

EUNOIA JUNIOR COLLEGE JC1 PROMO EXAMINATIONS 2022 General Certificate of Education Advanced Level Higher 2

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CIVICS GROUP	2	2	-		REGISTRATION NUMBER		
CANDIDATE NAME							

PHYSICS

Multiple Choice

9749/01

4th October 2022 1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your name, civics group and registration number on all the work you hand in. The use of an approved scientific calculator is expected where appropriate. Answer **all** questions.

There are **thirty** questions in this section.

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.

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.

This document consists of **20** printed pages.

Data

speed of light in free space,	$c = 3.00 \times 10^8 \text{ m s}^{-1}$
permeability of free space,	$\mu_0 = 4\pi \times 10^{-7} \text{ H m}^{-1}$
permittivity of free space,	$\mathcal{E}_0 = 8.85 \times 10^{-12} \text{ F m}^{-1}$
	$(1/(36\pi)) \times 10^{-9} \text{ F m}^{-1}$
elementary charge,	$e = 1.60 \times 10^{-19}$ C
the Planck constant,	$h = 6.63 \times 10^{-34} \text{ J s}$
unified atomic mass constant,	$u = 1.66 \times 10^{-27} \text{ kg}$
rest mass of electron,	$m_{\rm e} = 9.11 \times 10^{-31} {\rm ~kg}$
rest mass of proton,	$m_{\rm p} = 1.67 \times 10^{-27} \rm kg$
molar gas constant,	$R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$
the Avogadro constant,	$N_{\rm A} = 6.02 \times 10^{23} {\rm mol}^{-1}$
the Boltzmann constant,	$k = 1.38 \times 10^{-23} \text{ J K}^{-1}$
gravitational constant,	$G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$
acceleration of free fall,	$g = 9.81 \mathrm{m \ s^{-2}}$

Formulae

 $s = ut + \frac{1}{2}at^2$ uniformly accelerated motion, $v^2 = u^2 + 2as$ $W = p \Delta V$ work done on/by a gas, $p = \rho g h$ hydrostatic pressure, $\phi = -\frac{Gm}{r}$ gravitational potential, T / K = T / °C + 273.15temperature, $p = \frac{1}{3} \frac{Nm}{V} \langle c^2 \rangle$ pressure of an ideal gas, mean translational kinetic energy of an ideal gas $E=\frac{3}{2}kT$ molecule displacement of particle in s.h.m. $x = x_0 \sin \omega t$ $v = v_0 \cos \omega t$ velocity of particle in s.h.m. $=\pm \omega \sqrt{\left(x_0^2-x^2\right)}$ I = Anvqelectric current, $R = R_1 + R_2 + \dots$ resistors in series, $1/R = 1/R_1 + 1/R_2 + \dots$ resistors in parallel, $V = \frac{Q}{4\pi\epsilon_0 r}$ electric potential, alternating current/voltage, $x = x_0 \sin \omega t$ magnetic flux density due to a long straight wire $B = \frac{\mu_0 I}{2\pi d}$ $B = \frac{\mu_0 NI}{2r}$ magnetic flux density due to a flat circular coil magnetic flux density due to a long solenoid $B = \mu_0 nI$ $\boldsymbol{x} = \boldsymbol{x}_0 \, \exp\left(-\lambda t\right)$ radioactive decay, $\lambda = \frac{\ln 2}{t_1}$ decay constant

1 The speed of sound in a gas is given by the following formula

$$v = \sqrt{\frac{\gamma p}{d}}$$

where p is the gas pressure

d is the gas density *v* is the speed of sound

Which of the following correctly indicates the unit for γ ?

A m s⁻¹ **B** m² s⁻² **C** m⁻² s² **D** dimensionless

2 A car is travelling at 80 km h⁻¹ due east and a lorry is travelling at 50 km h⁻¹ with a bearing of 300°. What is the relative velocity of the lorry with respect to the car?

	magnitude	bearing
Α	126 km h⁻¹	281.5°
В	126 km h ^{−1}	101.4°
С	126 km h⁻¹	78.5°
D	44 km h ^{−1}	5.4°

3 A series of measurements of the diameter of a ball bearing made by four students are shown in the table below. The actual diameter of the ball bearing is 0.85 cm.

	Student A	Student B	Student C	Student D
First Measurement	0.91	0.88	0.83	0.84
Second Measurement	0.91	0.85	0.89	0.87
Third Measurement	0.84	0.85	0.95	0.83
Fourth Measurement	0.74	0.82	0.78	0.86

Which student's measurements are accurate but not precise?

A Student A B Student B C Student C D Student	Α	Student A	В	Student B	С	Student C	D	Student D
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4 Two cars X and Y are initially travelling on a straight level road. Car Y is 450 m ahead of Car X at t = 0 s. The velocity-time graph for cars X and Y in the first 12.0 s are shown in the diagram below.



A 45 m **B** 150 m **C** 300 m **D** 405 m

5 A rubber ball is dropped from a height of about 2.0 m and undergoes an elastic collision with the floor. Assuming no air resistance, which of the following graphs best represents the variation of the distance *s* above the floor with time *t* for the bouncing ball from the instant the ball is dropped?











6 The acceleration of free fall on the Moon is one-sixth of that on Earth.

On Earth it takes time *t* for a stone to fall from rest a distance of 6 m.

What is the time taken for a stone to fall from rest a distance of 3 m on the Moon?



- 7 Which one of the following pairs of forces is not a valid example of action and reaction to which Newton's Third Law of motion applies?
 - **A** The centripetal force holding a satellite in orbit round the Earth and the weight of the satellite.
 - **B** The force exerted by a man pushing a wall and the force exerted by the wall on the man.
 - **C** The forces of attraction experienced by each of the magnets placed near to each other.
 - **D** The forces of attraction between an electron and a proton in a hydrogen atom.

- **8** When a constant force of 4.0 N acts on a mass of 2.0 kg for a time of 2.0 s, what is the rate of change of momentum?
 - A 2.0 kg m s⁻²
 - **B** 4.0 kg m s⁻²
 - **C** 8.0 kg m s⁻²
 - **D** 16 kg m s⁻²



The mass flow rate of the jet from the hose is 2.5 kg s⁻¹ and it approaches the wall with a speed of 5.0 m s⁻¹. Given that the jet of water hits the wall elastically, what is the magnitude of the force exerted by the water on the wall?

A 6	5.3 N	В	11 N	С	13 N	D	22 N
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10 In the figure below, Liquid X and Liquid Y are used to fill the arms of a flexible U-tube. Liquid X and Liquid Y do not mix. Height difference between the two liquid surfaces is given by Δh .



Which of the following statements is true?

- **A** Point P and Point Q are at the same pressure.
- **B** Point R and Point S are at the same pressure.
- **C** Δh can vary by adjusting the arms of the flexible tube if the liquids do not overflow.
- **D** Δh can be zero by adding more liquid Y on the right arm.

9

11 A non-uniform beam has one of its end attached to a string and the other end resting on a rough wall. The centre of the gravity **G** of the beam is shown in the diagram below.



Which of the above arrows correctly shows the force acting by the beam on the wall?

12 A 1.0 kg ball is dropped from a height of 15.0 cm above an uncompressed spring with unknown spring constant that obeys Hooke's Law. Upon impact between the spring and the ball, the spring undergoes a maximum compression of 5.0 cm.



What is the average force exerted on the ball by the spring during this impact?

- **A** 9.81 N
- **B** 19.6 N
- **C** 29.4 N
- **D** 39.2 N

13 A car of mass 1500 kg is travelling as shown. Its engine develops a constant power of 108 kW during the journey, regardless of road conditions.



After travelling on a level road with a constant velocity of 15 m s⁻¹, the car encountered a slope that makes an angle of 30° to the horizontal.

Given that the resistive forces experienced by the car is proportional to its velocity, what is the deceleration of the car when its velocity up the slope is 10 m s⁻¹?

- **A** 0.91 m s⁻²
- **B** 3.3 m s⁻²
- **C** 4.9 m s⁻²
- **D** 5.8 m s⁻²

14 At a construction site, a 8.5 kW electrically powered winch hauls up building materials of mass 50 kg which were initially resting on the ground over a vertical height of 35 m over a duration of 4.47 s at an average acceleration of 3.5 m s⁻².

What is the overall efficiency of the winch?

Α	16 %	В	45 %	С	61 %	D	100 %
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15 A car travels with a constant speed *v* in a horizontal circle on a banked road which is inclined at an angle to the horizontal.



The total mass of the car and driver is *m* and the radius of the circular motion is *r*.

N is the normal reaction and *f* is the frictional force.

Which diagram shows the forces acting on the car and its driver?



16 A turntable rotates about a fixed axis starting with angular velocity that is increasing steadily over time. P and Q are fixed points on the turntable.



Which one of the graphs below correctly shows how the centripetal acceleration *a* for P and Q vary with time *t*?



17 Two identical masses P and Q are attached to two strings of length *r* each as shown in the figure below. P, Q and X remain collinear as the masses execute a uniform circular motion.



Which of the following statements is true?

- **A** The tension in the string along XP is larger than that along PQ.
- **B** The angular velocity experienced by mass Q is larger than that experienced by mass P.
- **C** The linear velocity experienced by mass P is larger than that experienced by mass Q.
- **D** The centripetal acceleration experienced by mass P is larger than that experienced by mass Q.

18 A space probe is at location X as shown in the diagram.



Given the following:

Mass of probe = 65.0 kg Mass of moon = 7.35×10^{22} kg Mass of earth = 5.97×10^{24} kg Distance between X and centre of moon = 2.50×10^3 km Distance between centres of moon and planet Earth = 385×10^3 km

What is the net gravitational field strength at X?

A 0.787 N kg⁻¹ **B** 1.6 N kg⁻¹ **C** 7.82 N kg⁻¹ **D** 51.2 N kg⁻¹

19 A stone of mass *m* moves radially away from Earth.

For a small distance x above the Earth's surface, the variation with x of the stone's gravitational potential energy E_p is shown.



At a distance d from Earth, the potential energy of the stone is E and the rate of change of potential with distance is P.

What is the force acting on the stone?



20 A shooting game involves using a gun that fires by itself at random times. The player can only point the gun in a fixed direction while the target moves from side to side with simple harmonic motion, as shown.



At which of the given region(s) would the player score the least number of hits if he is to aim at this region(s)?

Α	either 1 or 5	В	either 2 or 4	C 3	D	any of the regions
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21 A platform is oscillating vertically with simple harmonic motion of amplitude 3.0 cm. A mass is attached to the bottom of the platform by a string. The frequency of the platform gradually increases while the amplitude remains constant.



What is the lowest frequency at which the tension of the string becomes zero?

Α	0 Hz	В	2.9 Hz	С	8.3 Hz	D	9.8 Hz
	•••	_		-		_	

22 A pendulum is displaced 4.0 cm to the left and released.

Given that the period of the oscillation is 0.80 s, what is the time it takes to travel a distance of 17 cm after it is released?

- **A** 0.092 s
- **B** 0.85 s
- **C** 0.89 s
- **D** 0.95 s

23 A transverse wave is represented by the following displacement-distance graph.



What is the phase difference between P and Q?

- **A** $\frac{\pi}{8}$ radians **B** $\frac{\pi}{6}$ radians **C** $\frac{\pi}{4}$ radians **D** $\frac{\pi}{3}$ radians
- **24** The graph below shows the shape of a part of a transverse wave travelling along a string at a particular instant in time.

As this is a reflected wave, it is moving **towards** the source.



Which statement about the motion of the points on the string is correct?

- A P is moving upwards.
- **B** Q has maximum velocity and is moving upwards.
- **C** R is slowing down and moving upwards.
- **D** S is slowing down and moving upwards.

25 The diagram illustrates the relative positions of particles in air as a sound wave propagates through region RS of length 27 cm.



What is the frequency of the sound wave?

- A 1.2 kHz
- **B** 1.5 kHz
- **C** 3.1 kHz
- **D** 6.1 kHz

26 A point source emits sound waves uniformly in all directions. The loudness of the sound waves is initially measured at a distance of 8.0 m away from the source. The power of the source is then reduced to one-third of its original value.

What is the new position from the source where the loudness is perceived to be the same as before?

- **A** 1.6 m
- **B** 2.7 m
- **C** 4.6 m
- **D** 14 m

27 The diagram shows two tubes.

The tubes are identical except tube P is open at its lower end while tube Q is closed at its lower end. Both tubes have open upper ends.



A tuning fork placed above tube P causes resonance of the air at frequency f. No resonance is found at any frequency lower than f with tube P.

Which frequencies of the tuning forks will produce resonance when placed just above tube P and tube Q?



28 A plane water wave reaches an obstacle and passes through a gap in the obstacle.Which one of the following diagrams shows the resultant wave after emerging from the gap?



29 The diagram below shows an experiment which has been set up to demonstrate two source interference, using microwaves of wavelength λ .



The point O is equidistant from S_1 and S_2 and a low intensity is detected at that point. The detector is moved from O in the direction of the arrow. The detector will pick up signals of low intensity and high intensity depending on its position along OX. It is observed that the third maximum occurs at point X.

Which one of the following equations correctly determines the position of X?

- **A** $S_2X S_1X = 1.5\lambda$
- $\mathbf{B} \qquad \mathbf{S}_2 \mathbf{X} \mathbf{S}_1 \mathbf{X} = 2\lambda$
- **C** $S_2X S_1X = 2.5\lambda$
- $\mathbf{D} \qquad \mathbf{S}_2 \mathbf{X} \mathbf{S}_1 \mathbf{X} = 3\lambda$

30 The first order image observed from a diffraction grating is 20° from the zeroth order. What is the maximum number of images that can be observed?

A 2 **B** 3 **C** 4 **D** 5