Physics
Standard level
Paper 1

IB Physics SL prediction paper 1

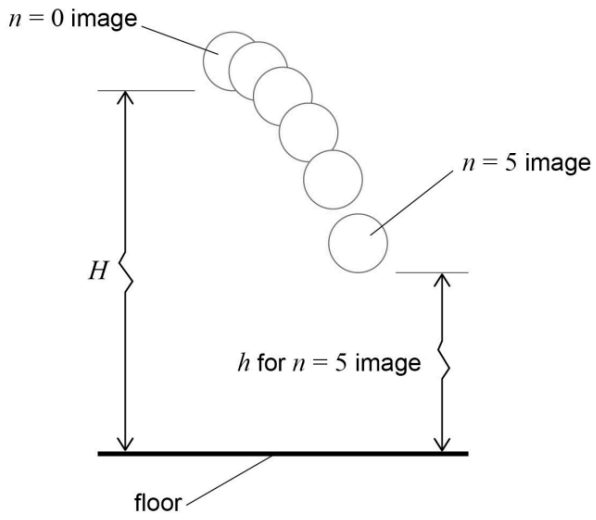
45 minutes

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 (not provided).
- This product is an unofficial resource and is not affiliated with, endorsed by, or produced by the International Baccalaureate Organization (IBO).
- A clean copy of the **physics data booklet** is required for this paper.
- The maximum mark for this examination paper is **[25 marks]**.

14 pages

1. The image shows six stroboscopic positions of a small ball released from rest, photographed at equal time intervals as it falls vertically towards the floor.



The flashes occur every 0.040 s. The vertical distance between the first image (n = 0) and the next (n = 1) is 7.8 cm. Neglecting air resistance, what is the magnitude of the vertical component of the ball's velocity at n = 0?

A. 0.36 m s^{-1}.

B. 1.8 m s^{-1}.

C. 2.5 m s^{-1}.

D. 3.4 m s^{-1}.

2. A sprinter accelerates uniformly from rest to 8.0 m s^{-1} in 2.0 s and then maintains this speed for a further 4.0 s. What is the total distance travelled in the 6.0 s?

A. 20 m.

B. 40 m.

C. 48 m.

D. 56 m.

3. A ball is projected vertically upward from the edge of a 20 m-high cliff with an initial speed of 14 m s^{-1}. Ignoring air resistance, after how long will the ball hit the ground at the base of the cliff?

A. 1.4 s.

B. 2.9 s.

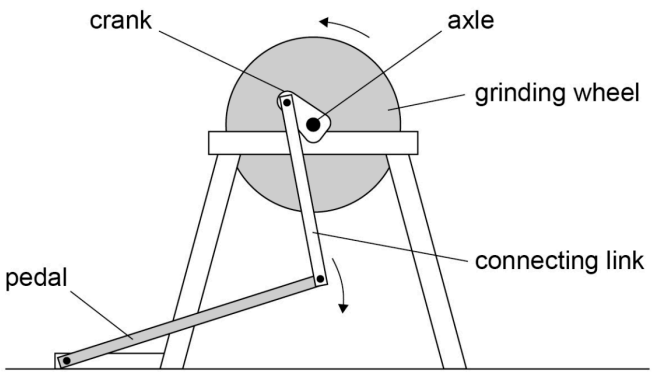
C. 3.9 s.

D. 5.6 s.

4. A small aircraft must reach 30 m s^{-1} for take-off. It accelerates uniformly from rest along a 210 m runway. Which pair gives the aircraft's acceleration and the time taken to leave the ground?

	a / m s^{-2}	**t / s**
A.	1.4	21
B.	2.1	14
C.	4.3	7.0
D.	8.6	3.5

5. The image shows a pedal-driven grinding wheel; the operator pushes the pedal down through a distance of 0.40 m with a constant downward force of 250 N.



Ignoring energy losses, what is the mechanical work done on the system during this down-stroke?

A. 62 J.

B. 1.0×10^2 J.

C. 2.5×10^2 J.

D. 1.0×10^3 J.

6. A 2.0 kg suitcase is lifted vertically at constant speed through 3.0 m. What is the work done against gravity? ($g = 9.8\ m\ s^{-2}$)

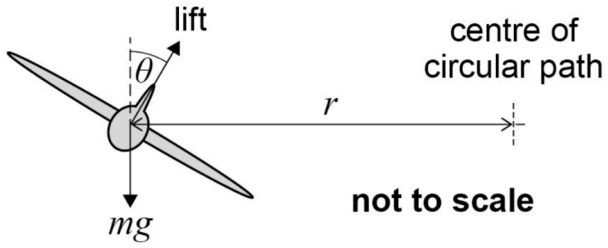
A. 6 J.

B. 20 J.

C. 59 J.

D. 120 J.

7. The image shows an aeroplane executing a level turn: its wings are banked so that the lift force makes an angle θ to the vertical toward the centre of a horizontal circular path of radius r.



Which expression gives the minimum speed v required to maintain this horizontal circular motion?

A. $v = \sqrt{(r\,g\tan\theta)}$

B. $v = \sqrt{(r\,g / \tan\theta)}$

C. $v = \sqrt{(r\,g\cot\theta)}$

D. $v = \sqrt{(r\,g\sin\theta)}$

8. A 0.15 kg rubber ball moving at 8.0 m s^{-1} strikes a rigid wall and rebounds in the opposite direction at 6.0 m s^{-1}. The impact lasts 0.020 s. What is the magnitude of the average force exerted on the wall?

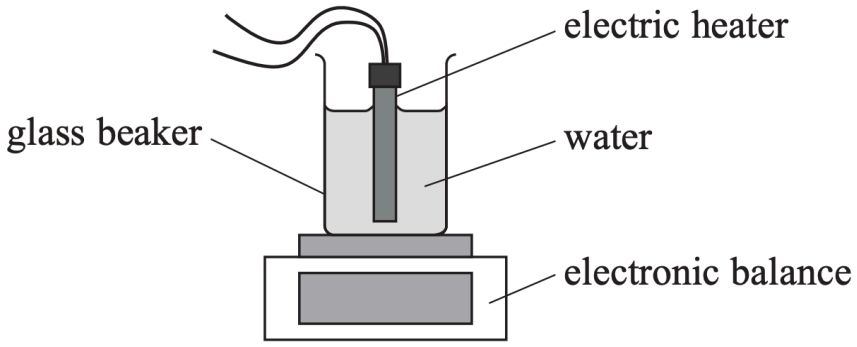
A. 30 N.

B. 60 N.

C. 90 N.

D. 1.0×10^2 N.

9. The image shows a beaker of water on a balance with an immersed electric heater used to determine the specific latent heat of vaporisation.



The heater supplies a constant power of 120 W for 5.0 min and the balance records a mass loss of 34 g. What experimental value of the specific latent heat L of water is obtained?

A. 1.1×10^{6} J kg^{-1}

B. 2.3×10^{6} J kg^{-1}

C. 3.6×10^{5} J kg^{-1}

D. 8.5×10^{6} J kg^{-1}

10. Which change must increase the average kinetic energy of the molecules of an ideal gas in a sealed rigid container?

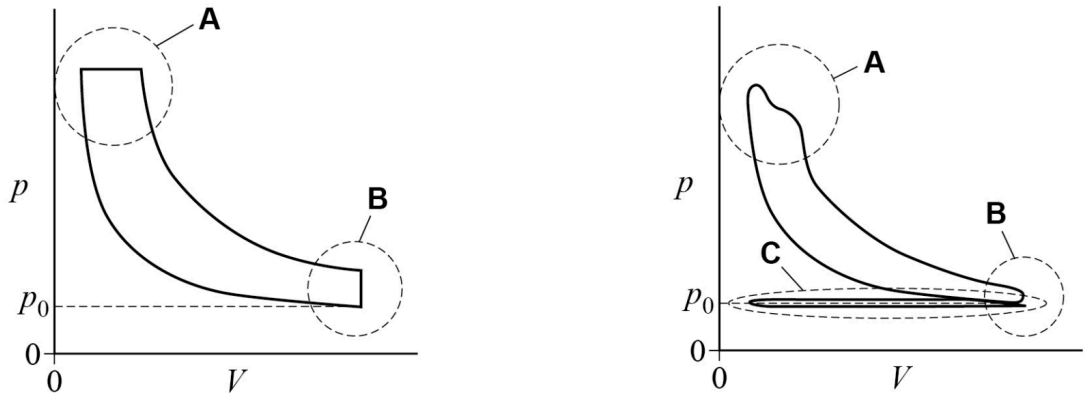
A. Doubling the pressure by adding gas at constant temperature.

B. Allowing the gas to expand so that its pressure halves at constant temperature.

C. Heating the gas so that its temperature rises from 27 °C to 127 °C.

D. Compressing the gas to half its volume at constant temperature.

11. The image compares a theoretical (left) and a real (right) diesel-engine p-V diagram; points A and B on the theoretical cycle are highlighted.



p_0 is atmospheric pressure.

During the isothermal compression from A to B the working gas behaves ideally. At A the volume is V and the pressure is 8.0×10^5 Pa. At B the volume is 4 V. What is the pressure at B?

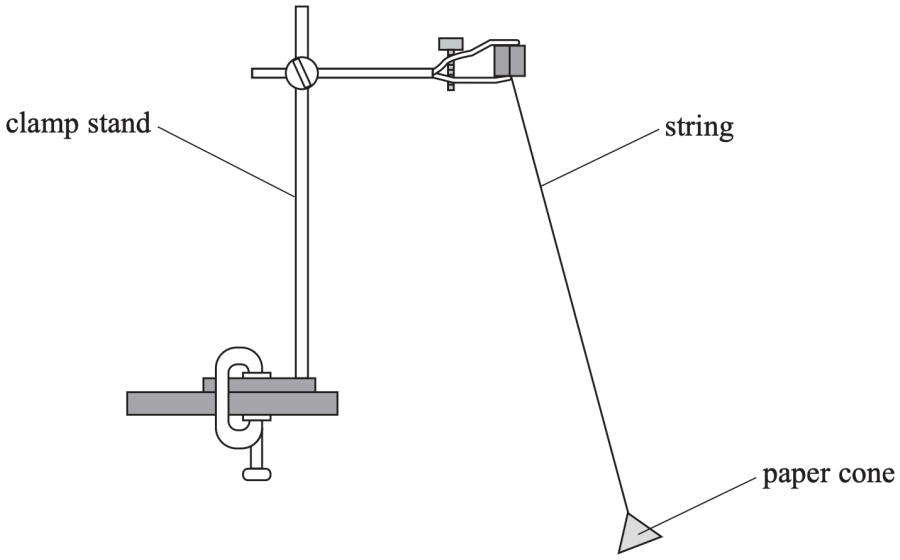
A. 2.0×10^5 Pa

B. 3.2×10^5 Pa

C. 8.0×10^6 Pa

D. 4.0×10^5 Pa

12. The image shows a paper-cone pendulum suspended from a clamp; the length of the string is 0.90 m.



Ignoring air resistance, what is the period of small oscillations? ($g = 9.8\ m\ s^{-2}$)

A. 0.60 s

B. 1.9 s

C. 1.3 s

D. 6.0 s

13. Two coherent waves of wavelength λ reach a point P. For destructive interference at P, the minimum path difference between the waves must be:

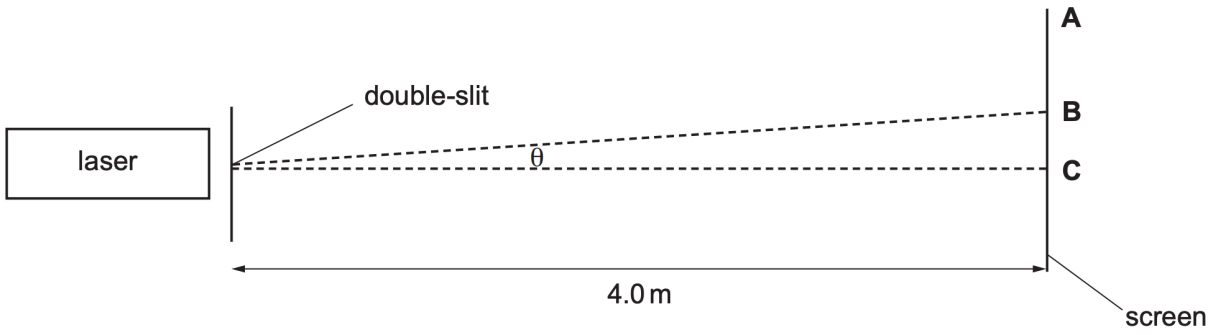
A. λ/4.

B. λ/2.

C. λ/4.

D. λ.

14. The image depicts a laser beam incident on a double slit; bright fringes appear on a screen 4.0 m away. The distance between successive bright fringes is 3.2 mm; the slit separation is 0.25 mm.



What is the wavelength of the laser light?

A. 2.0×10^{-7} m

B. 6.3×10^{-7} m

C. 8.0×10^{-7} m

D. 1.3×10^{-6} m

15. The image shows an instantaneous view of a stationary wave on a stretched string between fixed points P and Q; exactly one wavelength fits between P and Q. The length PQ is 0.80 m

If the generator vibrates at 120 Hz, what is the wave speed on the string?

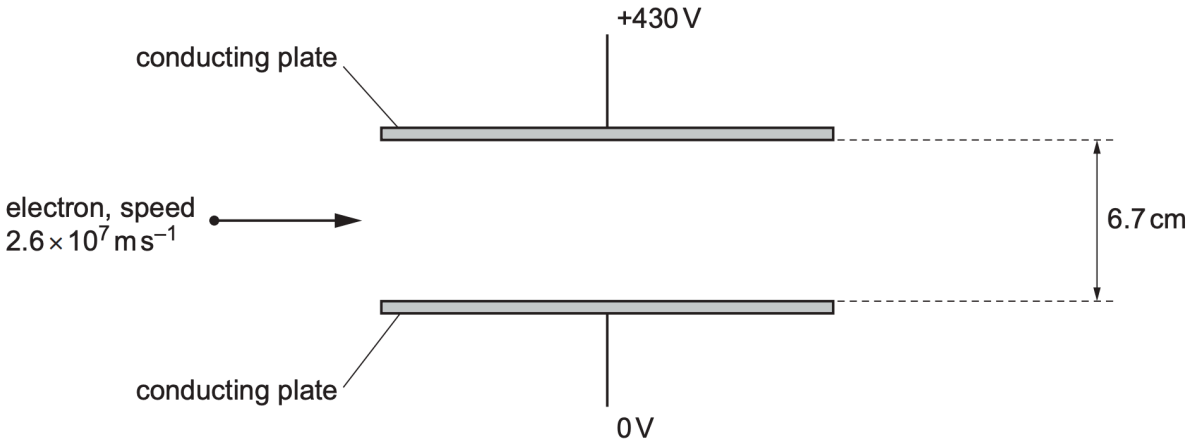
A. 48 m s^{-1}

B. 60 m s^{-1}

C. 96 m s^{-1}

D. 150 m s^{-1}

16. The image shows two parallel plates separated by 6.7 cm with a potential difference of 430 V.



What is the magnitude of the electric field strength between the plates?

A. 6.4 V m^{-1}

B. 29 V m^{-1}

C. 6.4 × 10^2 V m^{-1}

D. 2.9 × 10^4 V m^{-1}

17. Two resistors of 6 Ω and 3 Ω are connected in parallel across a 9 V battery of negligible internal resistance. What is the current supplied by the battery?

A. 0.33 A

B. 1.5 A

C. 3.0 A

D. 4.5 A

18. Singly ionised neon-20 ions (mass 3.3×10^{-26} kg, charge +e) enter a 0.20 T magnetic field perpendicular to their velocity and describe a semicircle of diameter 0.12 m before leaving the field. What is the kinetic energy of the ions on entry?

A. 35 eV

B. 3.5×10^{2} eV

C. 3.5×10^{3} eV

D. 3.5×10^{4} eV

19. A planet has mass 4.0×10^{23} kg and radius 1.6×10^{6} m. What is the escape speed from its surface? ($G = 6.67 \times 10^{-11}$ N m^2 kg^{-2})

A. 2.9 km s^{-1}

B. 4.1 km s^{-1}

C. 5.8 km s^{-1}

D. 8.2 km s^{-1}

20. A sample initially contains 1.00×10^{6} nuclei of a radionuclide. After 10 days, 6.25×10^{5} nuclei remain undecayed. What is the half-life of the radionuclide?

A. 6.0 days.

B. 10 days.

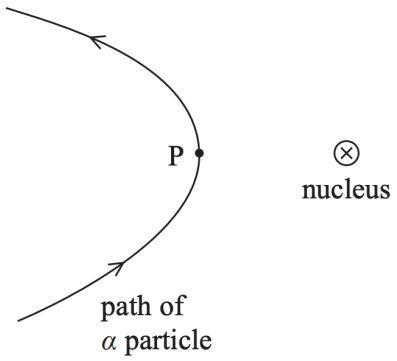
C. 15 days.

D. 20 days.

21. Which row gives both the electric charge and the relative mass of a neutron?

	Charge	Relative mass
A.	0 C	0
B.	+e	1
C.	0 C	1
D.	−e	1

22. The image shows an α-particle being deflected as it passes near a gold nucleus; point P is its closest approach.



Which observation from the original scattering experiment led directly to the conclusion that most of the atom is empty space?

A. A very small fraction of α-particles were deflected through angles greater than 90°.

B. A small fraction of α-particles were scattered through large angles while most passed straight through the foil.

C. All α-particles lost most of their kinetic energy when passing close to nuclei.

D. Some α-particles were absorbed by the gold foil and emitted X-rays.

23. In an open star cluster the main-sequence turn-off point is at spectral class B5. Using the approximate relation $\tau/\tau_\odot \approx (M/M_\odot)^{-2.5}$, where $\tau_\odot = 1.0 \times 10^{10}$ y, and taking the mass of a B5 star to be 6 $M_\odot$, estimate the age of the cluster.

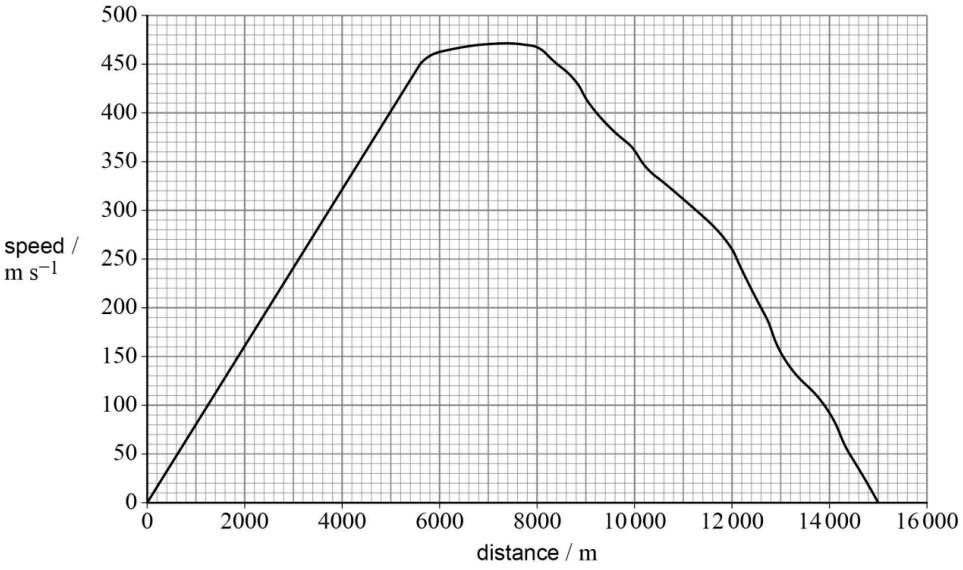
A. 1×10^7 y.

B. 1×10^8 y.

C. 5×10^8 y.

D. 1×10^9 y.

24. The image is a graph of the speed of a jet-powered car against the distance travelled from rest.



Estimate the kinetic energy of the car when it is 5600 m from the start. At this point its mass is 6.50×10^3 kg.

A. 6.6×10^7 J

B. 6.6×10^8 J

C. 6.6×10^9 J

D. 6.6×10^{10} J

25. Earth's surface at 288 K emits radiation with a peak wavelength λ_{max} given by Wien's law:

$\lambda_{max} T = b$ ($b = 2.9 \times 10^{-3}$ m K).

Which wavelength range is most strongly absorbed by atmospheric CO_2, enhancing the greenhouse effect?

A. 0.3 μm – 0.8 μm (visible).

B. 0.8 μm – 4 μm (near-IR).

C. 4 μm – 20 μm (thermal IR).

D. 100 μm – 1000 μm (microwave).