YISHUN INNOVA JUNIOR COLLEGE
JC 1 PROMOTIONAL EXAM
**Higher 2**

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|---|---|---|---|
| CANDIDATE NAME | | | |
| CG | | INDEX NO | |

# PHYSICS 9749/01

Paper 1 Multiple Choice **29 September 2022**

**50 minutes**

Additional Materials: Multiple Choice Answer Sheet

**READ THESE INSTRUCTIONS FIRST**

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid/tape.
Write your name and class on the Answer Sheet in the spaces provided unless this has been done for you.

There are **twenty five** 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, | $c$ | = | $3.00 \times 10^{8}$ m s$^{-1}$ |
| permeability of free space, | $\mu_o$ | = | $4\pi \times 10^{-7}$ H m$^{-1}$ |
| permittivity of free space, | $\varepsilon_o$ | = | $8.85 \times 10^{-12}$ F m$^{-1}$ |
| | | | $(1/(36\pi)) \times 10^{-9}$ F m$^{-1}$ |
| elementary charge, | $e$ | = | $1.60 \times 10^{-19}$ C |
| the Planck constant, | $h$ | = | $6.63 \times 10^{-34}$ J s |
| unified atomic mass constant, | $u$ | = | $1.66 \times 10^{-27}$ kg |
| rest mass of electron, | $m_e$ | = | $9.11 \times 10^{-31}$ kg |
| rest mass of proton, | $m_p$ | = | $1.67 \times 10^{-27}$ kg |
| molar gas constant, | $R$ | = | 8.31 J K$^{-1}$ mol$^{-1}$ |
| the Avogadro constant, | $N_A$ | = | $6.02 \times 10^{23}$ mol$^{-1}$ |
| the Boltzmann constant, | $k$ | = | $1.38 \times 10^{-23}$ J K$^{-1}$ |
| gravitational constant, | $G$ | = | $6.67 \times 10^{-11}$ N m$^2$ 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, | $p$ | = | $\rho g h$ |
| gravitational potential, | $\phi$ | = | $-\frac{Gm}{r}$ |
| temperature, | $T/K$ | = | $T/°C + 273.15$ |
| pressure of an ideal gas, | $p$ | = | $\frac{1}{3}\frac{Nm}{V}\langle C^2 \rangle$ |
| mean translational kinetic energy of an ideal gas molecule, | $E$ | = | $\frac{3}{2}kT$ |
| displacement of particle in s.h.m. | $x$ | = | $x_o \sin \omega t$ |
| velocity of particle in s.h.m., | $v$ | = | $v_o \cos \omega t$ |
| | | = | $\pm \omega \sqrt{(x_o^2 - x^2)}$ |
| electric current, | $I$ | = | $A n v q$ |
| resistors in series, | $R$ | = | $R_1 + R_2 + \ldots\ldots$ |
| resistors in parallel, | $\frac{1}{R}$ | = | $\frac{1}{R_1} + \frac{1}{R_2} + \ldots\ldots$ |
| electric potential, | $V$ | = | $\frac{Q}{4\pi\varepsilon_o r}$ |
| alternating current/voltage, | $x$ | = | $x_o \sin \omega t$ |
| magnetic flux density due to a long straight wire, | $B$ | = | $\frac{\mu_o I}{2\pi d}$ |
| magnetic flux density due to a flat circular coil, | $B$ | = | $\frac{\mu_o NI}{2r}$ |
| magnetic flux density due to a long solenoid, | $B$ | = | $\mu_o nI$ |
| radioactive decay, | $x$ | = | $x_o \exp(-\lambda t)$ |
| decay constant, | $\lambda$ | = | $\frac{\ln 2}{t_{\frac{1}{2}}}$ |

Answer **all** questions.

**1** What is equivalent to 2000 microseconds?

**A** 2 μs **B** 2 ms **C** 2 ps **D** 2000 ms

**2** The Planck constant *h* has SI units J s.

Which equation could be used to calculate the Planck constant?

**A** $h = \frac{DE}{v}$ where *D* is distance, *E* is energy and *v* is velocity

**B** $h = \frac{v}{D}$ where *v* is velocity and *D* is distance

**C** $h = \frac{1}{4\pi\rho}$ where $\rho$ is density

**D** $h = \frac{Fr^2}{m}$ where *F* is force, *r* is radius and *m* is mass

**3** A car moves to the right with uniform acceleration along a straight road. Oil leaks from the car at the rate of one drop every three seconds. The diagram shows the distances between three successive oil drops on the road.


What is the acceleration of the car?

**A** 0.33 m $s^{-2}$ **B** 0.66 m $s^{-2}$ **C** 1.2 m $s^{-2}$ **D** 2.0 m $s^{-2}$

**4** A ball is thrown vertically upwards from ground level and reaches a maximum height of 12.7 m before falling back to ground level. Assume air resistance is negligible.

What is the total time for which the ball is in the air?

**A** 1.61 s **B** 3.22 s **C** 3.88 s **D** 5.18 s

**5** Which statement is an **incorrect** representation of Newton's third law?

**A** The reason a person is unable to move a heavy box when he pushes it is because the box pushes back on him with an equal and opposite force.

**B** When the hammer hits a nail with a force of 100 N, the hammer will experience a force of 100 N due to the nail.

**C** The weight of the book and the normal force which acts on the book when placed on a table is not an action-reaction pair.

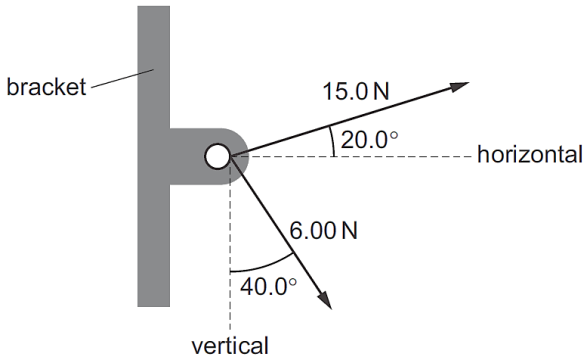
**D** The pull of the Earth on you and the pull you exert on the Earth is an action-reaction pair.

**6** Water is pumped through a hose at a rate of 20 kg per minute. It emerges from the hose horizontally with a speed of 5.0 m $s^{-1}$.

What is the force that a person, who is holding the hose, require to prevent it from moving backwards?

**A** 1.7 N **B** 4.0 N **C** 100 N **D** 6000 N

**7** Two cables are attached to a bracket and exert forces as shown.




What are the magnitudes of the horizontal and vertical components of the resultant of the two forces?

| | horizontal component / N | vertical component / N |
|---|---|---|
| **A** | 9.73 | 0.534 |
| **B** | 9.73 | 10.2 |
| **C** | 18.0 | 0.534 |
| **D** | 18.0 | 10.2 |

**8** A submarine descends vertically at constant velocity. The three forces acting on the submarine are viscous drag, upthrust and weight. Which one of the following options is correct?

**A** weight < drag

**B** weight = drag

**C** weight < upthrust

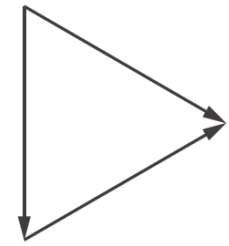
**D** weight > upthrust

**9** Four combinations of vectors are shown, each representing all the forces acting on an object. The forces all act in the same plane.

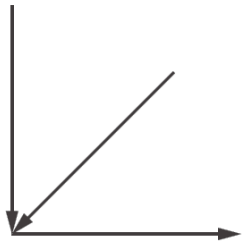
The object is in equilibrium.

Which combination of vectors could represent the forces acting on the object?

**A**

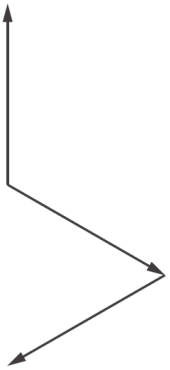


**B**

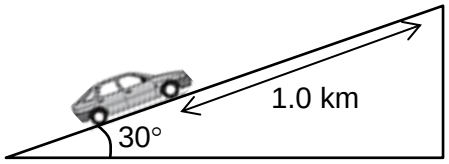


**C**

**D**



**10** A car engine exerts an average force of 5000 N in moving the car 1.0 km up a slope inclined at an angle of 30° to the horizontal. The weight of the car is 12000 N.




What is the work done by the weight of the car?

**A** – 6.0 MJ **B** – 12 MJ **C** 6.0 MJ **D** 12 MJ

**11** The force resisting the motion of a car is taken as being proportional to the square of the car's speed. The magnitude of the force at a speed of 20 m $s^{-1}$ is 800 N.

What effective power is required from the car's engine to maintain a steady speed of 40 m $s^{-1}$?

**A** 32 kW **B** 64 kW **C** 128 kW **D** 512 kW

**12** A weight of 2.0 N is raised at a constant speed through a vertical height of 80 cm in 4.0 s using an electric motor.

If the efficiency of the motor is 20%, what is the electrical power supplied to the motor?

**A** 0.080 W **B** 0.50 W **C** 2.0 W **D** 78 W

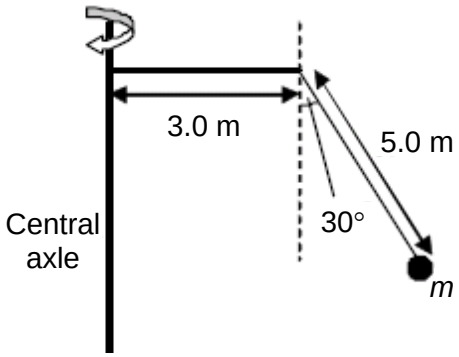
**13** The diagram shows an analogue watch.


What is the average angular velocity of the hour hand?

**A** $2.31 \times 10^{-5}$ rad $s^{-1}$ **B** $7.27 \times 10^{-5}$ rad $s^{-1}$

**C** $1.45 \times 10^{-4}$ rad $s^{-1}$ **D** $1.75 \times 10^{-3}$ rad $s^{-1}$

**14** A mass *m*, attached to one end of an inextensible string of length 5.0 m, is made to move in a horizontal circle as the central axle is rotated. In a particular circular motion, the string makes an angle of 30° with the vertical as shown.




What is the period of the mass's motion about the central axle?

**A** 1.0 s **B** 3.5 s **C** 4.8 s **D** 6.2 s

**15** The acceleration of free fall at the surface of Neptune is approximately equal to the acceleration of free fall at the surface of the Earth. The mass of Neptune is 17 times the mass of the Earth.

What is the value of the ratio $\frac{\text{radius of Neptune}}{\text{radius of the Earth}}$?

**A** 0.059 **B** 0.24

**C** 4.1 **D** 17

**16** Taking the Earth to be a perfect sphere of uniform density rotating about its polar axis, which of the following statements concerning the reading on a weighing scale of a man, *N*, at the surface of the Earth is true?

**A** The value of *N* at the equator is larger than that at the poles.

**B** If the rate of rotation of the Earth slows down, *N* at the equator increases.

**C** If the radius of the Earth increases with its density remaining unchanged, *N* at the pole decreases.

**D** If the radius of the Earth increases with its density remaining unchanged, *N* at the equator decreases.

**17** Earth has a mass of $6.0 \times 10^{24}$ kg and a radius of 6400 km.

A satellite of mass 320 kg is lifted from the Earth's surface to an orbit 1200 km above its surface.

What is the change in the gravitational potential energy of the satellite?

**A** $9.1 \times 10^{2}$ J

**B** $9.9 \times 10^{6}$ J

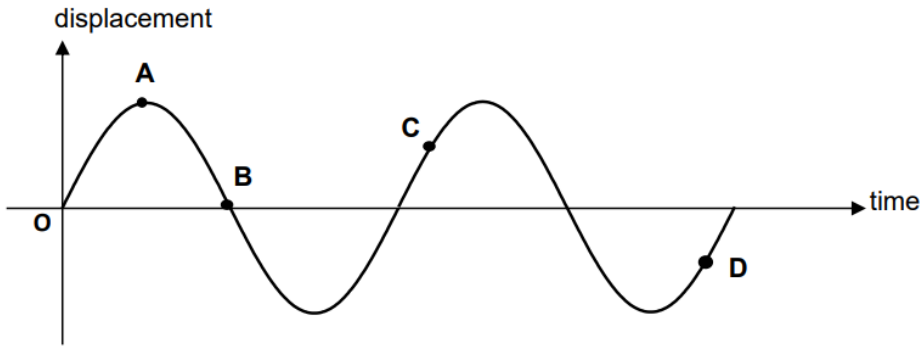
**C** $3.2 \times 10^{9}$ J

**D** $3.8 \times 10^{9}$ J

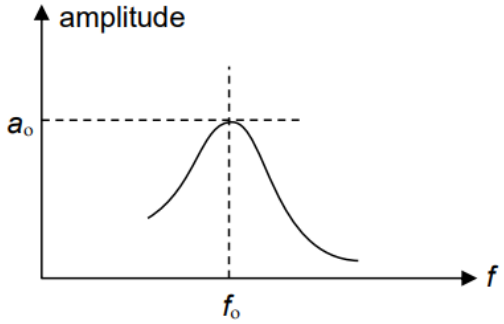
**18** A particle performs simple harmonic motion and makes $n$ complete oscillations in one second. What is its angular frequency?

**A** $n$ **B** $\frac{2\pi}{n}$ **C** $\frac{1}{n}$ **D** $2\pi n$

**19** The diagram shows the graph of displacement against time for a body performing simple harmonic motion. At which point are the velocity and acceleration in opposite directions?

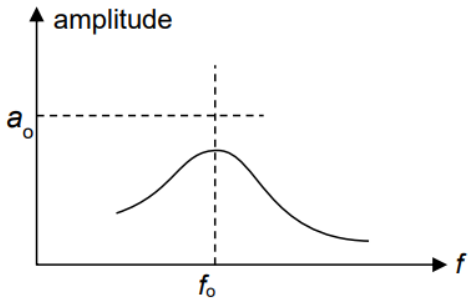


**20** A pendulum is constructed from a fixed length of light thread and a spherical pendulum bob. It is forced to oscillate in air at different frequencies *f*. The following diagram shows how the amplitude of its oscillation varies with *f*.

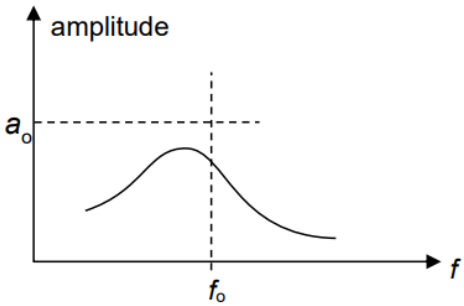



If the experiment is repeated in a partial vacuum, which graph best represents the variation with *f* of the amplitude?

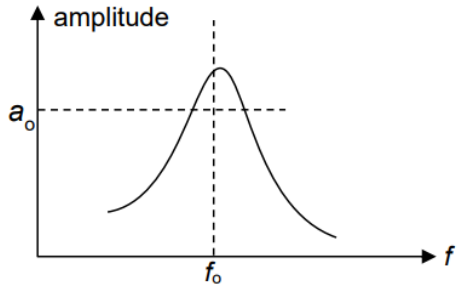
**A**



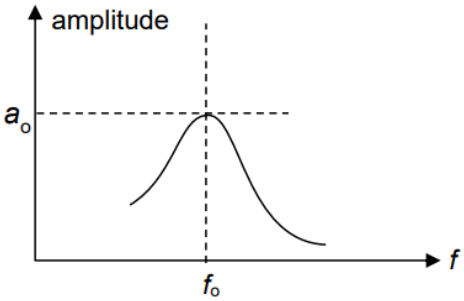

**B**




**C**




**D**




**21** A sound wave of frequency 400 Hz is travelling in air at a speed of 320 m $s^{-1}$.

What is the difference in phase between two points on the wave 0.20 m apart in the direction of travel?

**A** $\frac{\pi}{5}$

**B** $\frac{\pi}{4}$

**C** $\frac{\pi}{2}$

**D** $\frac{4\pi}{5}$

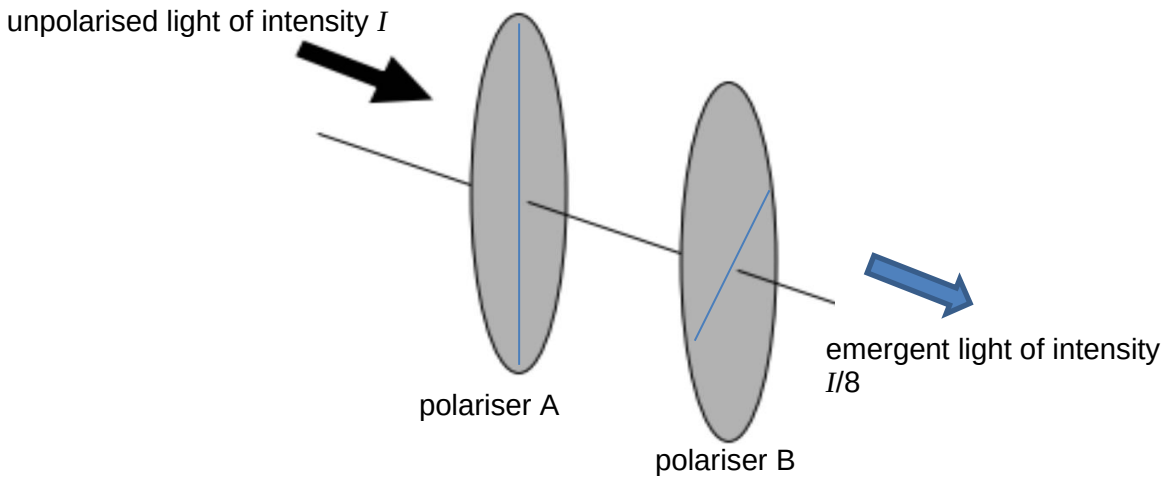
**22** Transverse progressive sinusoidal waves of wavelength λ are passing vertically along a horizontal rope.

P and Q are $\lambda/4$ apart and the waves are travelling from P to Q.

Which one of the following correctly describes Q at an instant when P is displaced upwards but is moving downwards?

| | **displacement of Q** | **movement of Q** |
|---|---|---|
| **A** | upwards | downwards |
| **B** | upwards | upwards |
| **C** | downwards | upwards |
| **D** | downwards | downwards |

**23** When unpolarised light of intensity $I$ is incident on a system of two polariser A followed by B, the intensity of the emergent light is $I/8$. What is the angle between polarisers A and B?



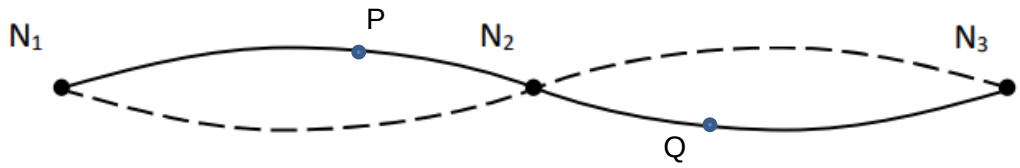

**A** 30°

**B** 45°

**C** 60°

**D** 69°

**24** The diagram shows a standing wave on a string. The standing wave has three nodes $N_1$, $N_2$ and $N_3$. P and Q are at the same distance away from $N_2$.




Which statement is correct?

**A** All points on the string between $N_1$ and $N_3$ vibrate in phase.

**B** All points on the string vibrate with the same amplitude.

**C** P and Q vibrate with the same frequency and in phase.

**D** P and Q vibrate with the same frequency and the same amplitude.

**25** In stationary longitudinal waves, displacement nodes are points of

**A** minimum displacement and maximum pressure change.

**B** maximum displacement and minimum pressure change.

**C** minimum displacement and minimum pressure change.

**D** maximum displacement and maximum pressure change.

**END OF PAPER**

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