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

PHYSICS
STANDARD LEVEL
PAPER 1

SPECIMEN PAPER

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 period T of oscillation of a mass m on a spring, having spring constant k is $T = 2\pi\sqrt{\frac{m}{k}}$.

The uncertainty in k is 11 % and the uncertainty in m is 5 %. The approximate uncertainty in T is

A. 4 %.

B. 6 %.

C. 8 %.

D. 16 %.

2. An electric motor has an input power of 160 W. In raising a load, 120 W of power is dissipated. The best estimate for the efficiency of the motor is

A. 25 %.

B. 33 %.

C. 57 %.

D. 75 %.

3. An elephant has a life expectancy of 60 years. Which of the following gives the order of magnitude of this lifetime?

A. 10^{11} s

B. 10^{9} s

C. 10^{7} s

D. 10^{5} s

4. The frequency f of waves of wavelength λ travelling on the surface of deep water is given by

$$f = \sqrt{\frac{g}{2\pi\lambda}}$$

where g is the acceleration of free fall.

Which of the following will yield a straight-line graph?

	***y*-axis**	***x*-axis**
A.	f^2	$\frac{1}{\lambda}$
B.	f^2	λ
C.	f	λ
D.	f	$\frac{1}{\lambda}$

5. Two trolleys P and Q, are connected by a rubber band. They are at rest on a horizontal surface. The mass of Q is twice that of P. The trolleys are pulled apart so that the band is stretched and are then released.

The ratio $\frac{\text{magnitude of initial acceleration of trolley P}}{\text{magnitude of initial acceleration of trolley Q}}$ is

A. $\frac{1}{4}$.

B. $\frac{1}{2}$.

C. 1.

D. 2.

6. An object of mass M is suspended from a spring. The extension of the spring is e. The same object is suspended from an identical spring on the Moon where the acceleration of free fall is less than that on Earth. Which of the following is correct?

	Mass of the object on Moon	**Extension of spring on Moon**
A.	M	e
B.	less than M	less than e
C.	M	less than e
D.	less than M	e

7. Gas leaks slowly out of a cylinder of constant volume. The temperature of the gas in the cylinder does not change. Which of the following is constant for the gas molecules in the cylinder?

A. The number striking unit area of surface in unit time

B. The number of the collisions between molecules per unit time

C. The number per unit volume

D. The average speed

8. A block of metal at a temperature of 90 °C is placed in a beaker of water at a temperature of 0 °C. The mass of the metal block and the mass of the water are equal. The final temperature of the water and the metal block is 9 °C.

Which of the following is the best estimate of the ratio

$$\frac{\text{specific heat of water}}{\text{specific heat of metal}}?$$

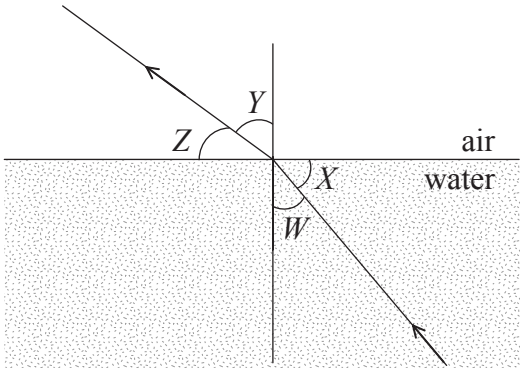
A. $\frac{1}{10}$

B. $\frac{1}{9}$

C. 9

D. 10

9. Light travelling from water to air is incident on a boundary.



Which of the following is a correct statement of Snell's law for this situation?

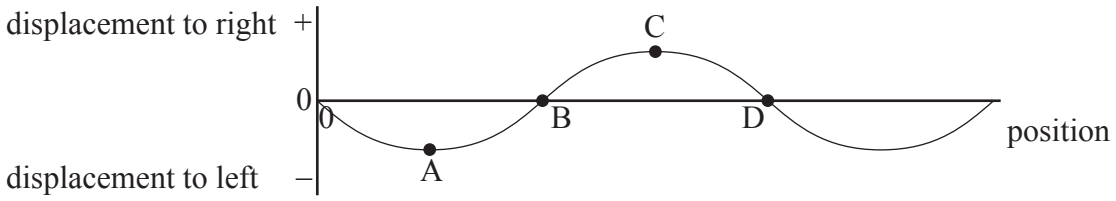
A. $\sin Z = constant \times \sin Y$

B. $\sin W = constant \times \sin Z$

C. $\sin X = constant \times \sin Z$

D. $\sin W = constant \times \sin Y$

10. The diagram below shows the displacement-position graph at a particular instant for a longitudinal wave travelling along a spring.



A positive displacement on the graph indicates that the coils of the spring are displaced to the right of their equilibrium position.

At which position along the spring is the displacement of two adjacent coils a maximum?

A. A

B. B

C. C

D. D

11. Which of the following is a unit for electrical resistance?

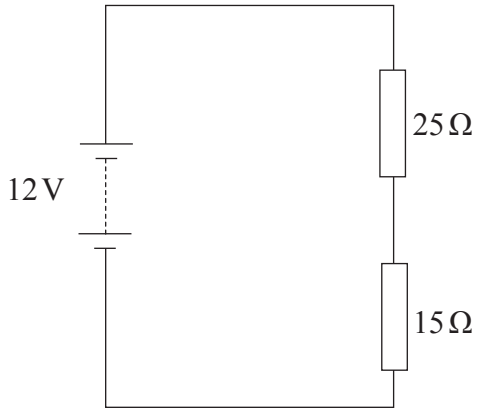
A. $W A^{-2}$

B. $A V^{-1}$

C. $V W^{-2} s$

D. $W V^{-2}$

12. The circuit contains a battery of e.m.f. 12 V and negligible resistance.



What is the potential difference across the 25 Ω resistor?

A. 3.0 V

B. 4.5 V

C. 5.0 V

D. 7.5 V

13. The diagram below shows two stationary point charges $+2Q$ and $-Q$.

At which point is the electric field strength greatest?

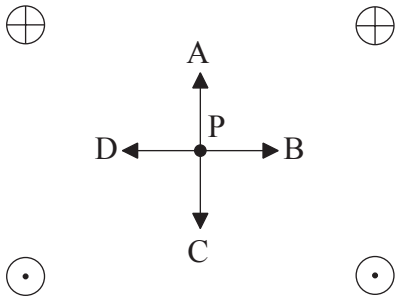
A. A

B. B

C. C

D. D

14. The diagram below represents four long straight wires perpendicular to the plane of the paper.



The magnitude of the direct current in each wire is the same. Wires with ⊕ have current into the plane of the paper and wires with ⊙ have current out of the plane of the paper. Point P is the same distance from each wire.

Which arrow shows the direction of the magnetic field at P?

A. A

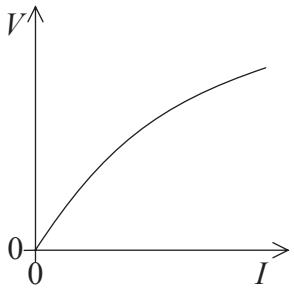
B. B

C. C

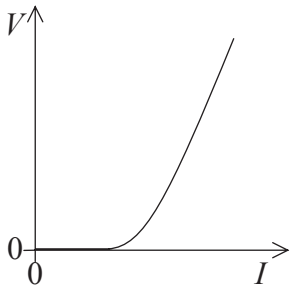
D. D

15. Which graph best represents the relationship between the current I and the voltage V of a filament lamp.

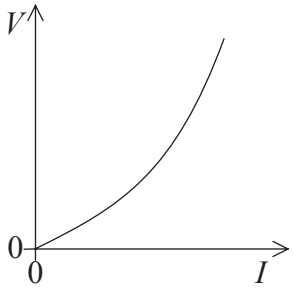
A.



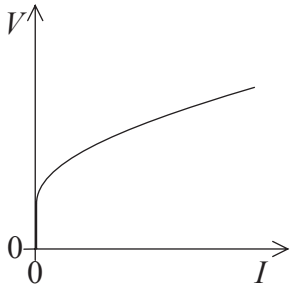
B.



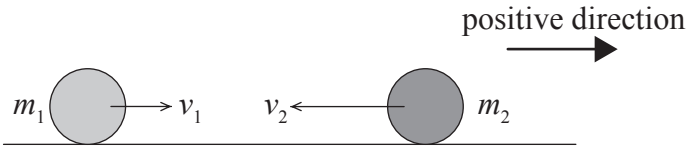
C.



D.



16. Two spheres of masses m_1 and m_2 are moving towards each other along the same straight-line with speeds v_1 and v_2 as shown.



The spheres collide. Which of the following gives the total change in linear momentum of the spheres as a result of the collision?

A. 0

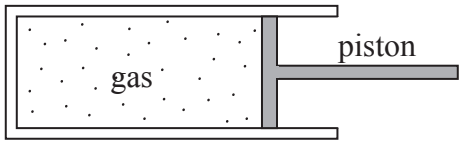
B. $m_1v_1 + m_2v_2$

C. $m_1v_1 - m_2v_2$

D. $m_2v_2 - m_1v_1$

o

17. A gas is contained in a cylinder fitted with a piston as shown below.



When the gas is compressed rapidly by the piston its temperature rises **because** the molecules of the gas

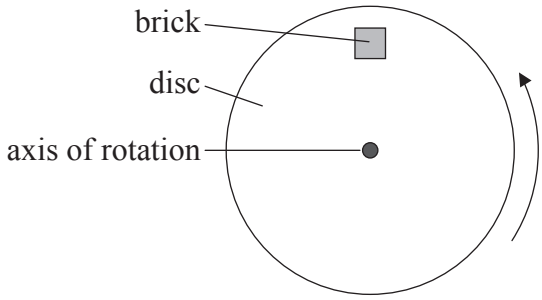
A. are squeezed closer together.

B. collide with each other more frequently.

C. collide with the walls of the container more frequently.

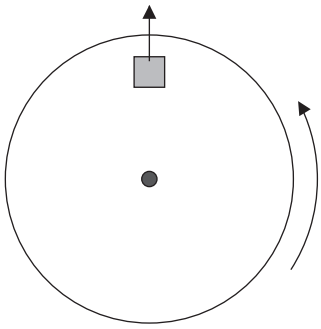
D. gain energy from the moving piston.

18. A brick is placed on the surface of a flat horizontal disc as shown in the diagram below. The disc is rotating at constant speed about a vertical axis through its centre. The brick does not move relative to the disc.

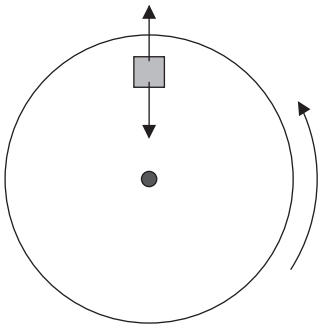


Which of the diagrams below correctly represents the **horizontal** force or forces acting on the brick?

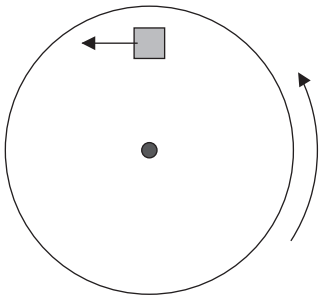
A.



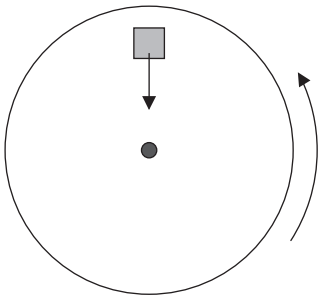
B.



C.



D.



19. A frictionless trolley of mass m moves down a slope with a constant acceleration a. A second similar frictionless trolley has mass $2m$. The acceleration of the second trolley as it moves down the slope is

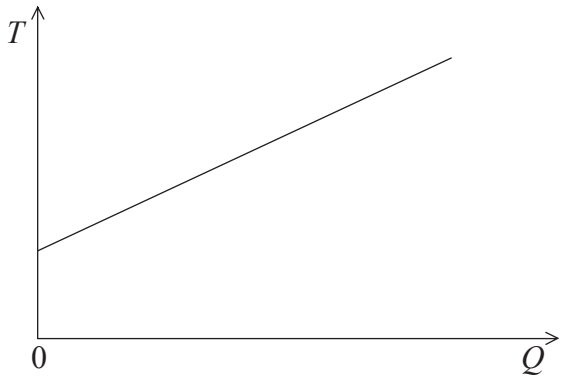
A. $\frac{1}{2}a$.

B. a.

C. $2a$.

D. $4a$.

20. The specific heat capacity c of a solid block of mass m is determined by heating the block and measuring its temperature. The graph below shows the variation of the temperature T of the block with the thermal energy Q transferred to the block.



The gradient of the line is equal to

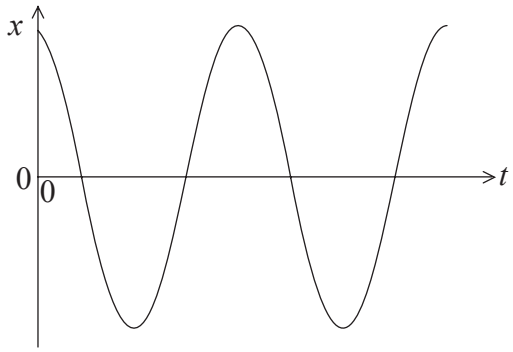
A. $\frac{c}{m}$.

B. $\frac{m}{c}$.

C. mc.

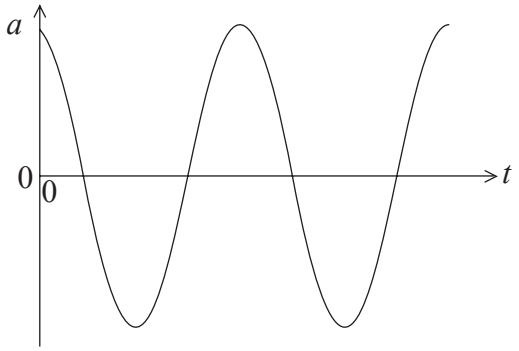
D. $\frac{1}{mc}$.

21. The graph below shows the variation with time t of the displacement x of a particle undergoing simple harmonic motion.

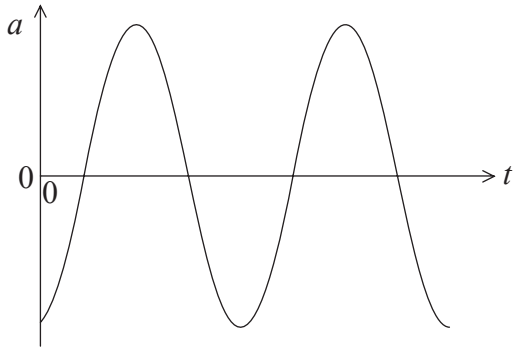


Which graph correctly shows the variation with time t of the acceleration a of the particle?

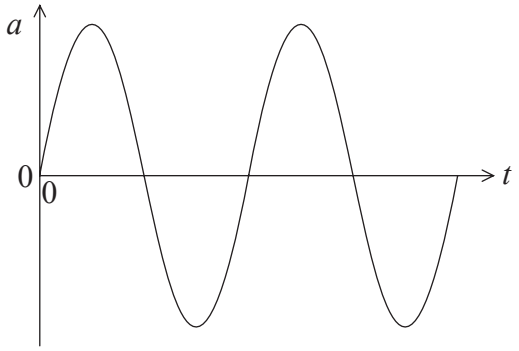
A.



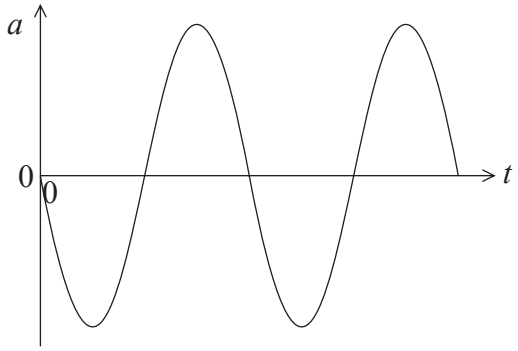
B.



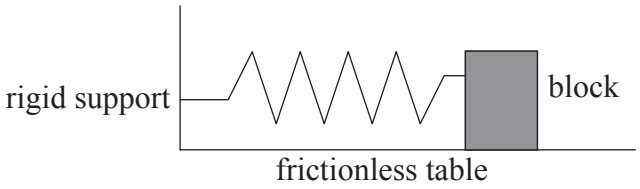
C.



D.



22. A wooden block is at rest on a horizontal frictionless surface. A horizontal spring is attached between the block and a rigid support.



The block is displaced to the right by an amount X and is then released. The period of oscillations is T and the total energy of the system is E.

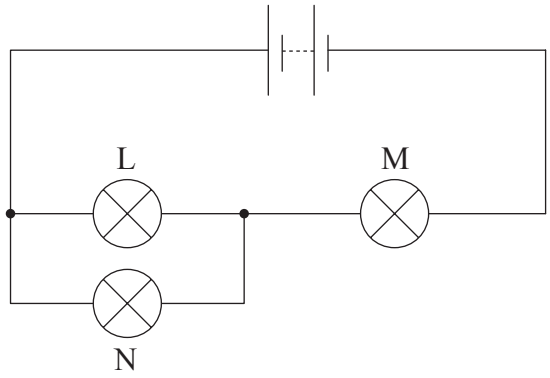
For an initial displacement of $\frac{X}{2}$ which of the following shows the best estimate for the period of oscillations and the total energy of the system?

	Period	Total energy
A.	T	$\frac{E}{2}$
B.	T	$\frac{E}{4}$
C.	$\frac{T}{2}$	$\frac{E}{2}$
D.	$\frac{T}{2}$	$\frac{E}{4}$

23. Which of the following correctly describes the change, if any, in the speed, wavelength and frequency of a light wave as it passes from air into glass?

	Speed	Wavelength	Frequency
A.	decreases	decreases	unchanged
B.	decreases	unchanged	decreases
C.	unchanged	increases	decreases
D.	increases	increases	unchanged

24. In the circuit below, the battery has negligible internal resistance. Three identical lamps L, M and N of constant resistance are connected as shown.



The filament of lamp N breaks. Which of the following shows the subsequent changes to the brightness of lamp L and lamp M?

	Lamp L	**Lamp M**
A.	stays the same	decreases
B.	increases	stays the same
C.	increases	decreases
D.	decreases	increases

25. The commercial production of energy by nuclear fusion is not yet possible mainly due to difficulties with

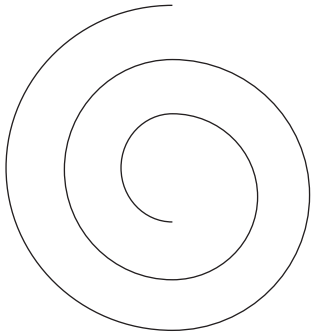
A. obtaining plentiful supplies of a suitable fuel.

B. reaching the high temperatures required.

C. confining the hot plasma.

D. disposing of the radioactive waste products.

26. An electron is moving in air at right angles to a uniform magnetic field. The diagram below shows the path of the electron. The electron is slowing down.



region of magnetic field

Which of the following correctly gives the direction of motion of the electron and the direction of the magnetic field?

	Direction of motion	Direction of magnetic field
A.	clockwise	into plane of paper
B.	clockwise	out of plane of paper
C.	anti-clockwise	into plane of paper
D.	anti-clockwise	out of plane of paper

27 The binding energy per nucleon of the nucleus $^{7}_{3}\text{Li}$ is approximately 5 MeV. The total energy required to completely separate the nucleons of this nucleus is approximately

A. 15 MeV.

B. 20 MeV.

C. 35 MeV.

D. 50 MeV.

28. A nuclide X has a half-life of 10 s. On decay the stable nuclide Y is formed. Initially a sample contains only atoms of X.

After what time will 87.5 % of the atoms in the sample have decayed into nuclide Y.

A. 9.0 s

B. 30 s

C. 70 s

D. 80 s

29. Which of the following best describes why alpha-particles travel only a short distance in air?

A. They undergo radioactive decay.

B. They undergo elastic collisions with air molecules.

C. They ionize air molecules.

D. They are attracted by the nuclei of air molecules.

30. A nucleus $^{90}_{38}Sr$ decays by the emission of an electron. What are the mass (nucleon) number and the atomic (proton) number of the resulting nucleus?

	Mass number	Proton number
A.	89	38
B.	90	39
C.	91	38
D.	91	39