Diploma Programme
Programme du diplôme
Programa del Diploma

Physics
Standard level
Paper 1

Tuesday 30 October 2018 (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.
- A clean copy of the **physics data booklet** is required for this paper.
- The maximum mark for this examination paper is **[30 marks]**.

8818 – 6504

1. What is the unit of power expressed in fundamental SI units?

A. $kg\ m\ s^{-2}$

B. $kg\ m^2\ s^{-2}$

C. $kg\ m\ s^{-3}$

D. $kg\ m^2\ s^{-3}$

2. The length of the side of a cube is 2.0 cm ± 4 %. The mass of the cube is 24.0 g ±8 %. What is the percentage uncertainty of the density of the cube?

A. ±2 %

B. ±8 %

C. ±12 %

D. ±20 %

3. A truck has an initial speed of $20\ m\ s^{-1}$. It decelerates at $4.0\ m\ s^{-2}$. What is the distance taken by the truck to stop?

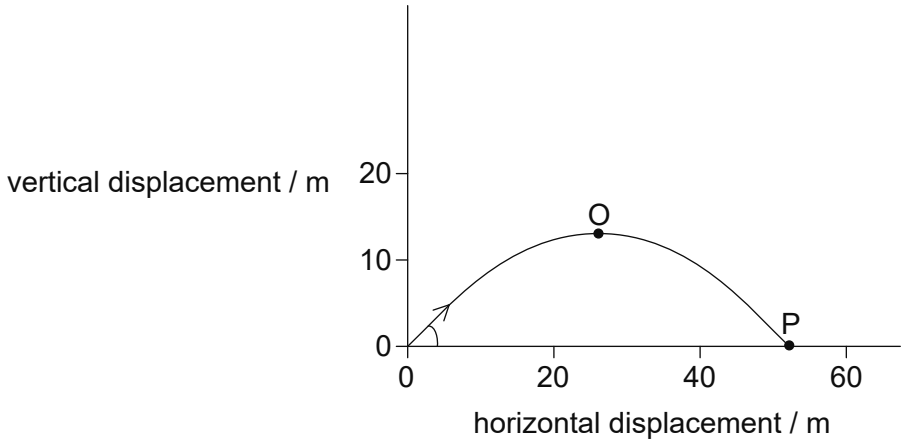
A. 2.5 m

B. 5.0 m

C. 50 m

D. 100 m

4. A projectile is fired at an angle to the horizontal. Air resistance is negligible. The path of the projectile is shown.

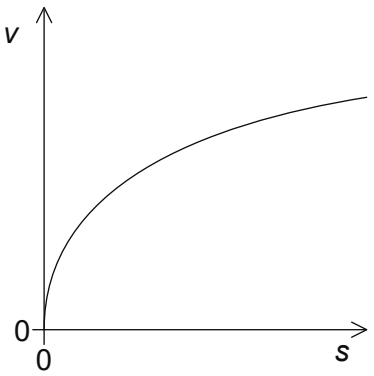


Which gives the magnitude of the horizontal component and the magnitude of the vertical component of the velocity of the projectile between O and P?

	Magnitude of horizontal component of velocity	**Magnitude of vertical component of velocity**
A.	constant	increases
B.	constant	constant
C.	increases	increases
D.	increases	constant

5. A runner starts from rest and accelerates at a constant rate throughout a race. Which graph shows the variation of speed *v* of the runner with distance travelled *s*?

A.



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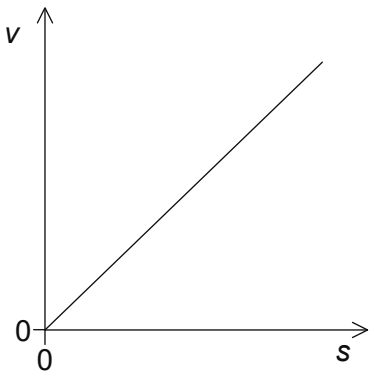

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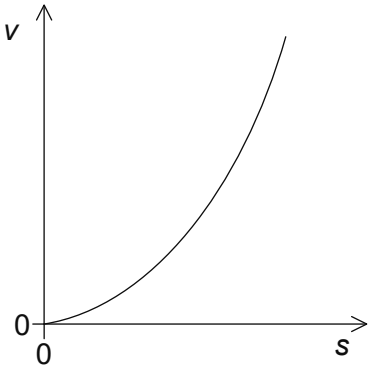

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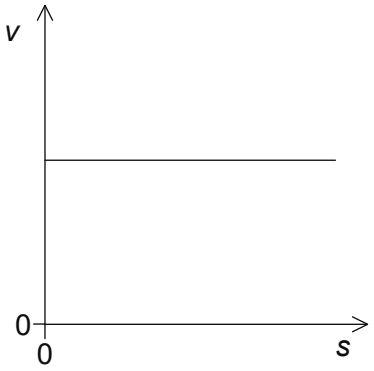
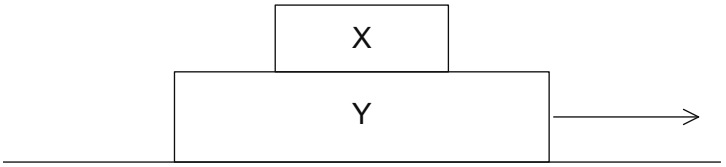
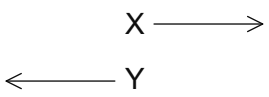


6. Two blocks X and Y rest on a frictionless horizontal surface as shown. A horizontal force is now applied to the larger block and the two blocks move together with the same speed and acceleration.



Which free-body diagram shows the frictional forces between the two blocks?

A.



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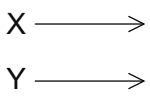

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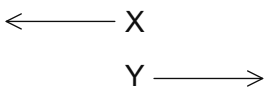

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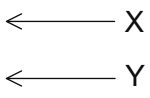
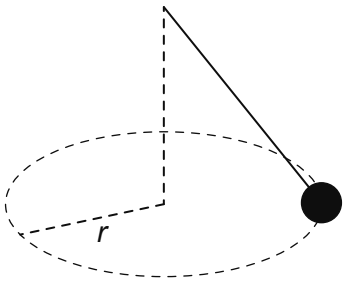


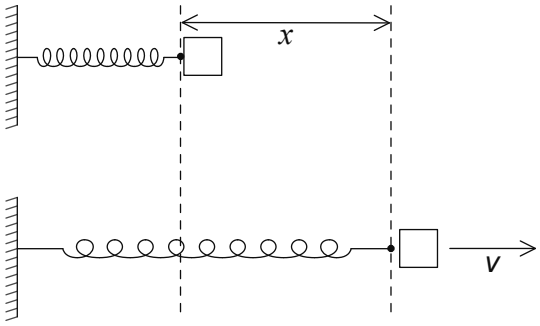
7. The mass at the end of a pendulum is made to move in a horizontal circle of radius r at constant speed. The magnitude of the net force on the mass is F.



What is the direction of F and the work done by F during half a revolution?

	Direction of F	Work done by F
A.	towards centre of circle	zero
B.	towards centre of circle	πrF
C.	away from centre of circle	zero
D.	away from centre of circle	πrF

8. A compressed spring is used to launch an object along a horizontal frictionless surface. When the spring is compressed through a distance x and released, the object leaves the spring at speed v. What is the distance through which the spring must be compressed for the object to leave the spring at $\frac{v}{2}$?



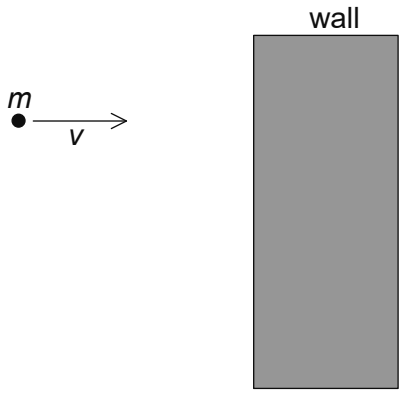
A. $\frac{x}{4}$

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

C. $\frac{x}{\sqrt{2}}$

D. $x\sqrt{2}$

9. A ball of mass *m* collides with a wall and bounces back in a straight line. The ball loses 75 % of the initial energy during the collision. The speed before the collision is *v*.



What is the magnitude of the impulse on the ball by the wall?

A. $\left(1-\frac{\sqrt{3}}{2}\right)mv$

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

C. $\frac{5}{4}mv$

D. $\frac{3}{2}mv$

10. A 700 W electric heater is used to heat 1 kg of water without energy losses. The specific heat capacity of water is 4.2 kJ kg^{-1} K^{-1}. What is the time taken to heat the water from 25 °C to 95 °C?

A. 7 s

B. 30 s

C. 7 minutes

D. 420 minutes

11. A container is filled with a mixture of helium and oxygen at the same temperature. The molar mass of helium is 4 g mol^{-1} and that of oxygen is 32 g mol^{-1}.

What is the ratio $\frac{\text{average speed of helium molecules}}{\text{average speed of oxygen molecules}}$?

A. $\frac{1}{8}$

B. $\frac{1}{\sqrt{8}}$

C. $\sqrt{8}$

D. 8

12. Container X contains 1.0 mol of an ideal gas. Container Y contains 2.0 mol of the ideal gas. Y has four times the volume of X. The pressure in X is twice that in Y.

What is $\frac{\text{temperature of gas in X}}{\text{temperature of gas in Y}}$?

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

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

C. 1

D. 2

13. A particle moving in a circle completes 5 revolutions in 3 s. What is the frequency?

A. $\frac{3}{5}$Hz

B. $\frac{5}{3}$Hz

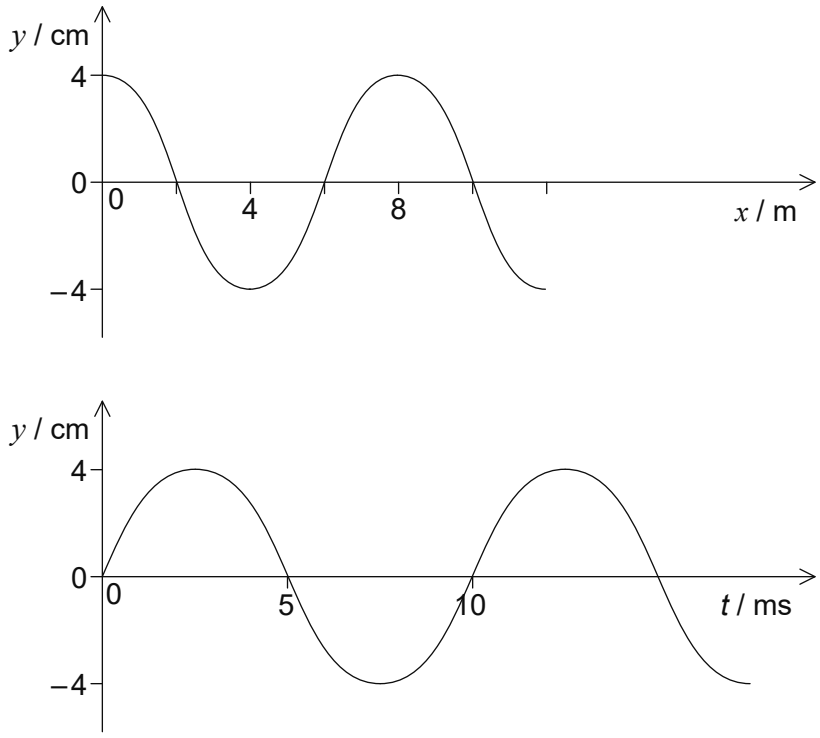
C. $\frac{3\pi}{5}$Hz

D. $\frac{5\pi}{3}$Hz

14. A longitudinal wave moves through a medium. Relative to the direction of energy transfer through the medium, what are the displacement of the medium and the direction of propagation of the wave?

	Displacement of medium	Direction of propagation of wave
A.	parallel	perpendicular
B.	parallel	parallel
C.	perpendicular	parallel
D.	perpendicular	perpendicular

15. The graphs show the variation of the displacement y of a medium with distance x and with time t for a travelling wave.



What is the speed of the wave?

A. 0.6 m s^{-1}

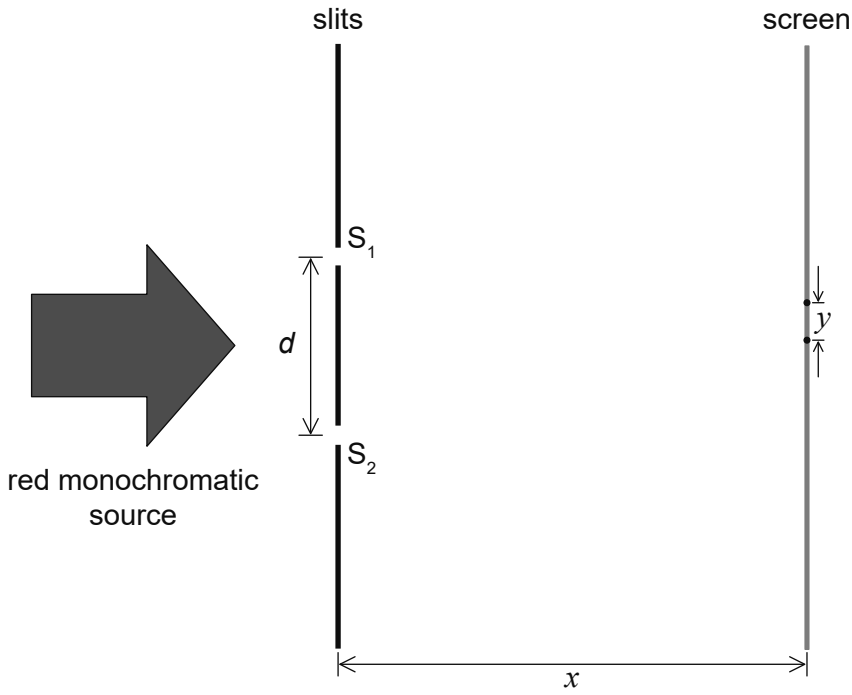
B. 0.8 m s^{-1}

C. 600 m s^{-1}

D. 800 m s^{-1}

16. In a double-slit experiment, a source of monochromatic red light is incident on slits S_1 and S_2 separated by a distance *d*. A screen is located at distance x from the slits. A pattern with fringe spacing y is observed on the screen.

not to scale



Three changes are possible for this arrangement

I. increasing x

II. increasing *d*

III. using green monochromatic light instead of red.

Which changes will cause a decrease in fringe spacing y?

A. I and II only

B. I and III only

C. II and III only

D. I, II, and III

17. Two strings of lengths L_1 and L_2 are fixed at both ends. The wavespeed is the same for both strings. They both vibrate at the same frequency. L_1 vibrates at its first harmonic. L_2 vibrates at its third harmonic.

What is $\frac{L_2}{L_1}$?

A. $\frac{1}{3}$

B. 1

C. 2

D. 3

18. Two copper wires X and Y are connected in series. The diameter of Y is double that of X. The drift speed in X is v. What is the drift speed in Y?

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

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

C. $2v$

D. $4v$

19. A wire of length L is used in an electric heater. When the potential difference across the wire is 200 V, the power dissipated in the wire is 1000 W. The same potential difference is applied across a second similar wire of length $2L$. What is the power dissipated in the second wire?

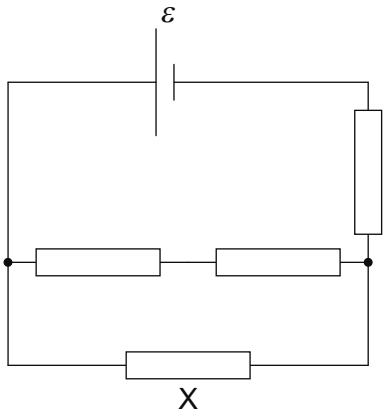
A. 250 W

B. 500 W

C. 2000 W

D. 4000 W

20. A combination of four identical resistors each of resistance R are connected to a source of emf ε of negligible internal resistance. What is the current in the resistor X?



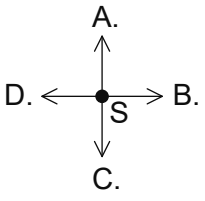
A. $\frac{\varepsilon}{5R}$

B. $\frac{3\varepsilon}{10R}$

C. $\frac{2\varepsilon}{5R}$

D. $\frac{3\varepsilon}{5R}$

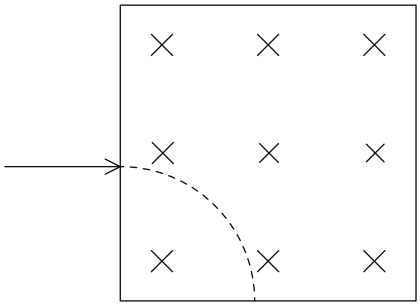
21. Two parallel wires are perpendicular to the page. The wires carry equal currents in opposite directions. Point S is at the same distance from both wires. What is the direction of the magnetic field at point S?



⊙ conventional current out of page

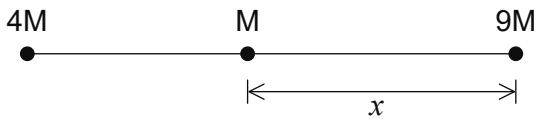
⊗ conventional current into page

22. A particle of mass m and charge of magnitude q enters a region of uniform magnetic field B that is directed into the page. The particle follows a circular path of radius R. What are the sign of the charge of the particle and the speed of the particle?



	Charge of the particle	Speed of the particle
A.	positive	$\frac{qBR}{m}$
B.	negative	$\frac{qBR}{m}$
C.	negative	$\sqrt{\frac{qBR}{m}}$
D.	positive	$\sqrt{\frac{qBR}{m}}$

23. Two isolated point particles of mass 4M and 9M are separated by a distance 1 m. A point particle of mass M is placed a distance x from the particle of mass 9M. The net gravitational force on M is zero.



not to scale

What is x?

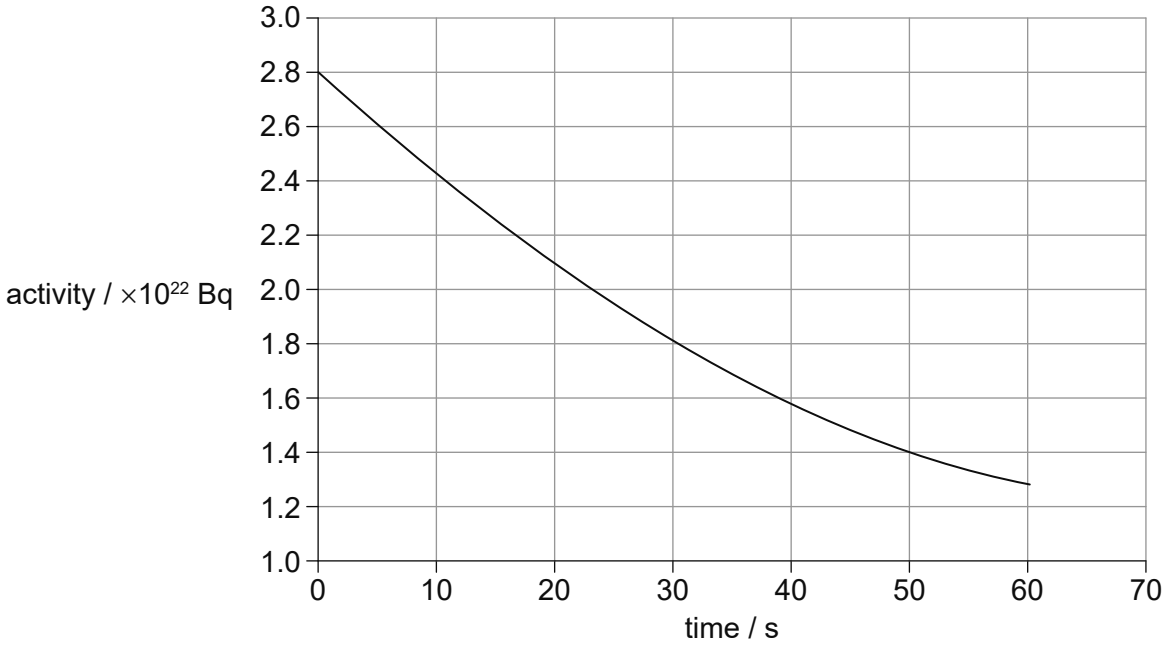
A. $\frac{4}{13}$m

B. $\frac{2}{5}$m

C. $\frac{3}{5}$m

D. $\frac{9}{13}$m

24. The graph shows the variation with time of the activity of a pure sample of a radioactive nuclide. What percentage of the nuclide remains after 200 s?



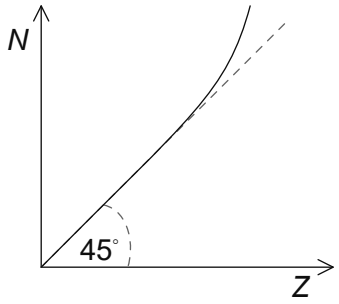
A. 3.1 %

B. 6.3 %

C. 13 %

D. 25 %

25. The graph shows the variation of the number of neutrons N with the atomic number Z for stable nuclei. The same scale is used in the N and Z axes.



Which information can be inferred from the graph?

I. For stable nuclei with high Z, N is larger than Z.

II. For stable nuclei with small Z, $N = Z$.

III. All stable nuclei have more neutrons than protons.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

26. Copper $\left({}^{64}_{29}\text{Cu}\right)$ decays to nickel $\left({}^{64}_{28}\text{Ni}\right)$. What are the particles emitted and the particle that mediates the interaction?

	Particles emitted	Mediating particle
A.	β^- and neutrino	W^+
B.	β^+ and neutrino	W^-
C.	β^- and neutrino	W^-
D.	β^+ and neutrino	W^+

27. The following interaction is proposed between a proton and a pion.

$$p^+ + \pi^- \rightarrow K^- + \pi^+$$

The quark content of the π^- is $\bar{u}d$ and the quark content of the K^- is $\bar{u}s$.

Three conservation rules are considered

I. baryon number

II. charge

III. strangeness.

Which conservation rules are violated in this interaction?

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

28. What is the function of control rods in a nuclear power plant?

A. To slow neutrons down

B. To regulate fuel supply

C. To exchange thermal energy

D. To regulate the reaction rate

29. A photovoltaic panel of area S has an efficiency of 20 %. A second photovoltaic panel has an efficiency of 15 %. What is the area of the second panel so that both panels produce the same power under the same conditions?

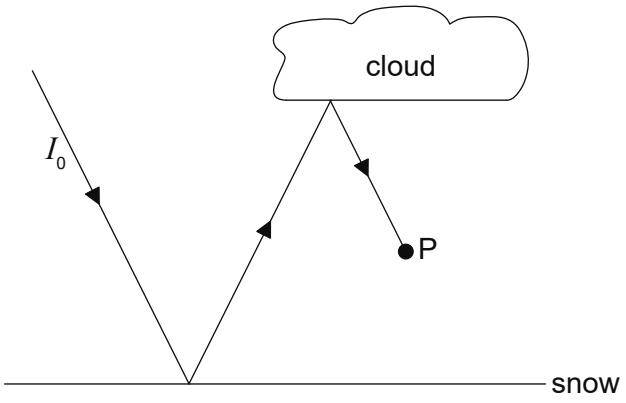
A. $\frac{S}{3}$

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

C. $\frac{5S}{4}$

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

30. Light of intensity I_0 is incident on a snow-covered area of Earth. In a model of this situation, the albedo of the cloud is 0.30 and the albedo for the snow surface is 0.80. What is the intensity of the light at P due to the incident ray I_0?



A. $0.14\, I_0$

B. $0.24\, I_0$

C. $0.50\, I_0$

D. $0.55\, I_0$