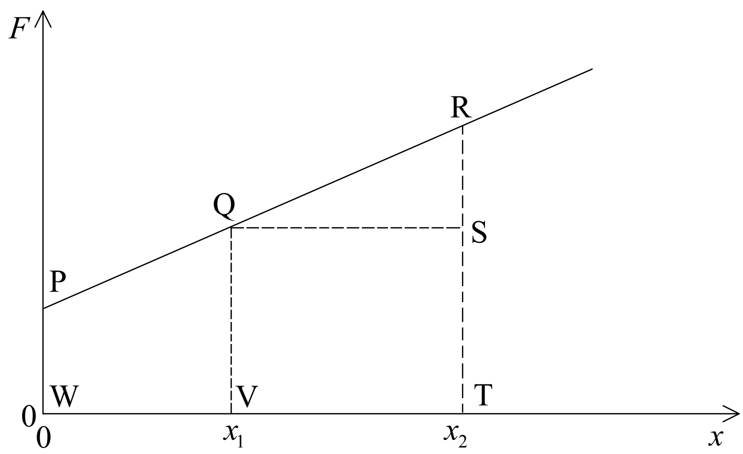
What change, if any, would occur in the measurements if they were repeated on the Moon's surface?

	Spring balance	**Lever balance**
A.	same	same
B.	same	decrease
C.	decrease	same
D.	decrease	decrease

11. Which of the following quantities are conserved in an **inelastic** collision between two bodies?

	Total linear momentum of the bodies	**Total kinetic energy of the bodies**
A.	yes	yes
B.	yes	no
C.	no	yes
D.	no	no

12. The diagram below shows the variation with displacement x of the force F acting on an object in the direction of the displacement.



Which area represents the work done by the force when the displacement changes from x_1 to x_2?

A. QRS

B. WPRT

C. WPQV

D. VQRT

13. An engine takes in an amount E of thermal energy and, as a result, does an amount W of useful work. An amount H of thermal energy is ejected. The law of conservation of energy and the efficiency of the engine are given by which of the following?

	Law of conservation of energy	Efficiency
A.	$E = W + H$	W
B.	$E = W + H$	$\frac{W}{E}$
C.	$E + H = W$	$\frac{W}{H}$
D.	$E + H = W$	$\frac{W}{(E - H)}$

14. Two different objects are in thermal contact with one another. The objects are at different temperatures. The temperatures of the two objects determine

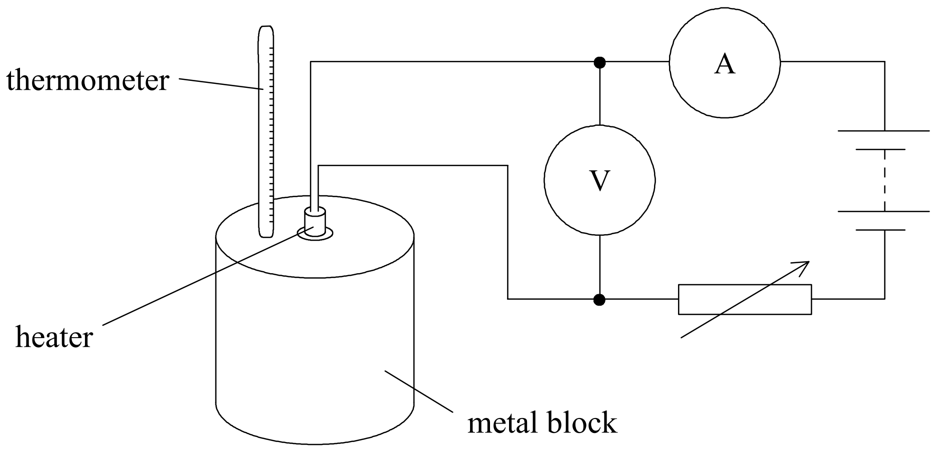
A. the process by which thermal energy is transferred.

B. the heat capacity of each object.

C. the direction of transfer of thermal energy between the objects.

D. the amount of internal energy in each object.

The following diagram refers to questions 15 and 16.



The specific heat capacity of a metal block of mass m is determined by placing a heating coil in its centre, as shown in the diagram above.

The block is heated for time t and the maximum temperature change recorded is $\Delta\theta$. The ammeter and voltmeter readings during the heating are I and V respectively.

15. The specific heat capacity is best calculated using which **one** of the following expressions?

A. $c = \dfrac{VIt}{m\Delta\theta}$

B. $c = \dfrac{VI}{m\Delta\theta}$

C. $c = \dfrac{m\Delta\theta}{VI}$

D. $c = \dfrac{m\Delta\theta}{VIt}$

16. Which **one** of the following is **not** a source of error in the experiment?

A. Some thermal energy is retained in the heater.

B. The thermometer records the temperature at one point in the block.

C. Some thermal energy is lost from the variable resistor in the circuit.

D. The block is heated at its centre, rather than throughout its whole volume.

17. A container holds 20 g of neon (mass number 20) and also 8 g of helium (mass number 4).

What is the ratio $\dfrac{\text{number of atoms of neon}}{\text{number of atoms of helium}}$?

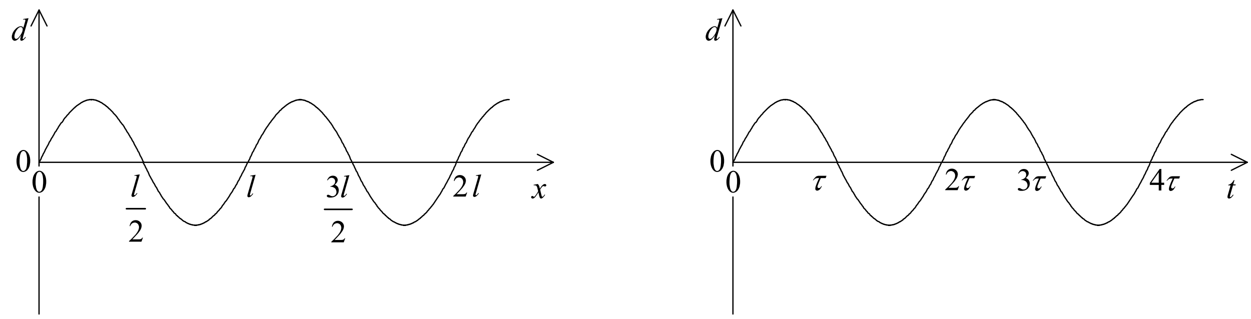
A. 0.4

B. 0.5

C. 2.0

D. 2.5

18. The displacement d of a particle in a wave varies with distance x along a wave and with time t as shown below.



Which expression gives the speed of the wave?

A. $\dfrac{l}{4\tau}$

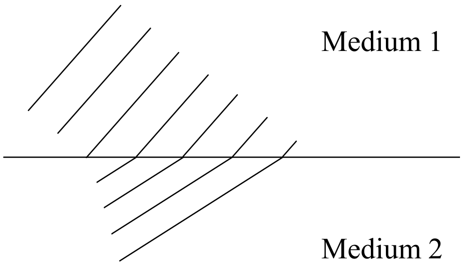
B. $\dfrac{l}{2\tau}$

C. $\dfrac{l}{\tau}$

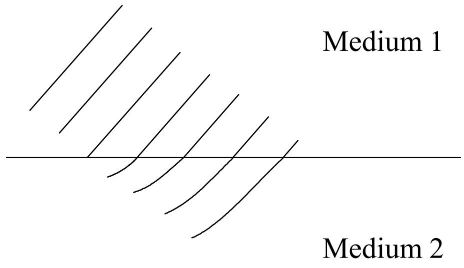
D. $\dfrac{2l}{\tau}$

19. A plane wave approaches and passes through the boundary between two media. The speed of the wave in medium 1 is greater than that in medium 2. Which **one** of the following diagrams correctly shows the wavefronts?

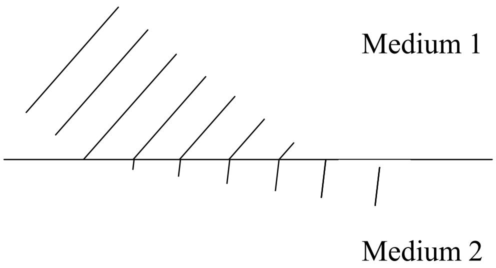
A.



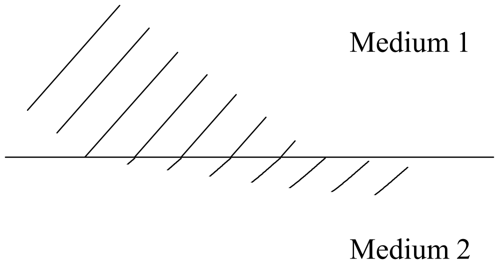
B.



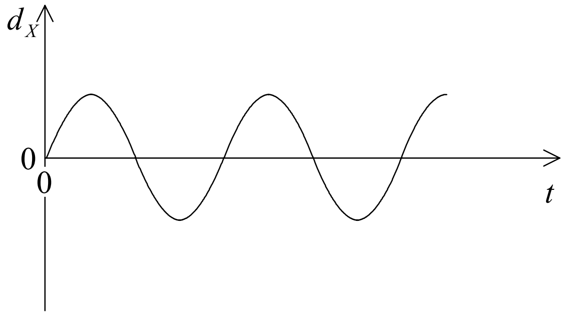
C.



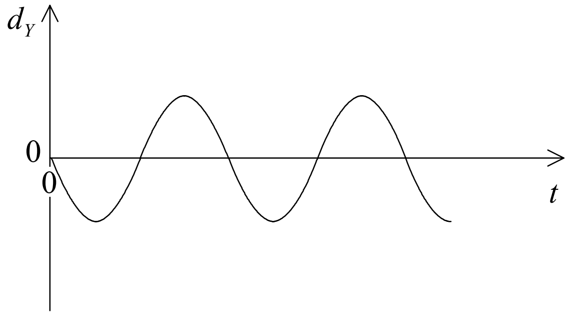
D.

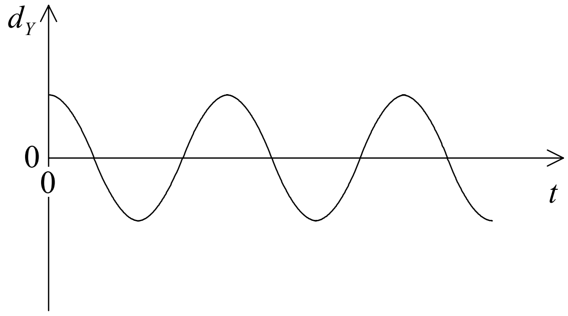


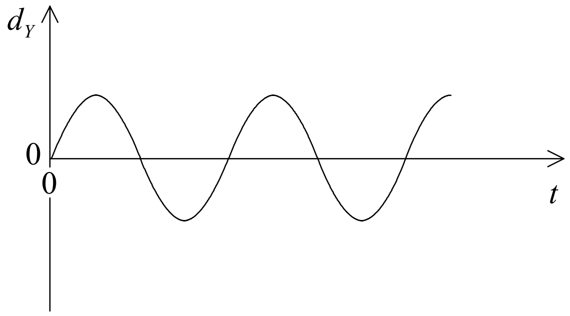
20. Two particles X and Y are situated a distance $\frac{1}{2}\lambda$ apart on a stationary wave of wavelength λ. The variation with time t of the displacement d_X of X is shown below.

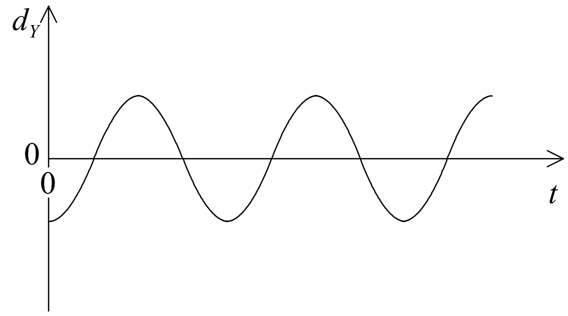


Which **one** of the following correctly shows the variation with time t of the displacement d_Y of particle Y?

A.


B.


C.


D.


21. A plastic rod is rubbed with a cloth. At the end of the process, the rod is found to be positively charged and the cloth is found to be uncharged. This involves the movement of

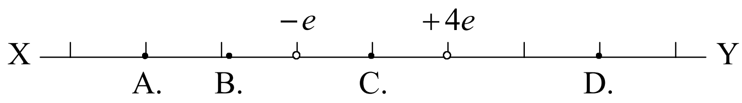
A. positive charge from the cloth to the rod.

B. positive charge from earth to the cloth.

C. negative charge from the rod to earth.

D. negative charge from earth to the cloth.

22. Two charges of $-e$ and $+4e$ are fixed at the positions shown below. At which position along the line XY is the electric field due to these charges equal to zero?



23. Which **one** of the following is a correct definition of electric potential difference between two points?

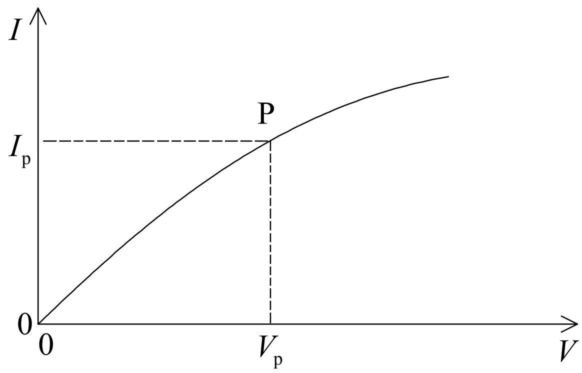
A. The power to move a small positive charge between the two points.

B. The work done to move a small positive charge between the two points.

C. The power per unit charge to move a small positive charge between the two points.

D. The work done per unit charge to move a small positive charge between the two points.

24. The variation with potential difference V of the current I in an electric lamp is shown below.



At point P, the current is I_p, the potential difference is V_p and the gradient of the tangent to the curve is G. What is the resistance of the lamp at point P?

A. $\frac{1}{G}$

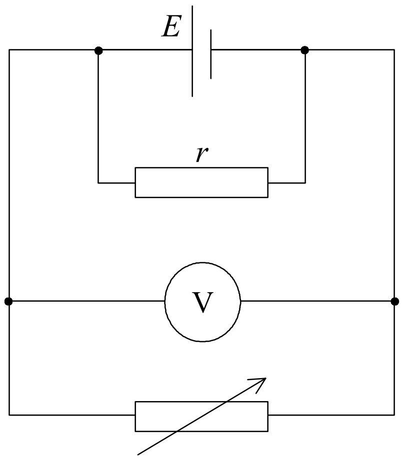
B. G

C. $\frac{I_p}{V_p}$

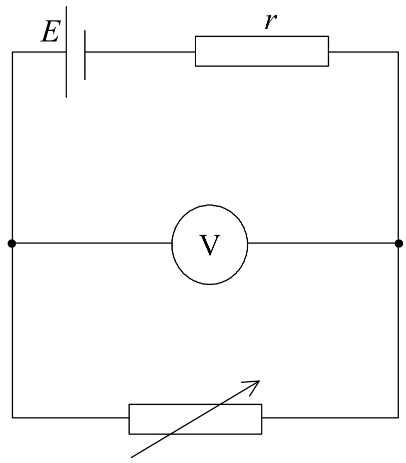
D. $\frac{V_p}{I_p}$

25. A cell of e.m.f. E and internal resistance r is connected to a variable resistor. A voltmeter is connected so as to measure the potential difference across the terminals of the cell. Which **one** of the following is the correct circuit diagram of the arrangement?

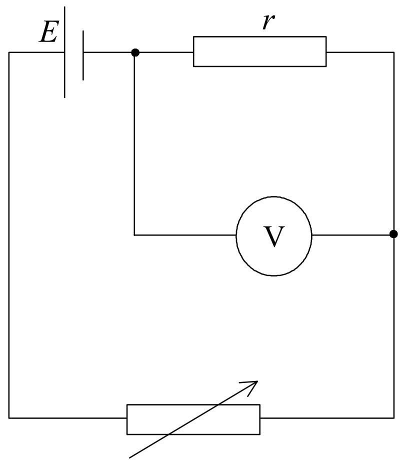
A.



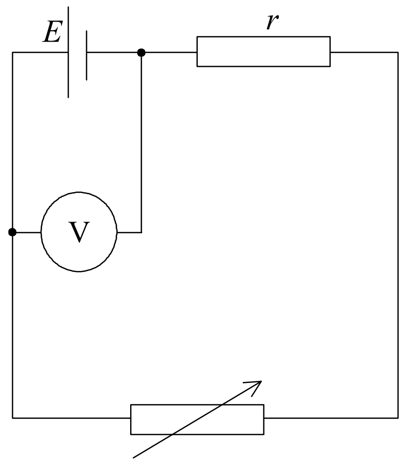
B.



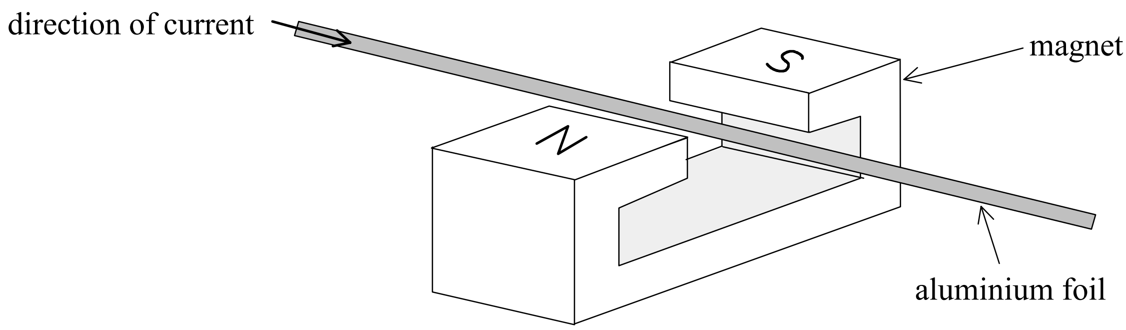
C.



D.



26. A strip of aluminium foil is held between the poles of a strong magnet, as shown below.



When a current is passed through the aluminium foil in the direction shown, the foil is deflected. In which direction is this deflection?

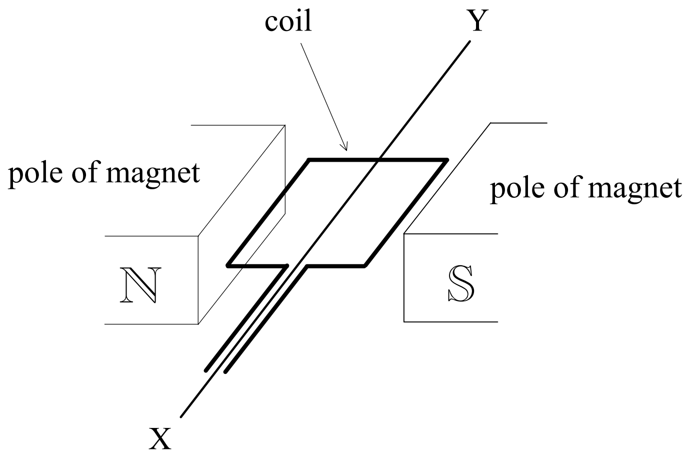
A. Vertically downwards

B. Vertically upwards

C. Towards the North pole of the magnet

D. Towards the South pole of the magnet

27. The diagram shows a coil of wire that can rotate between the poles of a magnet about the axis XY.



A current is passed through the coil by means of a commutator connected to the ends of the coil. What is the position of the coil in the magnetic field so that its turning effect is a maximum and what is the position of the coil when the current is reversed so that the coil rotates continuously?

	plane of coil for maximum turning effect	plane of coil for reversal of current
A.	parallel to direction of field	parallel to direction of field
B.	normal to direction of field	parallel to direction of field
C.	parallel to direction of field	normal to direction of field
D.	normal to direction of field	normal to direction of field

28. Which **one** of the following provides direct evidence for the existence of discrete energy levels in an atom?

A. The continuous spectrum of the light emitted by a white-hot metal.

B. The line emission spectrum of a gas at low pressure.

C. The emission of gamma radiation from radioactive atoms.

D. The ionization of gas atoms when bombarded by alpha particles.

29. A sample of material initially contains atoms of only one radioactive isotope. Which **one** of the following quantities is reduced to one half of its initial value during a time equal to the half-life of the radioactive isotope?

A. Total mass of the sample

B. Total number of atoms in the sample

C. Total number of nuclei in the sample

D. Activity of the radioactive isotope in the sample

30. In a fission chain reaction,

A. energy from one fission reaction causes further fission reactions.

B. nuclei produced in one fission reaction cause further fission reactions.

C. neutrons from one fission reaction cause further fission reactions.

D. gamma radiation produced in one fission reaction causes further fission reactions.