



National
Qualifications
2018

X757/76/02

Physics
Section 1 — Questions

TUESDAY, 8 MAY

9:00 AM – 11:30 AM

Instructions for the completion of Section 1 are given on *page 02* of your question and answer booklet X757/76/01.

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

Reference may be made to the Data Sheet on *page 02* of this booklet and to the Relationships Sheet X757/76/11.

Before leaving the examination room you must give your question and answer booklet to the Invigilator; if you do not, you may lose all the marks for this paper.



DATA SHEET

COMMON PHYSICAL QUANTITIES

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

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	Element	Wavelength/nm	Colour
Hydrogen	656	Red	Cadmium	644	Red
	486	Blue-green		509	Green
	434	Blue-violet		480	Blue
	410	Violet	Lasers		
	397	Ultraviolet	Element	Wavelength/nm	Colour
	389	Ultraviolet	Carbon dioxide	9550 } 10590 }	Infrared
Sodium	589	Yellow	Helium-neon	633	Red

PROPERTIES OF SELECTED MATERIALS

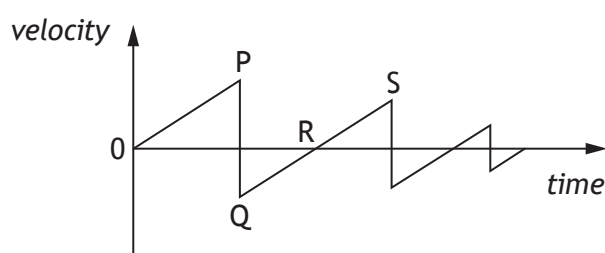
Substance	Density/kg m ⁻³	Melting Point/K	Boiling Point/K
Aluminium	2.70×10^3	933	2623
Copper	8.96×10^3	1357	2853
Ice	9.20×10^2	273	
Sea Water	1.02×10^3	264	377
Water	1.00×10^3	273	373
Air	1.29		
Hydrogen	9.0×10^{-2}	14	20

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

SECTION 1 — 20 marks

Attempt ALL questions

1. A car is moving at a speed of 2.0 m s^{-1} .
The car now accelerates at 4.0 m s^{-2} until it reaches a speed of 14 m s^{-1} .
The distance travelled by the car during this acceleration is
- A 1.5 m
B 18 m
C 24 m
D 25 m
E 48 m.
2. A ball is dropped from rest and allowed to bounce several times.
The graph shows how the velocity of the ball varies with time.



A student makes the following statements about the ball.

- I The ball hits the ground at P.
II The ball is moving upwards between Q and R.
III The ball is moving upwards between R and S.

Which of these statements is/are correct?

- A I only
B II only
C III only
D I and II only
E I and III only

[Turn over

3. A block of mass 6.0 kg and a block of mass 8.0 kg are connected by a string. A force of 32 N is applied to the blocks as shown.



A frictional force of 4.0 N acts on **each** block.

The acceleration of the 6.0 kg block is

- A 1.7 m s^{-2}
B 2.0 m s^{-2}
C 2.3 m s^{-2}
D 2.9 m s^{-2}
E 5.3 m s^{-2} .
4. A person stands on a weighing machine in a lift. When the lift is at rest, the reading on the weighing machine is 700 N .
The lift now descends and its speed increases at a constant rate.
The reading on the weighing machine
- A is a constant value higher than 700 N
B is a constant value lower than 700 N
C continually increases from 700 N
D continually decreases from 700 N
E remains constant at 700 N .
5. Enceladus is a moon of Saturn. The mass of Enceladus is $1.08 \times 10^{20}\text{ kg}$.
The mass of Saturn is $5.68 \times 10^{26}\text{ kg}$.
The gravitational force of attraction between Enceladus and Saturn is $7.24 \times 10^{19}\text{ N}$.
The orbital radius of Enceladus around Saturn is
- A $2.38 \times 10^8\text{ m}$
B $9.11 \times 10^{13}\text{ m}$
C $5.65 \times 10^{16}\text{ m}$
D $8.30 \times 10^{27}\text{ m}$
E $3.19 \times 10^{33}\text{ m}$.

6. A spacecraft is travelling at $0.10c$ relative to a star.

An observer on the spacecraft measures the speed of light emitted by the star to be

- A $0.90c$
- B $0.99c$
- C $1.00c$
- D $1.01c$
- E $1.10c$.

7. A spacecraft is travelling at a speed of $0.200c$ relative to the Earth.

The spacecraft emits a signal for 20.0 seconds as measured in the frame of reference of the spacecraft.

An observer on Earth measures the duration of the signal as

- A 19.2 s
- B 19.6 s
- C 20.0 s
- D 20.4 s
- E 20.8 s.

8. How many types of quark are there?

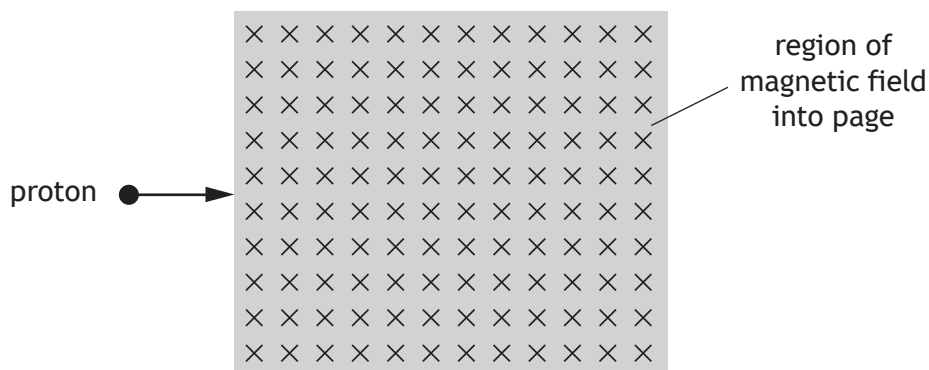
- A 8
- B 6
- C 4
- D 3
- E 2

9. An electron is a

- A boson
- B hadron
- C baryon
- D meson
- E lepton.

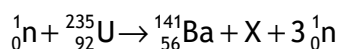
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10. A proton enters a region of magnetic field as shown.



On entering the magnetic field the proton

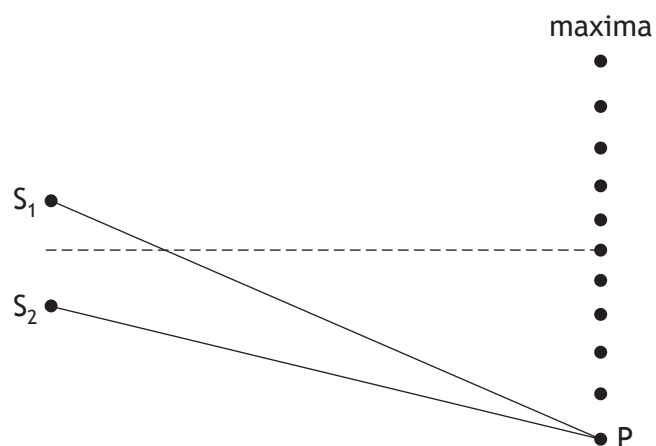
- A deflects into the page
 - B deflects out of the page
 - C deflects towards the top of the page
 - D deflects towards the bottom of the page
 - E is not deflected.
11. A nuclear fission reaction is represented by the following statement.



The nucleus represented by X is

- A ${}_{40}^{96}\text{Zr}$
 - B ${}_{36}^{92}\text{Kr}$
 - C ${}_{40}^{97}\text{Zr}$
 - D ${}_{36}^{93}\text{Kr}$
 - E ${}_{40}^{94}\text{Zr}$.
12. The irradiance on a surface 0.50 m from a point source of light is I .
The irradiance on a surface 1.5 m from this source is
- A $0.11I$
 - B $0.33I$
 - C $1.5I$
 - D $3.0I$
 - E $9.0I$.

13. Waves from two coherent sources, S_1 and S_2 , produce an interference pattern. Maxima are detected at the positions shown below.



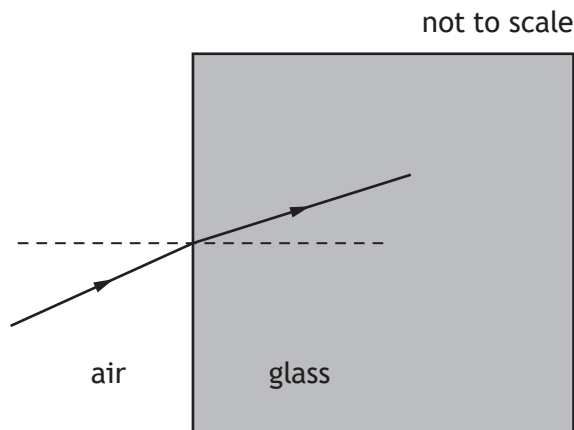
The path difference $S_1P - S_2P$ is 154 mm.

The wavelength of the waves is

- A 15.4 mm
- B 25.7 mm
- C 28.0 mm
- D 30.8 mm
- E 34.2 mm.

[Turn over

14. A ray of monochromatic light passes from air into a block of glass as shown.



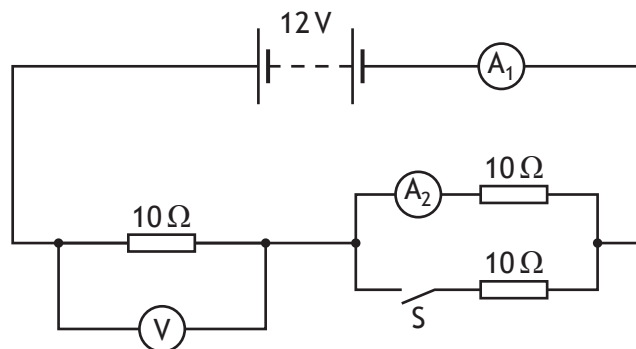
The wavelength of this light in air is 6.30×10^{-7} m.

The refractive index of the glass for this light is 1.50.

The frequency of this light in the glass is

- A 2.10×10^{-15} Hz
- B 1.26×10^2 Hz
- C 1.89×10^2 Hz
- D 4.76×10^{14} Hz
- E 7.14×10^{14} Hz.

15. A circuit is set up as shown.



The battery has negligible internal resistance.

A student makes the following statements about the readings on the meters in this circuit.

- I When switch S is open the reading on the voltmeter will be 6.0 V .
- II When switch S is open the reading on A_2 will be 0.60 A .
- III When switch S is closed the reading on A_1 will be 0.80 A .

Which of these statements is/are correct?

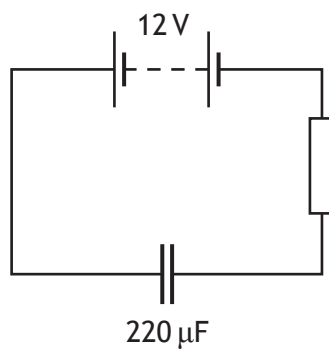
- A I only
 - B II only
 - C I and II only
 - D II and III only
 - E I, II and III
16. The power dissipated in a 120Ω resistor is 4.8 W .
The current in the resistor is
- A 0.020 A
 - B 0.040 A
 - C 0.20 A
 - D 5.0 A
 - E 25 A .

[Turn over

17. A $24.0\ \mu\text{F}$ capacitor is charged until the potential difference across it is $125\ \text{V}$.
The charge stored on the capacitor is

- A $5.21 \times 10^6\ \text{C}$
- B $7.75 \times 10^{-2}\ \text{C}$
- C $1.50 \times 10^{-3}\ \text{C}$
- D $3.00 \times 10^{-3}\ \text{C}$
- E $1.92 \times 10^{-7}\ \text{C}$.

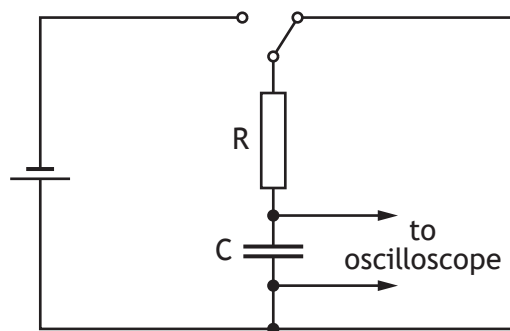
18. A circuit is set up as shown.



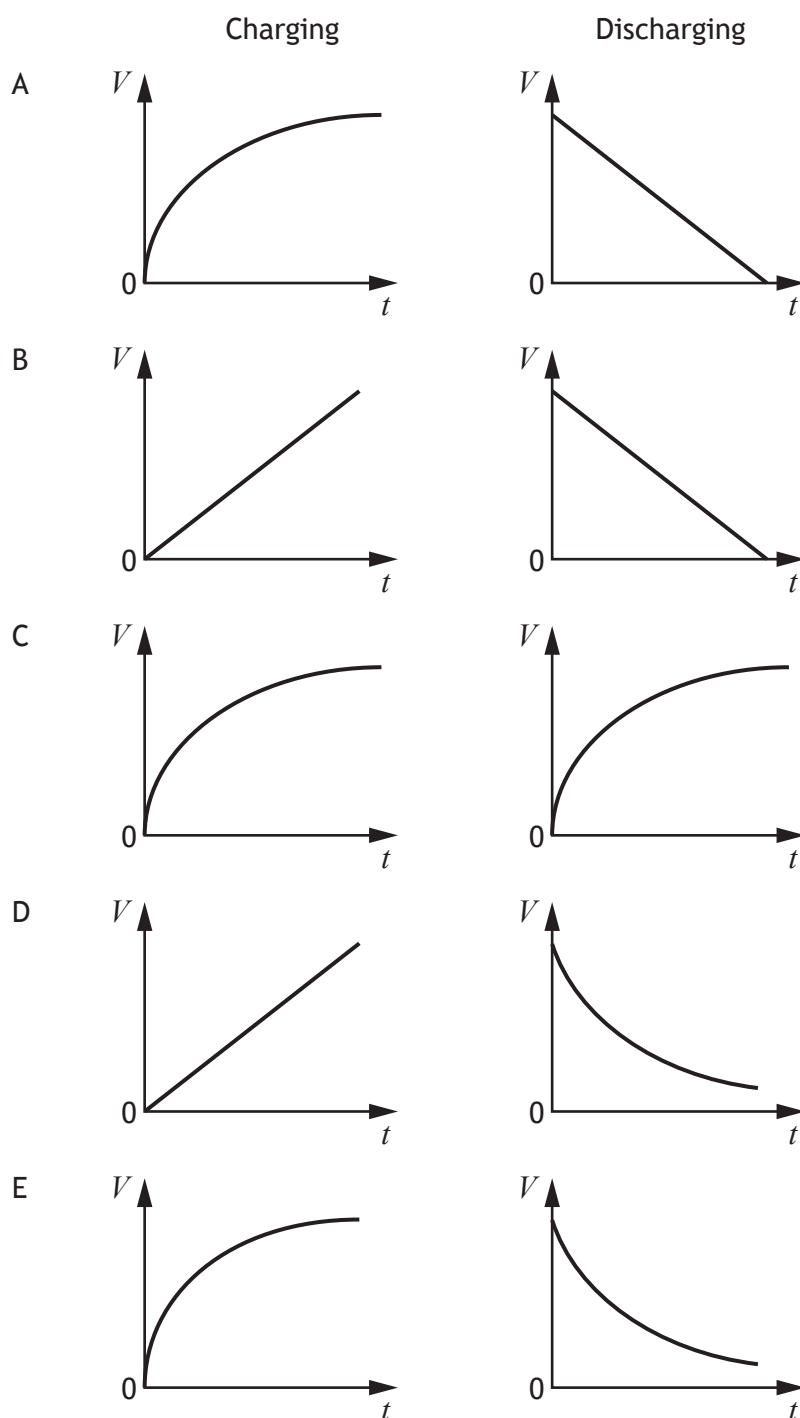
When the capacitor is fully charged the energy stored in the capacitor is

- A $1.6 \times 10^{-5}\ \text{J}$
- B $1.3 \times 10^{-3}\ \text{J}$
- C $2.6 \times 10^{-3}\ \text{J}$
- D $1.6 \times 10^{-2}\ \text{J}$
- E $1.6 \times 10^4\ \text{J}$.

19. The circuit shown is used to charge and then discharge a capacitor C.



Which pair of graphs shows how the potential difference V across the capacitor varies with time t during charging and discharging?



20. A student carries out an experiment to determine the specific heat capacity c of a solid. The relationship used to calculate c is

$$c = \frac{E}{m\Delta T}$$

The recorded measurements and their percentage uncertainties are shown.

energy supplied, $E = 5000 \text{ J} \pm 1\%$

mass of solid, $m = 0.20 \text{ kg} \pm 2\%$

change in temperature, $\Delta T = 4.5 \text{ }^\circ\text{C} \pm 5\%$

A good estimate of the percentage uncertainty in the calculated value of c is

- A 8%
- B 7%
- C 5%
- D 3%
- E 1%.

[END OF SECTION 1. NOW ATTEMPT THE QUESTIONS IN SECTION 2
OF YOUR QUESTION AND ANSWER BOOKLET]