

ANDERSON SERANGOON JUNIOR COLLEGE

2024 JC2 Preliminary Examination

PHYSICS Higher 1

8867/01

Paper 1 Multiple Choice

Monday 16 September 2024

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil. Do not use staples, paper clips, glue or correction fluid. Write your name and class on the Multiple Choice Answer Sheet. Shade and write your NRIC/FIN.

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 Multiple Choice Answer Sheet.

Read the instructions on the Multiple Choice 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 question paper. The use of an approved scientific calculator is expected, where appropriate.

Data

speed of light in free space,	$c = 3.00 \times 10^8 \text{ m s}^{-1}$
elementary charge,	$e = 1.60 \times 10^{-19} \text{C}$
unified atomic mass constant,	$u = 1.66 \times 10^{-27} \mathrm{kg}$
rest mass of electron,	$m_{\rm e} = 9.11 \times 10^{-31} \text{ kg}$
rest mass of proton,	$m_{\rm p} = 1.67 \times 10^{-27} \text{ kg}$
the Avogadro constant	$N_{\rm A} = 6.02 \times 10^{23} {\rm mol^{-1}}$
gravitational constant	$G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$
acceleration of free fall,	<i>g</i> = 9.81 m s ⁻²

Formulae

uniformly accelerated motion,	$s = ut + \frac{1}{2}at^2$
	$v^2 = u^2 + 2as$
resistors in series,	$R = R_1 + R_2 + \dots$
resistors in parallel,	$1/R = 1/R_1 + 1/R_2 + \dots$

1 When a beam of light is incident on a surface, it delivers energy to the surface. The intensity of the beam is defined as the energy delivered per unit area per unit time.

What is the unit of intensity, expressed in SI base units?

Α	kg m ⁻² s ⁻¹	В	kg m² s⁻³	С	kg s⁻²	D	kg s ⁻³
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2 The diagram shows two vectors X and Y.



In which vector triangle does the vector Z show the magnitude and direction of vector X - Y?









- 3 Which pair of quantities contains one vector and one scalar quantity?
 - A displacement; force
 - B velocity; distance
 - **C** acceleration; momentum
 - **D** kinetic energy; power
- 4 An object falls 10.0 m from rest before entering some water.

Assuming negligible air resistance, what is the time taken to reach the water and the speed with which the object reaches the water?

	time / s	speed / m s ⁻¹
Α	1.02	10.0
в	1.02	14.0
С	1.43	10.0
D	1.43	14.0

5 When a car driver sees a hazard ahead, she applies the brakes as soon as she can and brings the car to rest. The graph shows how the speed *v* of the car varies with time *t* after hazard is seen.



Which graph represents the variation with time t of the distance s travelled by the car after the hazard has been seen?



6 In the absence of air resistance, a stone is thrown from **P** and follows a parabolic path in which the highest point reached is **T**. The stone reaches point **Q** just before landing.



The vertical component of acceleration of the stone is

- A zero at T.
- B the same at Q as at T.
- **C** greatest at **Q**.
- D greatest at T.
- 7 A man is skiing down a slope with constant speed.

According to Newton's third law, which force makes an action-reaction pair with the weight of the man?

- A the friction from the slope
- **B** the normal contact force from the slope
- **C** the gravitational force on the Earth due to the man
- **D** the sum of normal contact force and friction from the slope
- **8** A mass of 8.0 kg, resting on a horizontal plane, is connected to a hanging mass of 2.0 kg. There is a frictional force of 5.0 N acting between the 8.0 kg mass and the plane.



What is the acceleration of the 8.0 kg mass?

Α	1.5 m s ^{−2}	В	1.8 m s⁻²	С	2.0 m s ⁻²	D	2.5 m s⁻²
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9 A ball of mass 200 g is thrown horizontally with a speed of 20 m s⁻¹ against a vertical wall.

The ball is in contact with the wall for a time of 0.10 s before rebounding back along its original path with a speed of 10 m s⁻¹.

What is the average force exerted by the wall on the ball during the collision?

- **A** 20 N **B** 60 N **C** 20 kN **D** 60 kN
- 10 A beam, the weight of which may be neglected, is supported by three identical springs. When a weight *W* is hung from the middle of the beam, the extension of each spring is *x*.



The middle spring and the weight are removed.

What is the extension when a weight of 2W is hung from the middle of the beam?



11 In which situation could the pair of forces applied to the rigid object produce a couple?



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12 A ladder rests on rough ground and leans against a rough wall.



Its weight W acts through the centre of gravity G. Forces also act on the ladder at P and Q. These forces are P and Q respectively.

Which vector triangle represents the forces on the ladder?



13 A man drags an object of mass 5.0 kg up a plane inclined at 30° to the horizontal. It travelled through a vertical height of 12 m at a constant speed. The total work done by the man is 1500 J.

What is the average friction force between the object and the plane?

$\mathbf{A} 0.5 \mathbf{N} \qquad \mathbf{B} 50 \mathbf{N} \qquad \mathbf{C} 05 \mathbf{N} \qquad \mathbf{D} 00$	A 8.3 N	B 38 N	C 63 N	D	88 N
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14 A man throws a ball vertically upwards. The ball reaches a maximum height, and then falls back into the man's hand. Air resistance may be assumed to be negligible.

Which graph shows how the kinetic energy E of the ball varies with the vertical displacement y?





A student at Singapore has centripetal acceleration a_S because of the Earth's rotation about its axis. The centripetal acceleration of another student at Cambridge is a_C .

	<i>a</i> _S / m s⁻²	<i>a</i> _c / m s⁻²
Α	3.4 x 10⁻²	2.1 x 10 ⁻²
В	3.4 x 10 ⁻²	2.7 x 10 ⁻²
С	3.4 x 10⁻²	3.4 x 10 ^{−2}
D	4.7 x 10 ²	4.7 x 10 ²

What are the magnitudes of the centripetal accelerations?

16 A stone of mass *m* is attached to a string. The stone is made to rotate in a vertical circle of radius *r*, as shown.



At the point where the stone is vertically above the centre of the circle, the stone has speed *v*.

Which of the following expressions gives the tension in the string?

A
$$mg - \frac{mv^2}{r}$$

B $\frac{mv^2}{r}$
C $\frac{mv^2}{r} - mg$
D $\frac{mv^2}{r} + mg$

- 17 Which statement about geostationary satellite is true?
 - A It can remain vertically above any chosen fixed point on the Earth.
 - **B** Its linear speed is equal to the speed of a point on the Earth's equator.
 - **C** It has the same angular velocity as any chosen fixed point on the Earth.
 - **D** It is always travelling from east to west.
- **18** A composite wire is made by connecting in series four uniform wires made of the same material but different diameters.



The resistance R of this composite wire is measured between X and other points on the wire at distances d from X.

Which graph best represents the relationship between R and d?



19 A cell is connected to a resistor of resistance 3.00Ω as shown in the diagram. The current in the resistor is 1.00 A.



A second identical resistor is added in parallel. The current becomes 1.93A.

	E/V r/Ω	
Α	0.113	3.11
в	3.04	0.0358
С	3.11	0.113
D	9.34	6.34

20 The resistors P, Q and R in the circuit have equal resistance.



The battery, of negligible internal resistance, supplies a total power of 12 W.

What is the power dissipated by heating in resistor R?

A 2 W **B** 3 W **C** 4 W **D** 6 W

21 The diagram shows a resistor network connected to a 12 V battery of negligible internal resistance. The variable resistor has the range indicated, and the voltmeter has infinite resistance.



What are the maximum and minimum possible values of the voltmeter reading as the resistance of the variable resistor is altered?

	maximum / V	minimum / V
Α	4	0
в	8	4
С	8	6
D	12	8

22 Safety on railways is increased by using several electrical switches.

In the diagram, switches P, Q, R, S and T control the current through a green lamp.



Which row does **not** allow the green lamp to light?

	Р	Q	R	S	Т
Α	closed	closed	closed	open	closed
В	closed	open	closed	closed	open
С	closed	open	open	closed	closed
D	open	open	closed	open	closed

23 A circuit is needed which switches on a warning lamp when the temperature of a thermistor is too high.

Which of the following circuits is suitable?











24 Four parallel conductors, carrying equal currents, pass vertically through the four corners of a square PQRS. In two conductors, the current is directed into the page and, in the other two, it is directed out of the page.



Due to the current in the four conductors, the resultant magnetic field at O is in the directions shown.

	into the page	out of the page
Α	P, Q	R, S
в	P, S	Q, R
С	Q, S	P, R
D	R, S	P, Q

Which of the following must be the direction of the current in each of the four conductors?

25 An electron, travelling horizontally at constant speed in a vacuum, enters a uniform electric field between two charged plates as shown.



Which of the following best describes the horizontal and vertical components of motion of the electron when it is in the field?

	horizontal component of motion	vertical component of motion			
Α	constant speed	constant speed acceleration upwards			
В	constant speed	constant speed acceleration downwards			
С	acceleration to the right	acceleration downwards			
D	acceleration to the right	acceleration upwards			

26 A single-turn rectangular wire loop hangs from a balance reading in grams so that its lower part is in a region of uniform magnetic field. The direction of the field is at right-angles to the plane of the loop. The arrangement is as shown in the diagram.



When there is no current in the loop, the reading of the balance is 10.060 g. When the current in the loop is 3.0 A, the balance reading is 10.040 g.

What is the magnitude of the flux density of the field?

Α	6.5 × 10⁻⁴ T	В	1.3 × 10⁻³ T	С	1.3 × 10⁻² T	D	6.6 × 10 ⁻¹ T
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27 Two alpha-particles with the same kinetic energy are moving towards, and are then deflected by a gold nucleus.



- **28** The rest-masses of deuteron ${}_{1}^{2}H$, proton and neutron are 2.0150 u, 1.0086 u and 1.0097 u respectively. Which one of the following reactions takes place so that the deuteron may disintegrate to a proton and neutron?
 - **A** Releasing a photon of energy 2 MeV.
 - **B** Releasing a photon of energy 3 MeV.
 - **C** Capturing a photon of energy 2 MeV.
 - **D** Capturing a photon of energy 3 MeV.
- **29** Which combination of successive emissions produces a final nucleus with the same proton number as the starting nucleus?
 - Α ααβ
 - **Β** αββ
 - **C** αβγ
 - **D** βγβ
- **30** When a radioactive nuclide emits γ-rays, which of the following statements about the nuclide is true?
 - **A** The total energy is not conserved.
 - **B** An electron falls from a higher energy level to a lower one.
 - **C** Mass number of the atom falls, hence energy of the nucleus falls.
 - **D** Mass number of the atom remains unchanged, but energy of the nucleus falls.

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