National
Qualifications
SPECIMEN ONLY

SQ37/H/02

Physics
Section 1—Questions

Date — Not applicable

Duration — 2 hours and 30 minutes

Instructions for the completion of Section 1 are given on *Page two* of your question and answer booklet SQ37/H/01.

Record your answers on the answer grid on *Page three* of your question and answer booklet.

Reference may be made to the Data Sheet on *Page two* of this booklet and to the Relationships Sheet SQ37/H/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	$3{\cdot}00 \times 10^{8}\ \text{m s}^{-1}$	Planck's constant	h	$6{\cdot}63 \times 10^{-34}\ \text{J s}$
Magnitude of the charge on an electron	e	$1{\cdot}60 \times 10^{-19}\ \text{C}$	Mass of electron	m_e	$9{\cdot}11 \times 10^{-31}\ \text{kg}$
Universal Constant of Gravitation	G	$6{\cdot}67 \times 10^{-11}\ \text{m}^3\ \text{kg}^{-1}\ \text{s}^{-2}$	Mass of neutron	m_n	$1{\cdot}675 \times 10^{-27}\ \text{kg}$
Gravitational acceleration on Earth	g	$9{\cdot}8\ \text{m s}^{-2}$	Mass of proton	m_p	$1{\cdot}673 \times 10^{-27}\ \text{kg}$
Hubble's constant	H_0	$2{\cdot}3 \times 10^{-18}\ \text{s}^{-1}$			

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*
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
	10590 }	
Helium-neon	633	Red

PROPERTIES OF SELECTED MATERIALS

Substance	*Density*/kg m^{-3}	*Melting Point*/K	*Boiling Point*/K
Aluminium	$2{\cdot}70 \times 10^{3}$	933	2623
Copper	$8{\cdot}96 \times 10^{3}$	1357	2853
Ice	$9{\cdot}20 \times 10^{2}$	273	. . . .
Sea Water	$1{\cdot}02 \times 10^{3}$	264	377
Water	$1{\cdot}00 \times 10^{3}$	273	373
Air	1·29	. . . .	. . . .
Hydrogen	$9{\cdot}0 \times 10^{-2}$	14	20

The gas densities refer to a temperature of 273 K and a pressure of $1{\cdot}01 \times 10^{5}$ Pa.

SECTION 1 — 20 marks

Attempt ALL questions

1. A trolley has a constant acceleration of $3\,m\,s^{-2}$. This means that

A the distance travelled by the trolley increases by 3 metres per second every second

B the displacement of the trolley increases by 3 metres per second every second

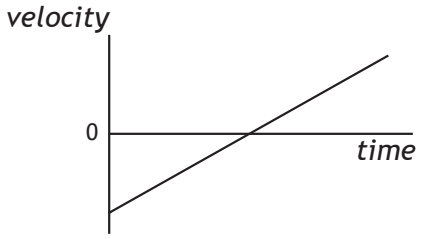
C the speed of the trolley is $3\,m\,s^{-1}$ every second

D the velocity of the trolley is $3\,m\,s^{-1}$ every second

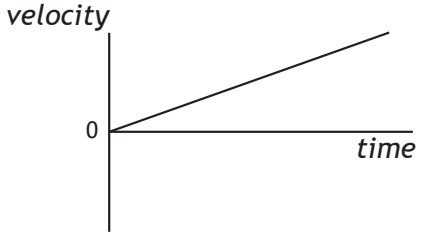
E the velocity of the trolley increases by $3\,m\,s^{-1}$ every second.

2. Which of the following velocity-time graphs represents the motion of an object that changes direction?

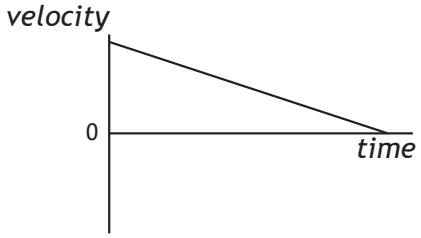
A



B



C



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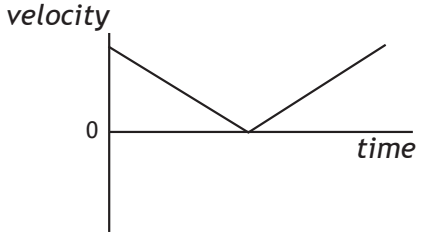
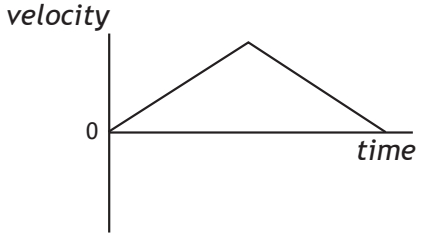


E



3. A football of mass 0·75 kg is initially at rest. A girl kicks the football and it moves off with an initial speed of 12 m s^{-1}. The time of contact between the girl's foot and the football is 0·15 s.

The average force applied to the football as it is kicked is

A 1·4 N

B 1·8 N

C 2·4 N

D 60 N

E 80 N.

4. Two small asteroids are 12 m apart.

The masses of the asteroids are $2{\cdot}0 \times 10^3$ kg and $0{\cdot}050 \times 10^3$ kg.

The gravitational force acting between the asteroids is

A $1{\cdot}2 \times 10^{-9}$ N

B $4{\cdot}6 \times 10^{-8}$ N

C $5{\cdot}6 \times 10^{-7}$ N

D $1{\cdot}9 \times 10^{-6}$ N

E $6{\cdot}8 \times 10^3$ N.

5. A spaceship on a launch pad is measured to have a length L. This spaceship has a speed of $2{\cdot}5 \times 10^8$ m s^{-1} as it passes a planet.

Which row in the table describes the length of the spaceship as measured by the pilot in the spaceship and an observer on the planet?

	Length measured by pilot in the spaceship	*Length measured by observer on the planet*
A	L	less than L
B	L	greater than L
C	L	L
D	less than L	L
E	greater than L	L

6. The siren on an ambulance is emitting sound with a constant frequency of 900 Hz. The ambulance is travelling at a constant speed of 25 m s^{-1} as it approaches and passes a stationary observer. The speed of sound in air is 340 m s^{-1}.

Which row in the table shows the frequency of the sound heard by the observer as the ambulance approaches and as it moves away from the observer?

	Frequency as ambulance approaches (Hz)	*Frequency as ambulance moves away* (Hz)
A	900	900
B	971	838
C	838	900
D	971	900
E	838	971

7. The photoelectric effect

A is evidence for the wave nature of light

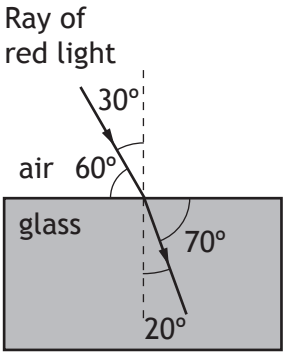
B can be observed using a diffraction grating

C can only be observed with ultra-violet light

D can only be observed with infra-red light

E is evidence for the particulate nature of light.

8. A ray of red light is incident on a glass block as shown.



The refractive index of the glass for this light is

A 0·53

B 0·68

C 1·46

D 1·50

E 2·53.

9. A ray of red light travels from air into water.

Which row in the table describes the change, if any, in speed and frequency of a ray of red light as it travels from air into water?

	Speed	*Frequency*
A	increases	increases
B	increases	stays constant
C	decreases	stays constant
D	decreases	decreases
E	stays constant	decreases

10. Light from a point source is incident on a screen. The screen is 3·0 m from the source.

The irradiance at the screen is 8·0 W m^{-2}.

The light source is now moved to a distance of 12 m from the screen.

The irradiance at the screen is now

A 0·50 W m^{-2}

B 1·0 W m^{-2}

C 2·0 W m^{-2}

D 4·0 W m^{-2}

E 8·0 W m^{-2}.

11. A student makes the following statements about an electron.

I An electron is a boson.

II An electron is a lepton.

III An electron is a fermion.

Which of these statements is/are correct?

A I only

B II only

C III only

D I and II only

E II and III only

12. Radiation of frequency $9{\cdot}40 \times 10^{14}$ Hz is incident on a clean metal surface.

The work function of the metal is $3{\cdot}78 \times 10^{-19}$ J.

The maximum kinetic energy of an emitted photoelectron is

A $2{\cdot}45 \times 10^{-19}$ J

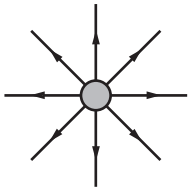
B $3{\cdot}78 \times 10^{-19}$ J

C $6{\cdot}23 \times 10^{-19}$ J

D $1{\cdot}00 \times 10^{-18}$ J

E $2{\cdot}49 \times 10^{33}$ J.

13. The diagram represents the electric field around a single point charge.



A student makes the following statements about this diagram.

I The separation of the field lines indicates the strength of the field.

II The arrows on the field lines indicate the direction in which an electron would move if placed in the field.

III The point charge is positive.

Which of these statements is/are correct?

A I only

B II only

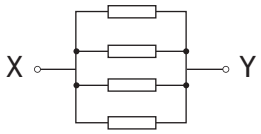
C I and III only

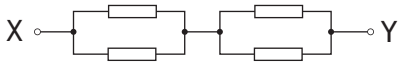
D II and III only

E I, II and III

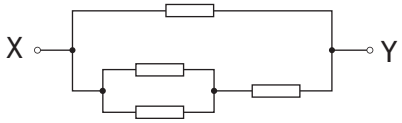
14. In the diagrams below, each resistor has the same resistance.

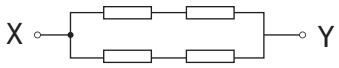
Which combination has the least value of the effective resistance between the terminals X and Y?

A 

B 

C 

D 

E 

15. A student makes the following statements about charges in electric fields.

I An electric field applied to a conductor causes the free electric charges in the conductor to move.

II When a charge is moved in an electric field work is done.

III An electric charge experiences a force in an electric field.

Which of these statements is/are correct?

A II only

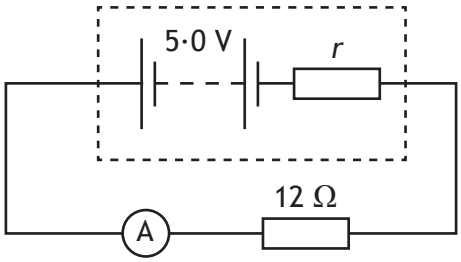
B III only

C I and II only

D II and III only

E I, II and III

16. A circuit is set up as shown.



The e.m.f. of the battery is 5·0 V.

The reading on the ammeter is 0·35 A.

The internal resistance *r* of the battery is

A 0·28 Ω

B 0·80 Ω

C 1·15 Ω

D 2·3 Ω

E 3·2 Ω.

17. The e.m.f. of a battery is

A the total energy supplied by the battery

B the voltage lost due to the internal resistance of the battery

C the total charge that passes through the battery

D the number of coulombs of charge passing through the battery per second

E the energy supplied to each coulomb of charge passing through the battery.

18. The r.m.s. voltage of the mains supply is 230 V.

The approximate value of the peak voltage is

A 115 V

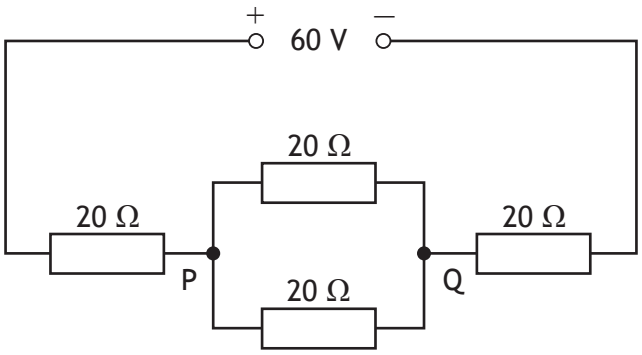
B 163 V

C 325 V

D 460 V

E 651 V.

19. Four resistors each of resistance 20 Ω are connected to a 60 V supply of negligible internal resistance as shown.



The potential difference across PQ is

A 12 V

B 15 V

C 20 V

D 24 V

E 30 V.

20. Photons with a frequency of $4{\cdot}57 \times 10^{14}$ Hz are incident on a p-n junction in a solar cell.

The maximum potential difference these photons produce across this junction is

A 1·34 V

B 1·89 V

C 2·67 V

D 3·79 V

E 5·34 V.

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