Diploma Programme
Programme du diplôme
Programa del Diploma

Physics
Standard level
Paper 1A

Specimen paper

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]**.

0000 – 6504

1. A car has an initial speed of $16\,m\,s^{-1}$. It decelerates at $4.0\,m\,s^{-2}$ until it stops.

What is the distance travelled by the car?

A. 4 m

B. 16 m

C. 32 m

D. 64 m

2. A block of mass 2.0 kg accelerates from a speed of $15\,m\,s^{-1}$ to a speed of $20\,m\,s^{-1}$ without changing its direction.

What impulse acts on the block?

A. 2.5 N s

B. 5.0 N s

C. 10 N s

D. 17.5 N s

3. A net force of 8.0 N accelerates a 4.0 kg body from rest to a speed of $5.0\,m\,s^{-1}$.

What is the work done by the force?

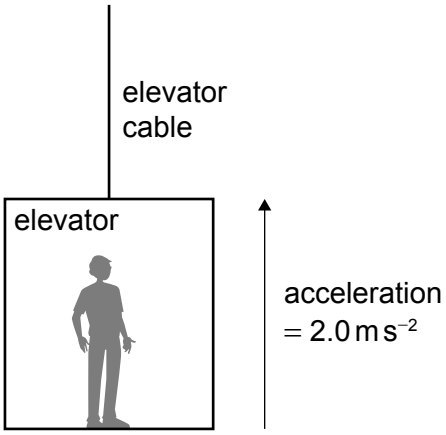
A. 50 J

B. 40 J

C. 32 J

D. 20 J

4. A person stands in an elevator (lift). The total mass of the person and the elevator is 800 kg. The elevator accelerates upward at $2.0\,m\,s^{-2}$.



What is the tension in the cable?

A. 1.6 kN

B. 6.4 kN

C. 8.0 kN

D. 9.6 kN

5. An object is released from rest in a vacuum at a height H above the Earth's surface.

As the object falls it passes a point at a height of $0.75H$ above the surface.

What is $\dfrac{\text{kinetic energy of the object at a height of } 0.75H}{\text{gravitational potential energy of the object at a height of } H}$?

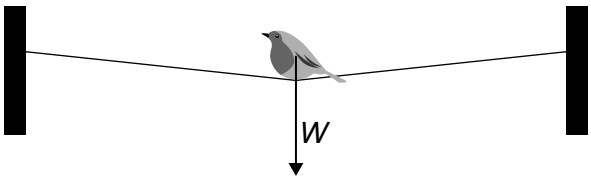
A. $\dfrac{1}{16}$

B. $\dfrac{1}{4}$

C. $\dfrac{9}{16}$

D. $\dfrac{3}{4}$

6. A bird of weight W sits on a thin rope at its midpoint. The rope is almost horizontal and has negligible mass.



The tension in the rope is

A. less than $\frac{W}{2}$

B. equal to $\frac{W}{2}$

C. between $\frac{W}{2}$ and W

D. greater than W

7. The internal energy of a real gas is

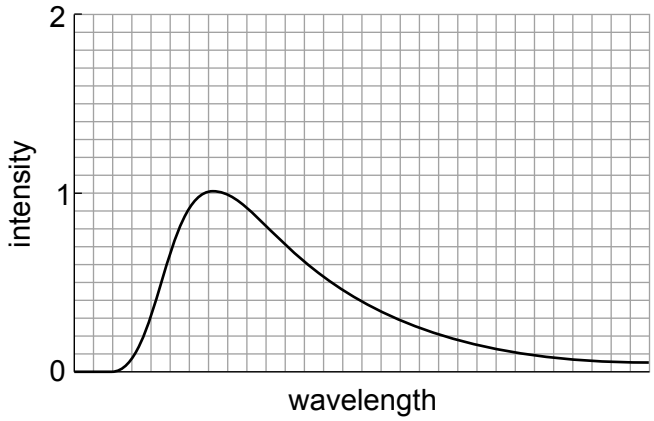
A. zero.

B. equal to the intermolecular potential energy of the particles.

C. equal to the total kinetic energy of the particles.

D. equal to the sum of the intermolecular potential energy and the total kinetic energy of the particles.

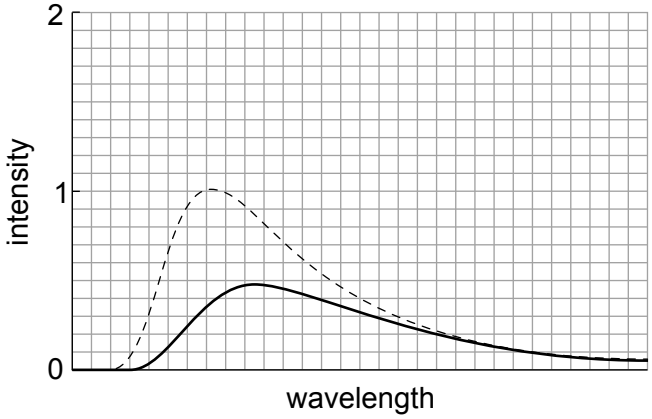
8. The black-body radiation curve of an object at 600 K is shown. The intensity units are arbitrary.



What is the radiation curve of the same object at 450 K?

The original curve is shown with a dashed line.

A.



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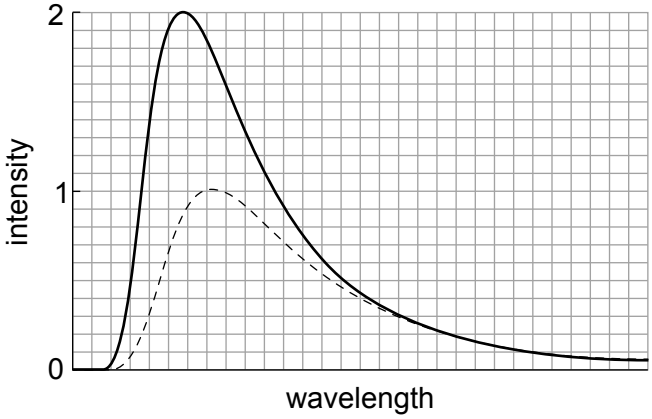
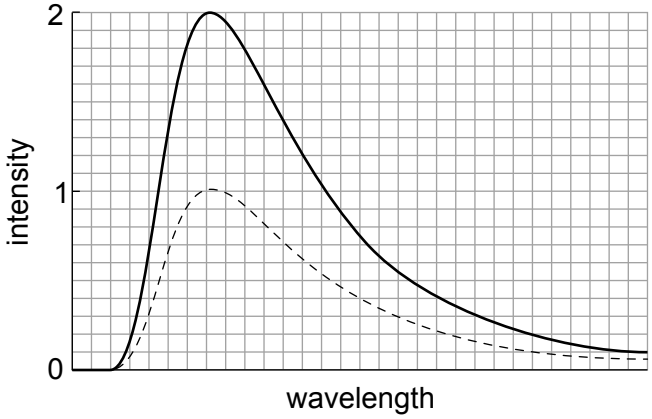
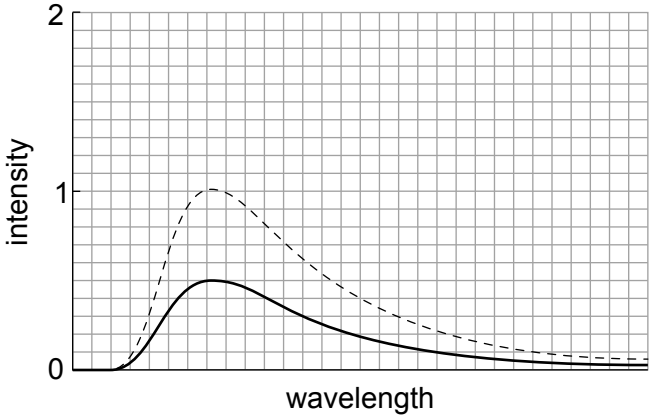


C.



D.



9. Star X has a luminosity L and an apparent brightness b. Star X is at a distance d from Earth.

Star Y has the same apparent brightness as X but is four times more luminous.

What is the distance of Star Y from Earth?

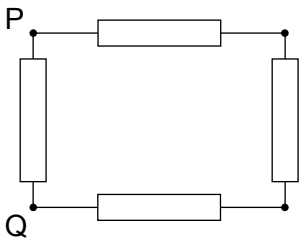
A. $4d$

B. $2d$

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

D. $\frac{d}{4}$

10. Four identical resistors, each of resistance R, are connected as shown.



What is the effective resistance between P and Q?

A. $\frac{3R}{4}$

B. R

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

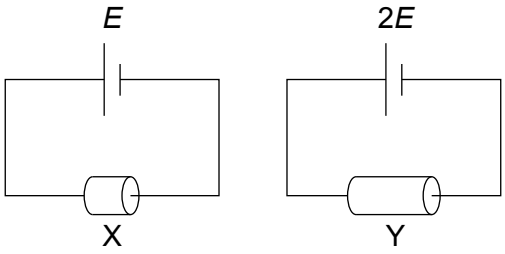
D. $4R$

11. Conductor X is connected to a cell of emf E. A power of 16 W is dissipated in X.

Conductor Y is made from the same material with the same diameter as X but is twice as long. A cell of emf $2E$ is connected to Y.

Both cells have negligible internal resistance.

What power is dissipated in Y?



A. 8.0 W

B. 16 W

C. 32 W

D. 64 W

12. Two containers, X and Y, are filled with an ideal gas at the same pressure.

The volume of X is four times the volume of Y. The temperature of X is 327 °C and the temperature of Y is 27 °C.

What is $\frac{\text{amount of substance in X}}{\text{amount of substance in Y}}$?

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

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

C. 2

D. 8

13. An electromagnetic wave has a wavelength that is about the size of the diameter of an atom.

What region of the electromagnetic spectrum does the wave belong to?

A. Infrared

B. Visible light

C. Ultraviolet

D. X-ray

14. A particle undergoes simple harmonic motion of period T. At time $t = 0$ the particle is at its equilibrium position.

What is t when the particle is at its greatest distance from the equilibrium position?

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

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

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

D. T

15. Diagram 1 shows the variation with position of the displacement of a standing wave formed on a string.

Diagram 2 shows the variation with position of the displacement of a travelling wave moving to the right along a string.

Diagram 1

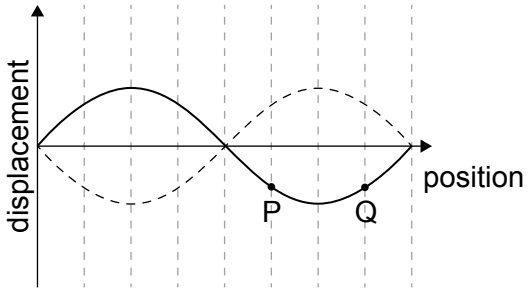
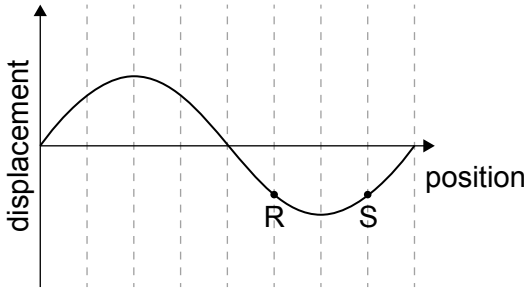


Diagram 2



Points P, Q, R and S are points on the string.

What is the phase difference between P and Q and the phase difference between R and S?

	Phase difference between P and Q	**Phase difference between R and S**
A.	0	0
B.	$\frac{\pi}{2}$	0
C.	0	$\frac{\pi}{2}$
D.	$\frac{\pi}{2}$	$\frac{\pi}{2}$

16. A mass of 0.25 kg hangs from a spring of spring constant 4.0 N m^{-1}.

What is the natural frequency of oscillation for this system?

A. 0.50 Hz

B. 0.64 Hz

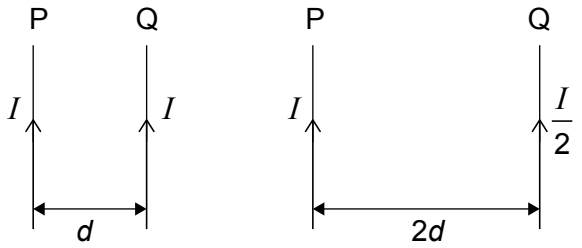
C. 1.6 Hz

D. 2.0 Hz

17. Two long parallel wires P and Q are a distance *d* apart. They each carry a current.

A magnetic force per unit length *F* acts on P due to Q.

The distance between the wires is increased to 2*d* and the current in Q is decreased to $\frac{I}{2}$.



What is the magnetic force per unit length that acts on P due to Q after the changes?

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

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

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

D. F

18. Planets X and Y orbit the same star.

The average distance between planet X and the star is five times greater than the average distance between planet Y and the star.

What is $\frac{\text{orbital period of planet X}}{\text{orbital period of planet Y}}$?

A. $\sqrt[3]{5}$

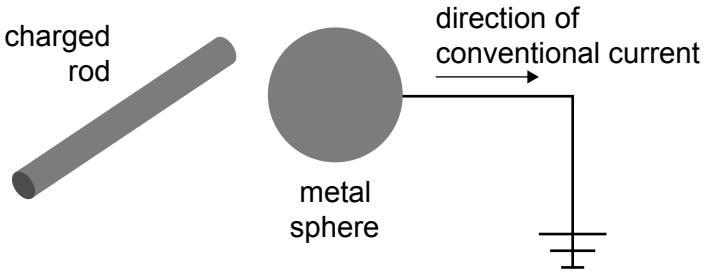
B. $\sqrt{5}$

C. $\sqrt[3]{5^2}$

D. $\sqrt{5^3}$

19. A charged rod is brought near an initially neutral metal sphere without touching it.

When the sphere is grounded (earthed), there is an electric current for a short time from the sphere to the ground.

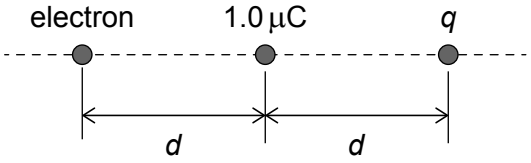


The ground connection is then removed.

What are the charge on the rod and the charge induced on the sphere when the connection is removed?

	Charge on the rod	Charge induced on the sphere
A.	negative	negative
B.	negative	positive
C.	positive	negative
D.	positive	positive

20. A positive point charge of magnitude 1.0 μC and a point charge *q* are separated by a distance *d*.



An electron is placed at a distance *d* from the +1.0 μC charge. The electric force on the electron is zero.

What is *q*?

A. –4.0 μC

B. –2.0 μC

C. 2.0 μC

D. 4.0 μC

21. What is the sequence for the evolution of a main sequence star of about 2 solar masses?

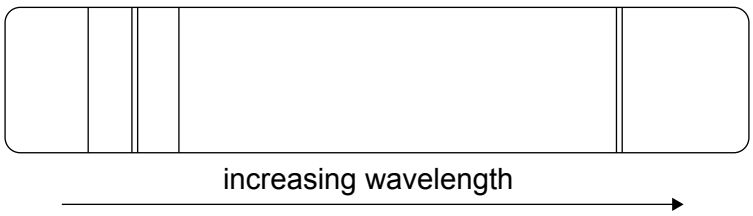
A. Red super giant → supernova → neutron star

B. Red giant → planetary nebula → white dwarf

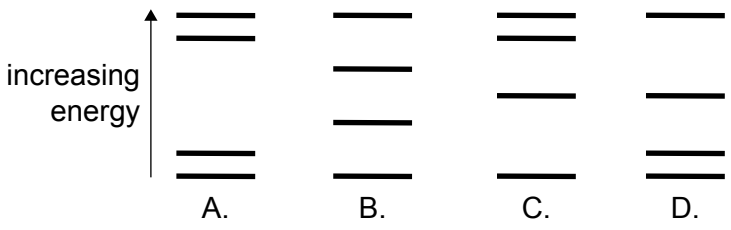
C. Red giant → supernova → white dwarf

D. Red super giant → planetary nebula → neutron star

22. The diagram shows the emission spectrum of an atom.



Which of the following atomic energy level models can produce this spectrum?



23. Two radioactive samples X and Y have the same half-life. Initially the ratio $\frac{\text{activity of X}}{\text{activity of Y}}$ is 4.

What is this ratio after 2 half-lives?

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

B. 1

C. 2

D. 4

24. Three statements about a nuclear fission reactor are:

I. The heat exchanger transfers energy from the fuel rods to the moderator.

II. The control rods must be good absorbers of neutrons.

III. The moderator must slow neutrons down.

Which statements about the reactor are correct?

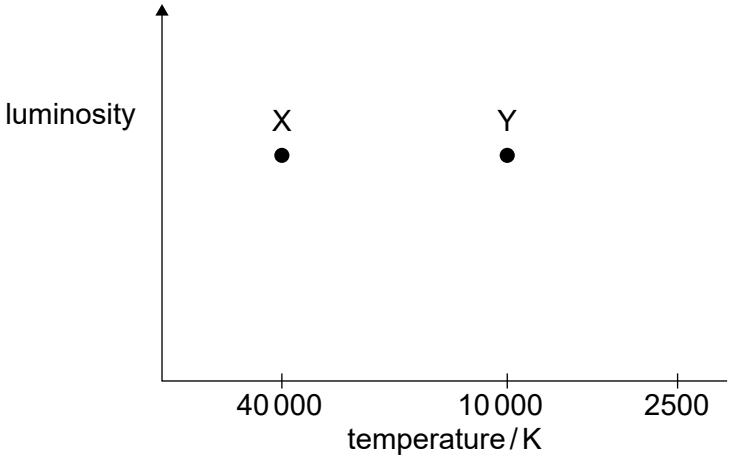
A. I and II only

B. I and III only

C. II and III only

D. I, II and III

25. The Hertzsprung–Russell diagram shows two stars, X and Y.



What is $\frac{\text{radius of X}}{\text{radius of Y}}$?

A. $\frac{1}{16}$

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

C. 4

D. 16