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Diploma Programme
Programme du diplôme
Programa del Diploma

Physics
Standard level
Paper 1A

29 April 2025

Zone A afternoon | **Zone B** afternoon | **Zone C** afternoon

1 hour 30 minutes [Paper 1A and Paper 1B]

Instructions to candidates

- Do not open this examination paper until instructed to do so.
- Answer all questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.
- A calculator is required for this paper.
- A clean copy of the **physics data booklet** is required for this paper.
- The maximum mark for paper 1A is **[25 marks]**.
- The maximum mark for paper 1A and paper 1B is **[45 marks]**.

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1. A ball is initially 50 m above the ground. The ball is thrown vertically upwards and takes 5.0 s to reach the ground. Air resistance is negligible.

What is the initial speed of the ball?

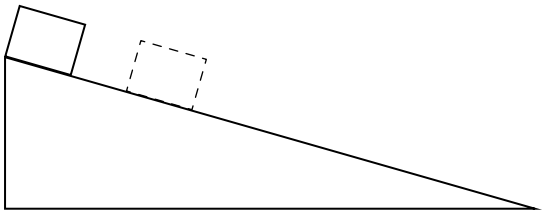
A. $10\,m\,s^{-1}$

B. $15\,m\,s^{-1}$

C. $25\,m\,s^{-1}$

D. $35\,m\,s^{-1}$

2. An object is sliding from rest down a frictionless inclined plane. The vertical displacement of the object is 1.5 m during the first second.



What is the vertical displacement during the next second?

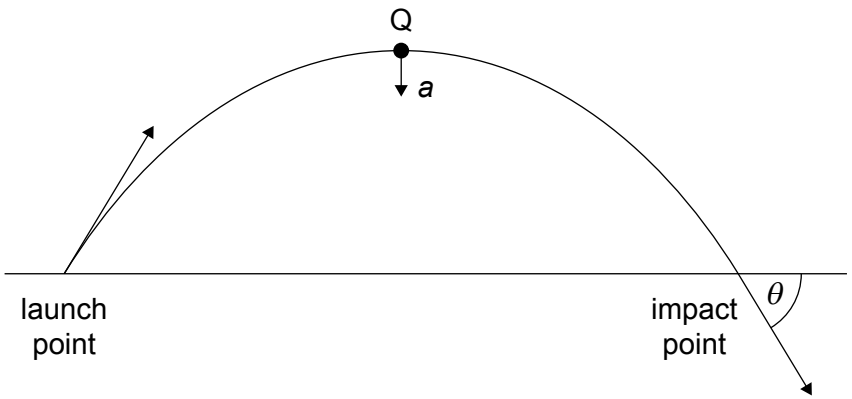
A. 1.5 m

B. 3.0 m

C. 4.5 m

D. 5.0 m

3. The diagram shows the path of a ball in the absence of air resistance. Q is the highest point of the ball's trajectory and *a* is the vertical acceleration at Q. At impact the velocity makes an angle θ to the horizontal.



Three statements about the actual motion of the ball when there is air resistance are:

I. Q is lower.

II. *a* remains the same.

III. θ increases.

Which statements are correct?

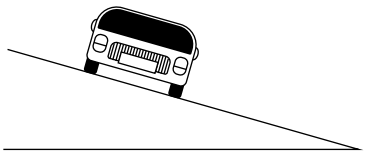
A. I and II only

B. I and III only

C. II and III only

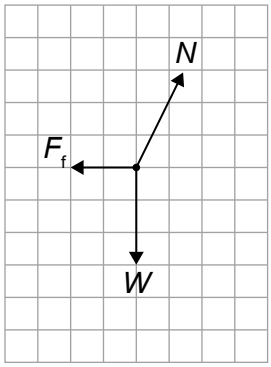
D. I, II and III

4. A car of weight W is travelling at maximum speed in a circular path along a horizontal banked road. The surface exerts a normal force N and a friction force F_f.

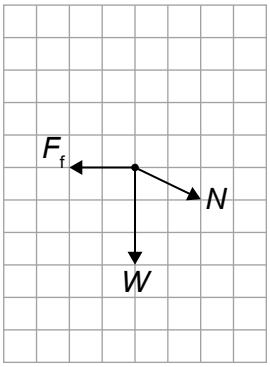


What is the correct free-body diagram for the car?

A.



B.



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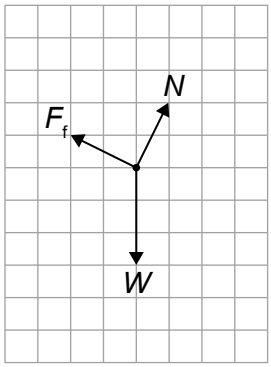
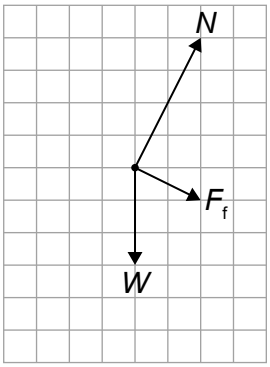


D.



5. Sphere X falls through a fluid with terminal velocity v. Sphere Y is made of the same material and falls through the same fluid. The radius of sphere Y is double that of sphere X.

What is the terminal velocity of sphere Y?

A. $\frac{v}{2}$

B. v

C. $2v$

D. $4v$

6. X and Y are two spherical black-body radiators. X has a radius R and emits half the total power of Y. The absolute temperature of X is double that of Y.

What is the radius of Y?

A. $2\sqrt{2}R$

B. $4R$

C. $4\sqrt{2}R$

D. $16R$

7. The albedo of the atmosphere above a small region on the Earth's surface is 0.25. The solar constant is S.

What is the incoming intensity of solar radiation incident on this region when the Sun is directly overhead?

A. $\frac{3S}{16}$

B. $\frac{S}{4}$

C. $\frac{3S}{4}$

D. S

8. A gas is held in a container. An identical container holds the same number of more massive molecules of another gas at the same temperature.

What is true about the density and pressure in both containers?

	Density in both containers	**Pressure in both containers**
A.	same	same
B.	same	different
C.	different	same
D.	different	different

9. A wire of length L is used in an electric heater. When the potential difference across the wire is 200 V, the power transferred in the wire is 500 W. A second wire is made from the same metal and has the same cross-sectional area. When a potential difference of 400 V is applied across the second wire, the power transferred is 2000 W.

What is the length of the second wire?

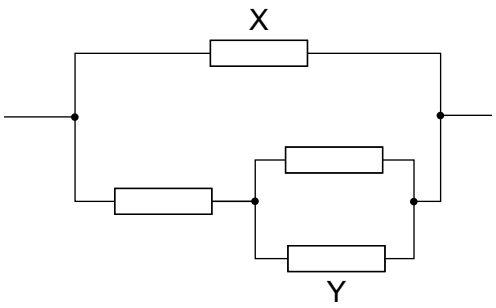
A. $\frac{L}{4}$

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

C. L

D. $2L$

10. Four identical resistors are connected as shown.



What is $\frac{\text{current in X}}{\text{current in Y}}$?

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

B. $\frac{2}{3}$

C. $\frac{3}{2}$

D. 3

11. A pendulum of length *L* oscillates with an angular frequency ω. The mass of the pendulum is doubled and its length is changed to $\frac{L}{4}$.

What is the new angular frequency of the pendulum?

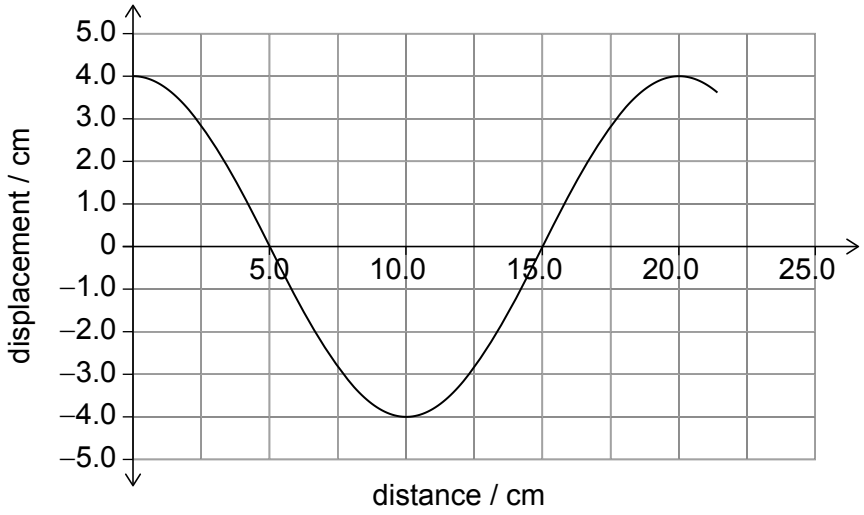
A. $\frac{\omega}{2}$

B. ω

C. 2ω

D. $2\sqrt{2}\omega$

12. A transverse wave of period 20 ms travels through a medium. The graph shows the variation of particle displacement with distance for the wave.



What is the average speed of the particle motion and the direction of particle motion relative to the direction of the wave travel during one cycle?

	Average speed of particle / m s^{-1}	**Direction of particle motion**
A.	8	parallel
B.	8	perpendicular
C.	10	parallel
D.	10	perpendicular

13. An ultraviolet wave is travelling in a vacuum.

What is the frequency and the nature of the wave?

	Wave frequency / Hz	Nature of the wave
A.	10^{15}	transverse
B.	10^{15}	longitudinal
C.	10^{-7}	transverse
D.	10^{-7}	longitudinal

14. A pipe of length 0.75 m is closed at one end. The speed of sound of the air in the pipe is 330 $m\,s^{-1}$.

What are the frequencies of the first two harmonics in the pipe?

A. 110 Hz and 220 Hz

B. 110 Hz and 330 Hz

C. 220 Hz and 440 Hz

D. 220 Hz and 660 Hz

15. For a lightly damped oscillation…

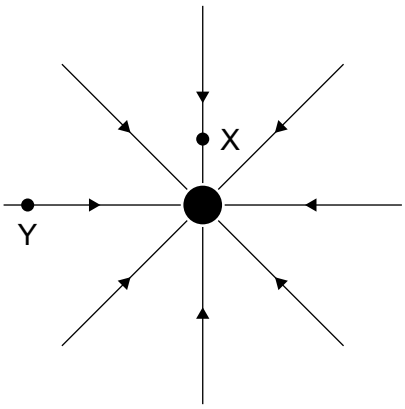
A. the amplitude goes to zero within one period of oscillation.

B. the oscillation frequency does not change with time.

C. energy is transferred from the oscillation as quickly as possible.

D. the oscillation frequency equals the undamped oscillation frequency.

16. Two point masses X and Y are released from rest at different positions in the gravitational field of a planet. Y is further from the planet's surface than X. The masses of X and Y are much smaller than that of the planet.

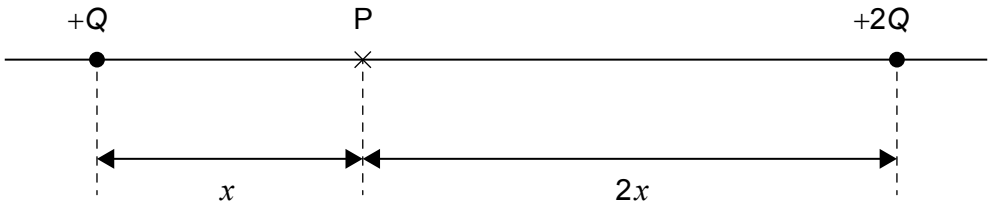


Both masses eventually collide with the planet.

Which is the correct comparison of the initial and final accelerations of X and Y?

	Initial acceleration	**Final acceleration**
A.	different	same
B.	different	different
C.	same	same
D.	same	different

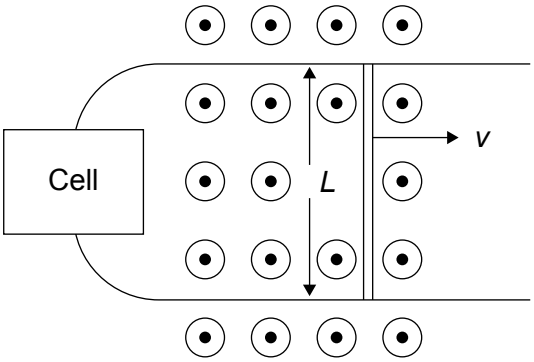
17. A charge $+Q$ and a charge $+2Q$ are a distance $3x$ apart. Point P is on the line joining the charges, at a distance x from one of the charges as shown.



What is the electric field strength *E* at P?

	Magnitude of *E*	**Direction of *E***
A.	$\frac{kQ}{2x^2}$	left
B.	$\frac{kQ}{2x^2}$	right
C.	$\frac{kQ}{x^2}$	left
D.	$\frac{kQ}{x^2}$	right

18. A circuit is created with a cell, two parallel conducting wires and a moveable metal rod of length L. When a uniform magnetic field B is directed out of the page through the circuit, the metal rod moves to the right with velocity v. The initial current in the circuit is I.



What is the direction of the current through the circuit and the initial force on the metal rod?

	Direction of I	Initial force on the metal rod
A.	anti-clockwise	$BIL\sin(90°)$
B.	clockwise	$BIL\sin(90°)$
C.	anti-clockwise	$BIL\sin(0°)$
D.	clockwise	$BIL\sin(0°)$

19. Two parallel wires X and Y carry the same current. There is a repulsive force per unit length F on each wire. The direction of the current in each wire is reversed. The current in X is doubled and the current in Y stays the same. The separation of X and Y is also doubled.

What is the magnitude and direction of the force per unit length on each wire?

	Magnitude	Direction
A.	F	repulsive
B.	F	attractive
C.	$\frac{F}{2}$	repulsive
D.	$\frac{F}{2}$	attractive

20. Gases in the atmosphere are compounds of $^{12}_{6}C$, $^{1}_{1}H$, $^{16}_{8}O$ and $^{14}_{7}N$.

Four of these gases are CO_2, N_2O, CH_4 and H_2O. A pure sample of each gas is produced. Each sample has the same volume, pressure, and temperature.

Which sample has the smallest mass?

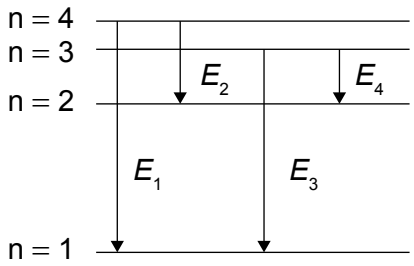
A. CH_4

B. N_2O

C. CO_2

D. H_2O

21. Some transitions between the energy states of an atom are shown.



Which transition will emit a photon with the longest wavelength?

A. E_1

B. E_2

C. E_3

D. E_4

22. A fusion reaction of one nucleus of hydrogen-2 and one nucleus of hydrogen-3 converts a mass of 0.024 u into energy. A fission reaction of one nucleus of uranium-235 converts a mass of 0.48 u into energy.

What is $\frac{\text{energy released per unit mass of hydrogen}}{\text{energy released per unit mass of uranium}}$?

A. 0.050

B. 0.426

C. 2.35

D. 20.0

23. Three statements about gamma radiation are:

I. It travels faster than beta radiation in a vacuum.

II. It has a greater penetration ability than beta radiation.

III. It has a greater ionizing ability than beta radiation.

Which statements are correct?

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

24. The moderator in a nuclear power station…

A. increases the proportion of U-235 in the fuel source.

B. transfers internal energy from the reactor to the turbines.

C. allows operators to regulate the rate of power production.

D. decreases the kinetic energy of neutrons in the reactor.

25. Stars X and Y have the same surface temperature. Star X has a radius R and is a distance d from Earth. The distance of star Y from Earth is $\frac{d}{2}$. The apparent brightness of Y is double that of X.

What is the radius of star Y?

A. $\frac{R}{2}$

B. $\frac{\sqrt{2}}{2}R$

C. R

D. $2R$