National Qualifications 2026

X857/76/12

Physics
Paper 1 — Multiple choice

THURSDAY, 21 MAY
9:00 AM – 9:45 AM

Total marks — 25

Attempt ALL questions.

You may use a calculator.

Instructions for the completion of Paper 1 are given on *page 02* of your answer booklet X857/76/02.

Record your answers on the answer grid on *page 03* of your answer booklet.

Reference may be made to the data sheet on *page 02* of this question paper and to the relationships sheet X857/76/22.

Space for rough work is provided at the end of this booklet.

You must leave your answer booklet on your desk; if you do not, you could lose all the marks for this paper.

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DATA SHEET

COMMON PHYSICAL QUANTITIES

Quantity	Symbol	Value	Quantity	Symbol	Value
Speed of light in vacuum	c	3.00×10^{8} m s^{-1}	Planck's constant	h	6.63×10^{-34} J s
Magnitude of the charge on an electron	e	1.60×10^{-19} C	Mass of electron	m_e	9.11×10^{-31} kg
Universal Constant of Gravitation	G	6.67×10^{-11} m^3 kg^{-1} s^{-2}	Mass of neutron	m_n	1.675×10^{-27} kg
Gravitational acceleration on Earth	g	9.8 m s^{-2}	Mass of proton	m_p	1.673×10^{-27} kg
Hubble's constant	H_0	2.3×10^{-18} s^{-1}	Speed of sound in air	v_{air}	3.40×10^{2} m s^{-1}

REFRACTIVE INDICES

The refractive indices refer to sodium light of wavelength 589 nm and to substances at a temperature of 273 K.

Substance	Refractive index	Substance	Refractive index
Diamond	2.42	Water	1.33
Crown glass	1.50	Air	1.00

SPECTRAL LINES

Element	Wavelength (nm)	Colour
Hydrogen	656	Red
	486	Blue-green
	434	Blue-violet
	410	Violet
	397	Ultraviolet
	389	Ultraviolet
Sodium	589	Yellow

Element	Wavelength (nm)	Colour
Cadmium	644	Red
	509	Green
	480	Blue

Lasers

Element	Wavelength (nm)	Colour
Carbon dioxide	9550 }	Infrared
	10 590 }	
Helium-neon	633	Red

PROPERTIES OF SELECTED MATERIALS

Substance	Density (kg m^{-3})	Melting point (K)	Boiling point (K)
Aluminium	2.70×10^{3}	933	2623
Copper	8.96×10^{3}	1357	2853
Ice	9.20×10^{2}	273	. . . .
Sea Water	1.02×10^{3}	264	377
Water	1.00×10^{3}	273	373
Air	1.29	. . . .	. . . .
Hydrogen	9.0×10^{-2}	14	20

The gas densities refer to a temperature of 273 K and a pressure of 1.01×10^{5} Pa.

Total marks — 25 marks

Attempt ALL questions

1. A car is travelling at 15 $m\,s^{-1}$ along a straight road.
The brakes are applied and the car comes to rest in a time of 6.0 s.
The distance travelled by the car during this time is

A 45 m
B 83 m
C 90 m
D 98 m
E 140 m.

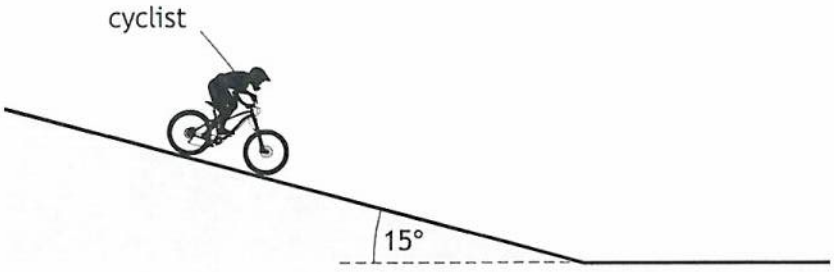
2. A falling object travels at its terminal velocity because

A the air resistance is less than the weight of the object
B the air resistance is balanced by the weight of the object
C the air resistance is greater than the weight of the object
D the acceleration of the object is 9.8 $m\,s^{-2}$
E the acceleration of the object is greater than 9.8 $m\,s^{-2}$.

[Turn over

3. A cyclist is freewheeling down a slope.

The slope is at an angle of 15° to the horizontal as shown.



The cyclist and bicycle have a combined mass of 70.0 kg.

The component of the combined weight of the cyclist and bicycle down the slope is

A 18 N

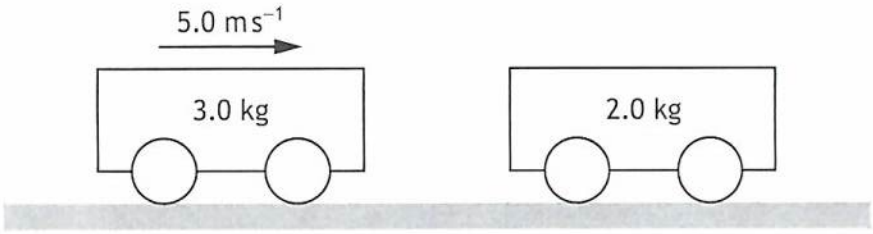
B 68 N

C 180 N

D 660 N

E 690 N.

4. A trolley of mass 3.0 kg is travelling along a level bench towards a stationary trolley of mass 2.0 kg.



The speed of the 3.0 kg trolley just before it collides with the 2.0 kg trolley is 5.0 m s^{-1}.

After the collision the trolleys stick together.

The effects of friction are negligible.

Which row in the table gives the total kinetic energy of the trolleys immediately before the collision and the total kinetic energy of the trolleys immediately after the collision?

	Total kinetic energy of the trolleys before the collision (J)	Total kinetic energy of the trolleys after the collision (J)
A	7.5	7.5
B	23	38
C	38	23
D	38	29
E	75	45

[Turn over

5. A toy car of mass 0.50 kg is travelling along a frictionless track with a constant speed of 0.80 $m\,s^{-1}$.

A constant force of 1.2 N is now applied to the toy car, in the same direction as the car is travelling, for a time of 1.5 s.

The **change in speed** of the toy car is

A 2.4 $m\,s^{-1}$

B 2.8 $m\,s^{-1}$

C 3.6 $m\,s^{-1}$

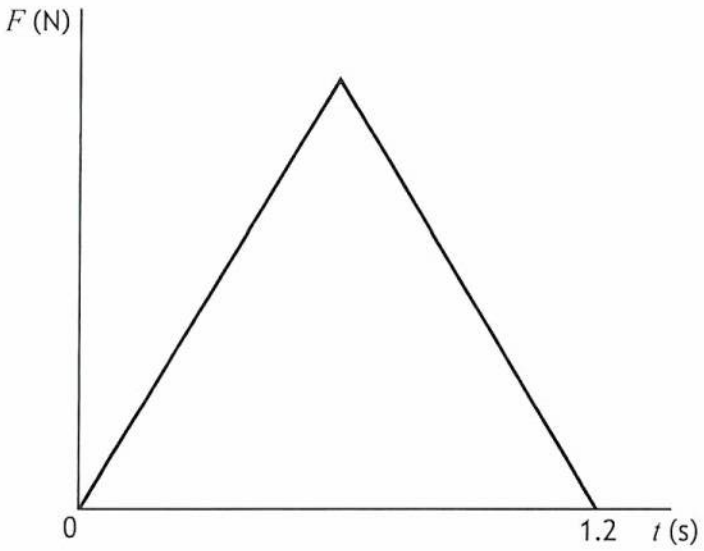
D 4.4 $m\,s^{-1}$

E 9.0 $m\,s^{-1}$.

6. A car of mass 1400 kg is travelling at a speed of 18 $m\,s^{-1}$.

A force is now applied to the car bringing it to rest.

The graph shows how the force F applied to the car varies with time t.



The magnitude of the average force applied to the car during this time is

A 1.1×10^4 N

B 2.1×10^4 N

C 2.5×10^4 N

D 4.2×10^4 N

E 5.0×10^4 N.

7. The International Space Station (ISS) is orbiting the Earth at a height of 420 km above the Earth's surface.

A group of students make the following statements about the ISS in this orbit:

I The ISS is accelerating towards the Earth.

II The magnitude of the vertical velocity of the ISS increases as it is orbiting the Earth.

III The gravitational field strength is zero at a height of 420 km above the Earth's surface.

Which of these statements is/are correct?

A I only

B I and II only

C I and III only

D II and III only

E I, II and III

8. An astronaut in a spacecraft measures the length of the spacecraft as 25.0 m.

The spacecraft is travelling at a speed of $0.200c$ as it passes a planet.

An observer on the planet measures the length of the spacecraft as

A 20.0 m

B 22.4 m

C 24.0 m

D 24.5 m

E 25.5 m.

[Turn over

9. During a demonstration of the Doppler effect, a buzzer emitting sound travels at a constant speed as it approaches, passes, and moves away from a stationary observer.

The buzzer emits sound of constant frequency.

The frequency of the sound heard by the observer as the buzzer approaches, passes, and moves away

A remains constant

B continually decreases

C continually increases

D changes from a low frequency to a high frequency

E changes from a high frequency to a low frequency.

10. Evidence supporting the existence of dark energy comes from

A estimations of the mass of galaxies

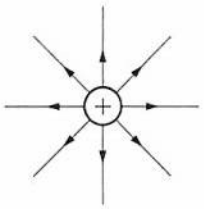
B the darkness of the night sky (Olbers' paradox)

C large numbers of galaxies showing redshift, rather than blueshift

D the accelerating rate of expansion of the Universe

E the abundance of the elements hydrogen and helium in the Universe.

11. The electric field around a positive point charge is shown.



A particle with a negative charge is placed in this electric field.

A student makes the following statements:

I The electric field around the point charge is uniform.

II The electric field exerts a force on the particle.

III The particle moves towards the point charge.

Which of these statements is/are correct?

A II only

B III only

C I and II only

D II and III only

E I, II and III

12. A physicist determines the mass of two subatomic particles X and Y.

Subatomic particle X has a mass of 2.18×10^{-25} kg.

Subatomic particle Y has a mass of 1.68×10^{-27} kg.

The mass of subatomic particle X is

A 130 orders of magnitude less than the mass of subatomic particle Y

B 130 orders of magnitude greater than the mass of subatomic particle Y

C 100 orders of magnitude greater than the mass of subatomic particle Y

D 2 orders of magnitude less than the mass of subatomic particle Y

E 2 orders of magnitude greater than the mass of subatomic particle Y.

[Turn over

13. The force-mediating particle associated with the electromagnetic force is the

A gluon
B meson
C W-boson
D Z-boson
E photon.

14. The following statement represents a nuclear reaction.

$$^{2}_{1}H + {}^{2}_{1}H \rightarrow {}^{3}_{2}He + {}^{1}_{0}n$$

The reaction is an example of

A spontaneous nuclear fission
B induced nuclear fission
C nuclear fusion
D alpha particle emission
E beta particle emission.

15. Light from a point source is incident on a surface.

At a distance of 0.30 m from the light source the irradiance on the surface is 4.8 $W\,m^{-2}$.

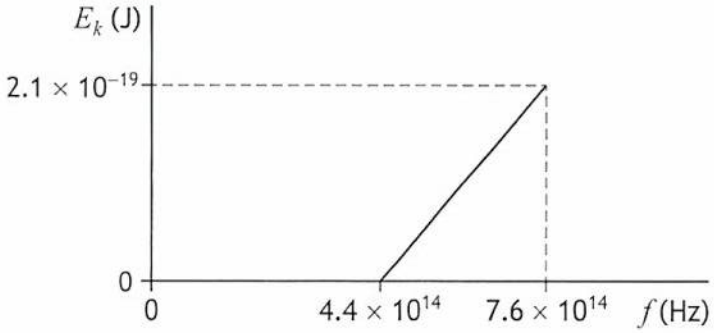
The light source is now moved a **further** 0.90 m from the surface.

The irradiance on the surface is now

A 0.30 $W\,m^{-2}$
B 0.53 $W\,m^{-2}$
C 1.2 $W\,m^{-2}$
D 1.6 $W\,m^{-2}$
E 4.0 $W\,m^{-2}$.

16. Electrons are emitted from a metal surface when certain frequencies of electromagnetic radiation are incident on the metal surface.

The graph shows how the maximum kinetic energy E_k of the emitted electrons varies with the frequency f of the incident radiation.



The work function of the metal is

A 5.0×10^{-19} J

B 2.9×10^{-19} J

C 2.1×10^{-19} J

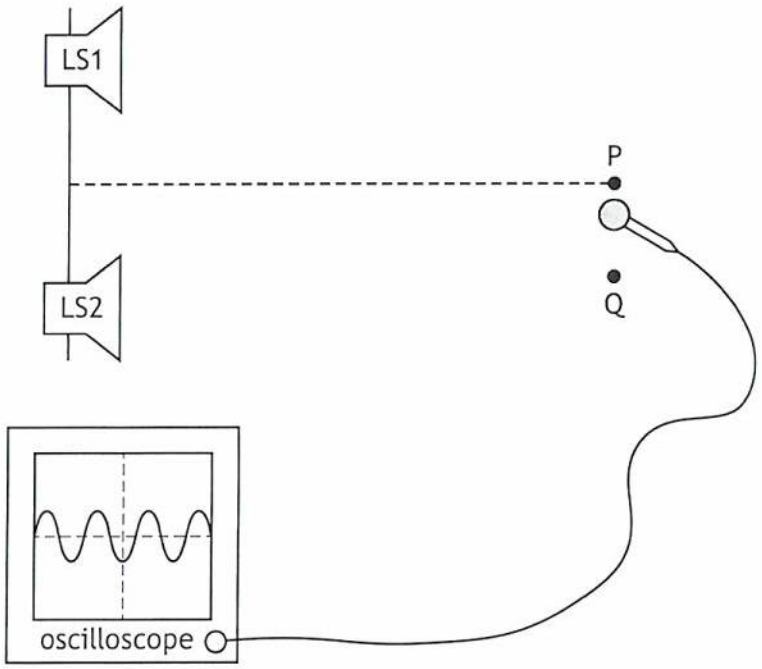
D 1.5×10^{-48} J

E 8.7×10^{-49} J.

[Turn over

17. Two loudspeakers LS1 and LS2 produce coherent waves.

A microphone connected to an oscilloscope is used to detect the sound from the loudspeakers.



The path difference for the sound detected at position P is zero.

The path difference for the sound detected at position Q is one wavelength.

Which of the following best describes what happens to the amplitude of the trace observed on the oscilloscope as the microphone is moved slowly from position P to position Q?

A The amplitude remains constant.

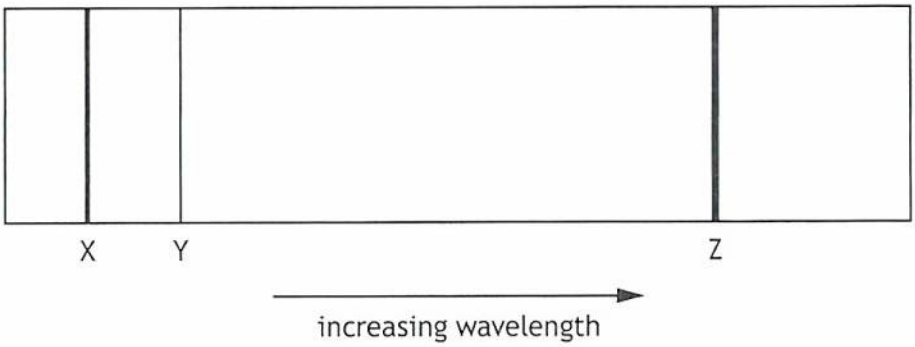
B The amplitude is a minimum at P and increases to a maximum at Q.

C The amplitude is a maximum at P and decreases to a minimum at Q.

D The amplitude is a minimum at P, increases to a maximum and then decreases to a minimum at Q.

E The amplitude is a maximum at P, decreases to a minimum and then increases to a maximum at Q.

18. Light from a gas discharge lamp is used to produce the line emission spectrum shown.



The spectral line at position Z is brighter than the spectral lines at positions X and Y.

Compared to spectral lines X and Y, spectral line Z is brighter because

A electrons transition between two energy levels and release photons with greater energy

B electrons transition between two energy levels and release photons with less energy

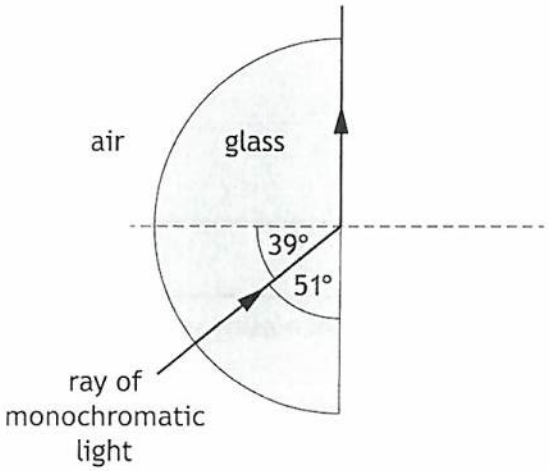
C more electrons per second make the transition between the energy levels that produces spectral line Z

D fewer electrons per second make the transition between the energy levels that produces spectral line Z

E fewer photons per second are emitted for spectral line Z.

[Turn over

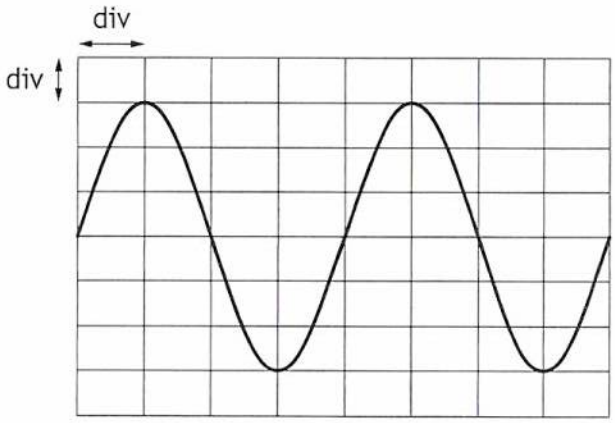
19. A ray of monochromatic light passes from air into a semi-circular glass block as shown.



Which row in the table gives the critical angle and the refractive index for the light in this glass?

	Critical angle (°)	Refractive index
A	39	1.6
B	39	1.3
C	51	1.6
D	51	1.3
E	90	0.63

20. The output from an AC power supply is connected to an oscilloscope.
The trace on the oscilloscope screen is shown.

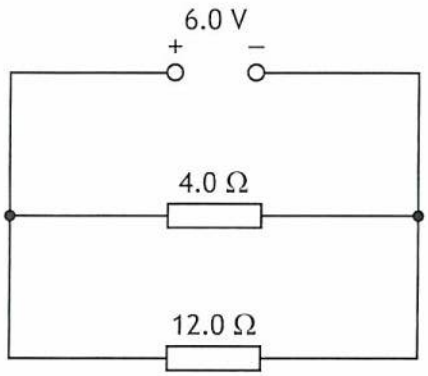


The Y-gain setting on the oscilloscope is 1.5 V/div.
The timebase setting on the oscilloscope is 2.5 ms/div.
Which row in the table shows the rms voltage V_{rms} and the frequency f of the power supply?

	V_{rms} (V)	f (Hz)
A	3.2	50
B	3.2	100
C	4.5	100
D	6.4	50
E	6.4	100

[Turn over

21. A circuit is set up as shown.



The internal resistance of the supply is negligible.

The power dissipated in the 4.0 Ω resistor is

A 0.5 W

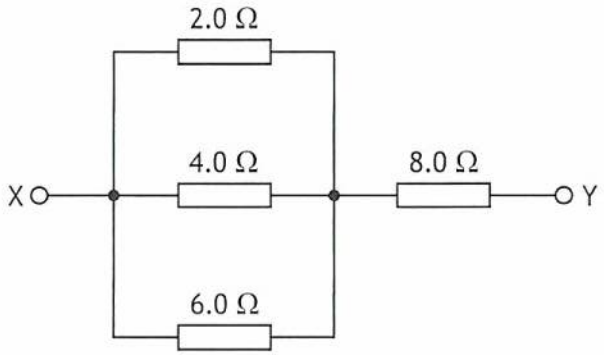
B 2.0 W

C 3.0 W

D 9.0 W

E 24 W.

22. Four resistors are connected as shown.



The total resistance between X and Y is

A 0.96 Ω
B 1.1 Ω
C 9.1 Ω
D 14 Ω
E 20 Ω.

23. One ampere is equivalent to one

A coulomb per joule
B coulomb per second
C coulomb per volt
D joule per second
E joule per coulomb.

24. A 220 μF capacitor is connected to a 12 V DC supply.
The maximum charge stored by the capacitor is

A 5.5×10^{4} C
B 1.6×10^{2} C
C 1.3×10^{-3} C
D 2.6×10^{-3} C
E 1.8×10^{-5} C.

[Turn over

25. The frequency f of the sound produced by a vibrating guitar string is given by the relationship

$$f = \frac{1}{2L}\sqrt{\frac{T}{\mu}}$$

where: L is the length of the vibrating guitar string in m

T is the tension in the guitar string in N

μ is the mass per unit length of the guitar string in kg m^{-1}.

A vibrating guitar string produces a sound with a frequency of 160 Hz when the length of the string is 0.64 m.

The mass per unit length of the guitar string is 1.5×10^{-3} kg m^{-1}.

The tension in the guitar string is

A 23 N

B 31 N

C 63 N

D 98 N

E 260 N.

[END OF QUESTION PAPER]

