

DUNMAN HIGH SCHOOL Preliminary Examination Year 6

H2 PHYSICS

Paper 1 Multiple Choice

9749/01

23 September 2022 1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your centre number, index number, name and class at the top of this page. Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

There are **thirty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.

Choose the one you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done in this booklet.

The use of an approved scientific calculator is expected, where appropriate.

Data

speed of light in free space,	С	=	3.00 × 10 ⁸ m s ^{−1}
permeability of free space,	μ_0	=	$4\pi \times 10^{-7} \text{ H m}^{-1}$
permittivity of free space,	E0	=	8.85 × 10 ⁻¹² F m ⁻¹
			(1/(36π)) × 10 ^{−9} F m ^{−1}
elementary charge,	е	=	1.60 × 10 ⁻¹⁹ C
the Planck constant,	h	=	6.63 × 10 ⁻³⁴ J s
unified atomic mass constant,	и	=	1.66 × 10 ^{−27} kg
rest mass of electron,	$m_{ m e}$	=	9.11 × 10 ⁻³¹ kg
rest mass of proton,	$m_{ m p}$	=	1.67 × 10 ⁻²⁷ kg
molar gas constant,	R	=	8.31 J K ⁻¹ mol ⁻¹
the Avogadro constant,	N _A :	=	6.02 × 10 ²³ mol ⁻¹
the Boltzmann constant,	k	=	1.38 × 10 ⁻²³ J K ⁻¹
gravitational constant,	G	=	$6.67 \times 10^{-11} \mathrm{N} \mathrm{m}^2 \mathrm{kg}^{-2}$
acceleration of free fall,	g	=	9.81 m s⁻²

Formulae

uniformly accelerated motion	s	=	$ut+\frac{1}{2}at^2$
	V ²	=	$u^{2} + 2as$
work done on/by a gas	W	=	$p\Delta V$
hydrostatic pressure	р	=	hogh
gravitational potential	ϕ	=	$-\frac{Gm}{r}$
temperature	T/K	=	<i>T</i> /⁰C + 273.15
pressure of an ideal gas	p	=	$rac{1}{3}rac{Nm}{V}\langle c^2 angle$
mean translational kinetic energy of an ideal gas molecule	E	=	$\frac{3}{2}kT$
displacement of particle in s.h.m.	x	=	x ₀ sin ωt
velocity of particle in s.h.m.	V	=	$v_0 \cos \omega t$
		=	$\pm \omega \sqrt{x_0^2 - x^2}$
electric current	Ι	=	Anvq
resistors in series	R	=	$R_1 + R_2 + \ldots$
resistors in parallel	1/ <i>R</i>	=	$1/R_1 + 1/R_2 + \dots$
electric potential	V	=	$\frac{Q}{4\pi\varepsilon_0 r}$
alternating current / voltage	x	=	x₀ sin <i>∞t</i>
magnetic flux density due to a long straight wire	В	=	$\frac{\mu_o I}{2\pi d}$
magnetic flux density due to a flat circular coil	В	=	$\frac{\mu_{o}NI}{2r}$
magnetic flux density due to a long solenoid	В	=	μ _o nI
radioactive decay	x	=	$x_0 \exp(-\lambda t)$
decay constant	λ	=	$\frac{\ln 2}{\frac{t_1}{2}}$

1 A computer memory stick is labelled as having a storage capacity of 128 GB.

The letter B stands for byte, which is a unit.

What is the equivalent storage capacity, in B?

A 1.28×10^8 **B** 1.28×10^9 **C** 1.28×10^{10} **D** 1.28×10^{11}

2 A steel rule can be read to the nearest millimetre. It is used to measure the length of a bar whose true length is 895 mm. Repeated measurements give the following readings.

length / mm 892, 891, 892, 891, 891, 892

Are the readings accurate and precise to within 1 mm?

	results are accurate to within 1 mm	results are precise to within 1 mm
Α	no	yes
В	no	no
С	yes	no
D	yes	yes

- 3 A body having uniform acceleration *a* increases its velocity from *u* to *v* in time *t*. Which expression would **not** give a correct value for the body's displacement during time *t*?
 - **A** $ut + \frac{1}{2}at^2$
 - **B** $vt \frac{1}{2}at^2$
 - $c \quad \frac{(v+u)(v-u)}{2a}$

$$D \quad \frac{(v-u)t}{2}$$

5

A sphere is released from a tall building and falls.Which displacement-time graph best represents the motion of the sphere?



5 A book of weight W is at rest on a table. A student attempts to state Newton's third law by saying that 'action equals reaction'.



If the weight of the book is the 'action' force, what is the 'reaction' force?

- **A** The force *W* acting downwards on the Earth from the table.
- **B** The force *W* acting upwards on the book from the table.
- **C** The force *W* acting upwards on the Earth from the book.
- **D** The force *W* acting upwards on the table from the floor.

6 A ball drops onto a horizontal surface and bounces elastically.

What happens to the kinetic energy of the ball during the very short time that it is in contact with the surface?

- **A** The kinetic energy remains constant because it is an elastic collision.
- **B** The kinetic energy remains constant in magnitude but changes direction.
- **C** The kinetic energy decreases to zero and then returns to its original value.
- **D** Most of the kinetic energy is lost as heat and sound.
- 7 A trailer of weight 30 kN is attached to a cab at X, as shown in the diagram.



What is the upward force exerted at X by the cab on the trailer?



8 A solid metal cylinder stands on a horizontal surface, as shown.



The cylinder has length x and cross-sectional area A. The cylinder exerts a pressure p on the surface. The acceleration of free fall is g.

Which expression gives the density of the metal of the cylinder?

A
$$\frac{gx}{pA}$$
 B $\frac{pA}{gx}$ **C** $\frac{gx}{p}$ **D** $\frac{p}{gx}$

9 A car of mass 500 kg is at rest at point X on a slope, as shown.



The car's brakes are released, and the car rolls down the slope with its engine switched off. At point Y the car has moved through a vertical height of 30 m and has a speed of 11 m s^{-1} .

What is the energy dissipated by frictional forces when the car moves from X to Y?

A 3.0×10^4 J **B** 1.2×10^5 J **C** 1.5×10^5 J **D** 1.8×10^5 J

10 A water pump is driven by an engine. The pump raises a volume of 0.50 m³ of water in 1.0 minute from a depth of 30 m. The pump has an efficiency of 70%.

The density of water is 1000 kg m⁻³.

What is the useful output power from the engine?

A 2.5 kW B 3.5 kW C 150 kW D 210	10 kW
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11 Two objects of masses 5.0 kg and 8.0 kg are fixed on a horizontal circular platform 2.0 m and 6.0 m from the centre respectively.

When the platform is rotated with uniform circular motion, what is the ratio of the net force on the 5.0 kg mass to the 8.0 kg mass?

- **A** 8:15 **B** 5:24
- **C** 15:8 **D** 24:5

12 At a point on the surface of a uniform sphere of diameter *d*, the gravitational field strength due to the sphere is X.

What would be the gravitational field strength on the surface of a uniform sphere of the same density but of diameter 2*d*?

- **A** $\frac{X}{4}$ **B** $\frac{X}{2}$ **C** 2X **D** 4X
- **13** A communication satellite is in a geostationary orbit at a height of 3.59×10^7 m above the equator. The radius of the Earth is 6.40×10^6 m.

How fast is the satellite travelling?

- 14 The two graphs are for the motion of a body undergoing simple harmonic motion.





What could the two graphs show?

- A acceleration with time and velocity with time
- **B** acceleration with time and displacement with time
- C displacement with time and velocity with time
- D resultant force with time and velocity with time
- **15** A small mass on a vibrating platform undergoes simple harmonic motion. The total energy of the mass is 18 mJ.

The amplitude of the oscillation is now doubled and the time period is tripled.

What is the new total energy of the mass?

A 8.0 mJ **B** 12 mJ **C** 36 mJ **D** 72 mJ

16 A cathode-ray oscilloscope (CRO) is used to display a wave of frequency 5.0 kHz. The display is shown.



17 Two loudspeakers X and Y emit sound waves that are in phase and of wavelength 0.75 m. An observer O is able to stand anywhere on a straight line that passes through X and Y, as shown. The observer stands at a point where the sound waves from X and Y meet in phase.

What could be the distances OY and XY?

	distance OY / m	distance XY / m
Α	1.25	3.50
В	2.00	2.75
С	2.75	2.00
D	3.25	1.50

18 The graph shows the variation in light intensity produced on a screen when a parallel beam of monochromatic light passes through a narrow slit.

10



Which of the following statements is incorrect?

- **A** The area under the graph is unchanged by increasing the slit width.
- **B** The width *x* is increased by increasing the wavelength of light.
- **C** The width *x* is increased by increasing the distance between the slit and screen.
- **D** The width *x* is increased by decreasing the slit width.
- **19** The diagram shows the path of a horizontal beam of electrons passing through the uniform vertical electric field between two horizontal electrodes. The diagram is not to scale.



The vertical displacements of the beam after travelling through horizontal distances of x, 2x, 3x and 4x are represented by p, q, r and s.

	<i>p</i> / mm	<i>q</i> / mm	<i>r</i> / mm	s / mm
Α	1.0	1.4	1.7	2.0
В	1.0	2.0	3.0	4.0
С	1.0	2.0	4.0	8.0
D	1.0	4.0	9.0	16.0

Which row represents the values of *p*, *q*, *r* and *s*?

20 A network of resistors, each of resistance 1.0 Ω , is connected as shown.



The current passing through the end resistor is 1.0 A. What is the potential difference *V* across the input terminals?



21 Which graph shows the variation with current *I* of the potential difference *V* of a filament lamp?



22 Three resistors are connected in parallel across a power supply, as shown.



What is the ratio of the currents $I_1 : I_2 : I_3$?

A 3:4:6 **B** 6:4:3 **C** 9:16:18 **D** 18:16:9

23 The figure shows a horizontal power cable of length 2.0 m carrying a steady current *I* of 3.0 A into the plane of the paper.



What is the force acting on the cable that is caused by the Earth's magnetic field of flux density 4.0×10^{-5} T, in a region where this field is at 65° to the horizontal?

A $82 \mu N$ B $220 \mu N$ C $240 \mu N$ D	660 μN
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24 Two long and parallel wires carrying currents in the same direction separate the surrounding space into three regions 1, 2 and 3, as shown.



In which region(s) can there be a neutral point (i.e., a point of zero magnetic field)?

- A Region 2 only
- **B** Both regions 1 and 3.
- **C** Either region 1 or region 3 but not both.
- **D** There are no neutral points.
- **25** A circuit consists of an a.c. supply, two diodes, and two resistors with resistance R_1 and R_2 respectively.



Which of the following graphs represents the variation of current *I* with time *t* through R_1 of the circuit?



26 The magnetic flux, Φ , through a coil varies with time, *t*, as shown by the first graph. Which one of the following graphs, best represents how the magnitude of the induced emf, ε , varies in this same period of time?



27 The stopping voltage when metal X is irradiated with light of wavelength λ and intensity I is V.

Which of the following is most likely the stopping voltage when metal X is irradiated with light of wavelength λ / 2 and intensity *I*/2?



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28 Evidence for the wave-particle duality may be observed by the diffraction of an electron beam at a slit. A diffraction pattern is observed on a suitable screen.

For an electron passing through the slit, the uncertainty in its position Δx and the uncertainty in its momentum Δp are related by the following expression

$$\Delta p \Delta x \ge h$$

Which diagram below shows the positions where Δx and Δp in the equation above are defined and shows them in the correct direction?



29 When the number of protons and the number of neutrons in a nuclide are both "magic numbers", it is more stable than expected. Such nuclides are termed "doubly magic". The first few "magic numbers" are 2, 8, 20, 28, 50, 82, and 126.

How many of the five nuclides above are "doubly magic"?

- **A** 1 **B** 2 **C** 3 **D** 4
- **30** An experiment is carried out in which the count rate is measured at a fixed distance from a sample of a certain radioactive material. The figure below shows the variation of count rate with time.



What is the approximate half-life of the material?

Α	60 s	В	80 s	С	100 s	D	120 s