EUNOIA JUNIOR COLLEGE
JC1 Promotional Examination 2017
General Certificate of Education Advanced Level
Higher 2

PHYSICS

Paper 1 Multiple Choice

9749/01

03 October 2017

40 minutes

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use paper clips, glue or correction fluid.
Write your name, civics group and registration number on the Answer Sheet in the spaces provided.

There are **twenty** 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.

This document consists of **11** printed pages and **1** blank page.

Data

speed of light in free space,	c	=	3.00×10^{8} m s^{-1}
permeability of free space,	μ_o	=	$4\pi \times 10^{-7}$ H m^{-1}
permittivity of free space,	ε_o	=	8.85×10^{-12} F m^{-1} $(1/(36\,\pi)) \times 10^{-9}$ F m^{-1}
elementary charge,	e	=	1.60×10^{-19} C
the Planck constant,	h	=	6.63×10^{-34} J s
unified atomic mass constant,	u	=	1.66×10^{-27} kg
rest mass of electron,	m_e	=	9.11×10^{-31} kg
rest mass of proton,	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	=	6.67×10^{-11} N m^2 kg^{-2}
acceleration of free fall,	g	=	9.81 m s^{-2}

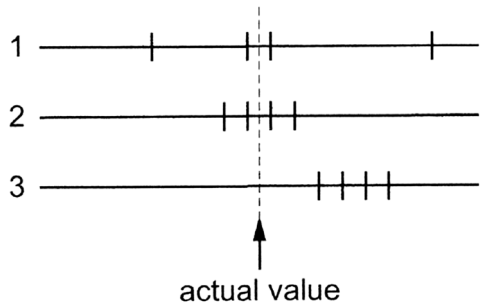
Formulae

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	=	ρgh
gravitational potential,	ϕ	=	$-\frac{Gm}{r}$
temperature,	T/K	=	$T / ^{\circ}C + 273.15$
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	=	$Anvq$
resistors in series,	R	=	$R_1 + R_2 + \ldots$
resistors in parallel,	$1/R$	=	$1/R_1 + 1/R_2 + \ldots$
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	=	$\frac{\mu_o N I}{2r}$
magnetic flux density due to a long solenoid	B	=	$\mu_o n I$
radioactive decay,	x	=	$x_o \exp(-\lambda t)$
decay constant	λ	=	$\frac{\ln 2}{t_{\frac{1}{2}}}$

1 Which is the best estimate of the total mass of all the people living in Singapore?

A 3×10^8 kg **B** 3×10^9 kg **C** 3×10^{10} kg **D** 3×10^{11} kg

2 Three sets of measurements, 1, 2 and 3, are made to determine the length of a piece of wire. Each set of measurements has four readings.



Which statement about the sets of measurements is correct?

A Set 1 is less precise than set 3.

B Set 2 is less accurate than set 1.

C Set 3 has less systematic error than set 1.

D Set 3 has more random error than set 1.

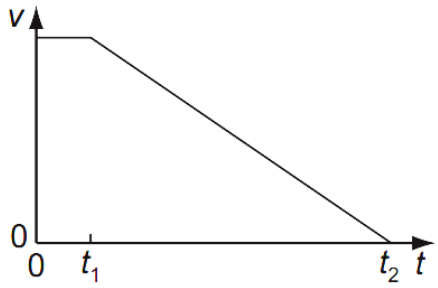
3 To study the performance of a car, a student measures the time t taken for the car of mass m to accelerate from rest to speed v. He calculates the quantity $P = \frac{1}{2}\frac{mv^2}{t}$.

The percentage uncertainty in the value of m is 0.5 %, in v is 3.0 % and in t is 2.0 %.

What is the percentage uncertainty in the calculated value of P?

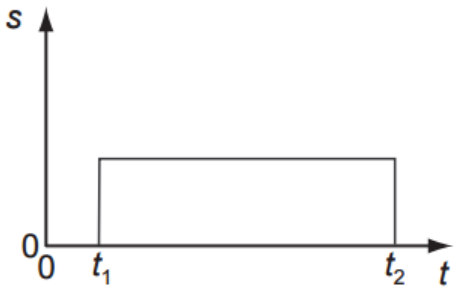
A 4.3 % **B** 5.5 % **C** 8.5 % **D** 11.5 %

4 When the driver of a car sees a hazard ahead, the driver applies the brakes and brings the car to rest. The graph shows how the velocity v of the car varies with time t after the hazard is seen.

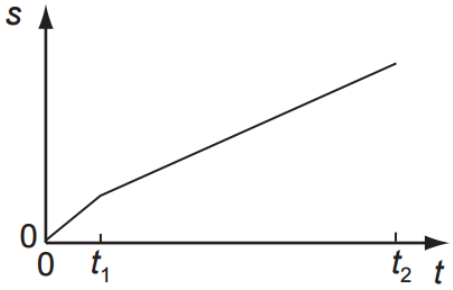


Which graph represents the variation with time t of the displacement s travelled by the car after the hazard has been seen?

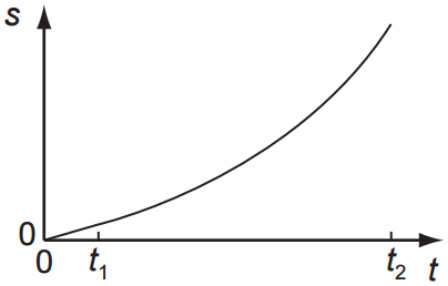
A



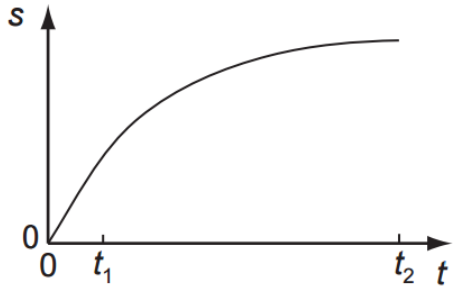
B



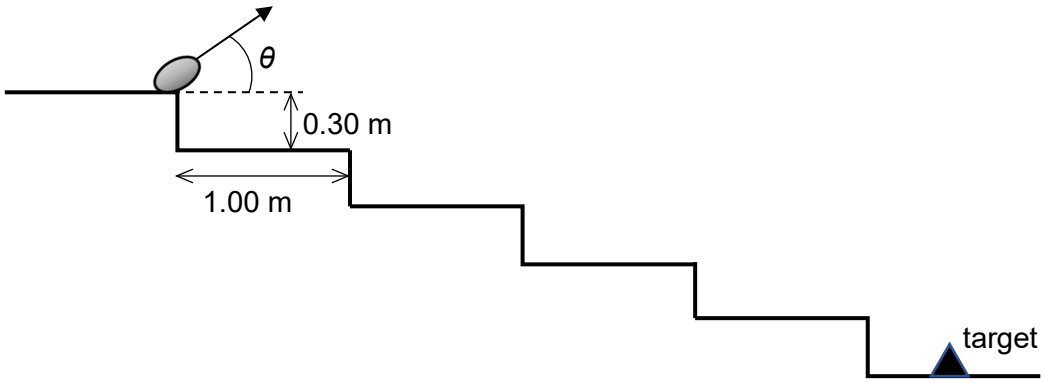
C



D



5 In a design challenge, a student builds a launcher that fires a water balloon at a speed of 10 m s^{-1}. The student then sets up his launcher such that the water balloon is fired from the top of the steps with the target placed at the middle of the fifth step below the top as shown.



The height of each step is 0.30 m and the width of each step is 1.00 m.

If the effects of air resistance may be ignored, at which angle(s) θ above the horizontal can he project the water balloon such that it will strike the target?

A 0° **B** 45° **C** 12° and 57° **D** 12° and 78°

6 An empty conveyor belt requires a constant force of 17 N to be driven horizontally at 1.5 m s^{-1}. Sand is then poured vertically onto the conveyor belt at a rate of 4.0 kg s^{-1}.

What is the total average force that is required to maintain the conveyor belt at the speed of 1.5 m s^{-1} while the sand is being poured?

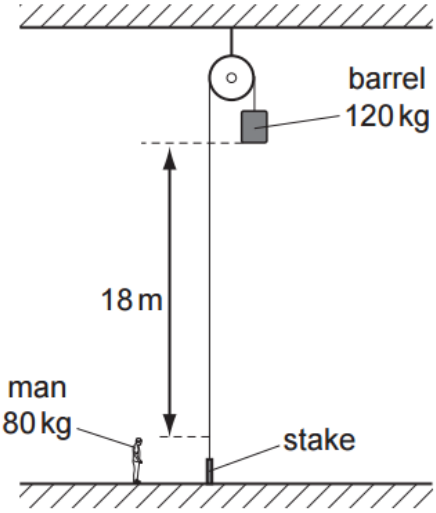
A 6.0 N **B** 11 N **C** 17 N **D** 23 N

7 A cyclist and his bicycle, of total mass 80.0 kg, coasts down a slope inclined at 5.0° below the horizontal at a steady speed of 1.38 m s^{-1} without paddling.

If the air resistance acting on the cyclist and his bicycle is proportional to its speed, what is the additional force that the cyclist must apply in order to descend the hill at a steady speed of 5.55 m s^{-1}?

A 107 N **B** 207 N **C** 275 N **D** 3140 N

8 The diagram shows a barrel suspended from a frictionless pulley on a building. The rope supporting the barrel goes over the pulley and is secured to a stake at the bottom of the building.

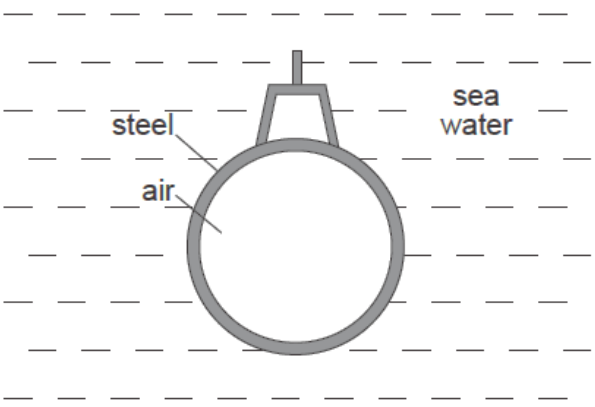


A man stands close to the stake. The bottom of the barrel is 18 m above the man's head. The mass of the barrel is 120 kg and the mass of the man is 80 kg. The man keep hold of the rope after untying it from the stake and is lifted upwards as the barrel falls.

What is the man's upward speed when his head is level with the bottom of the barrel?

A 5.9 m s^{-1} **B** 12 m s^{-1} **C** 13 m s^{-1} **D** 27 m s^{-1}

9 A submarine is in equilibrium in a fully submerged position as shown.



What causes the upthrust on the submarine?

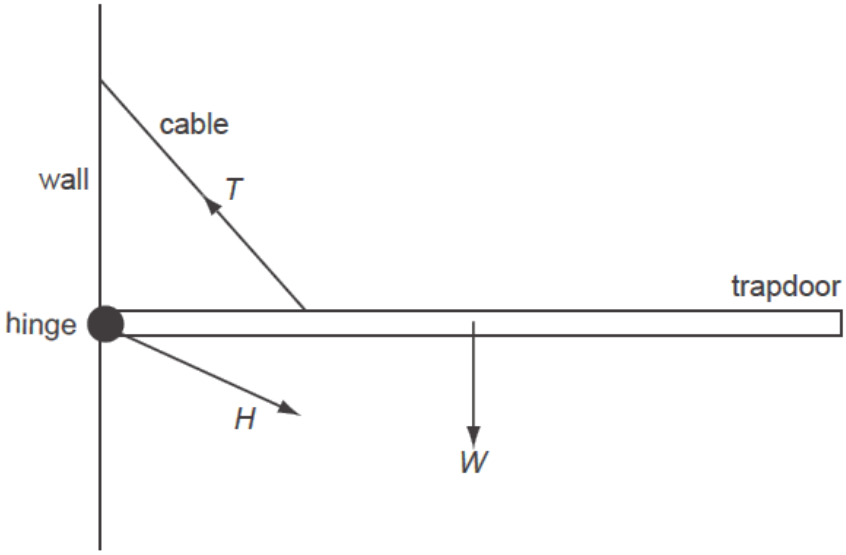
A The air in the submarine is less dense than sea water.

B The submarine displaces its own volume of sea water.

C The sea water exerts a greater upward force on the submarine than the weight of the submarine.

D There is a difference in water pressure acting on the top and on the bottom of the submarine.

10 A hinged trapdoor is held closed in the horizontal position by a cable that is connected midway between the hinge and the centre of gravity of the trapdoor.



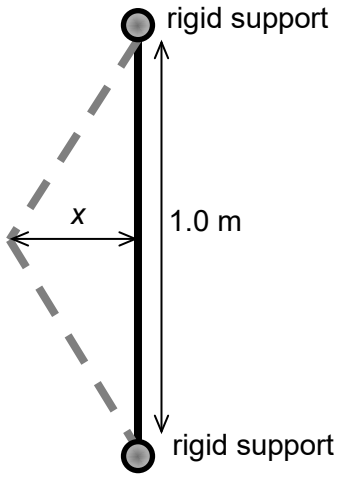
(forces are not drawn to scale)

Three forces act on the trapdoor: the weight *W* of the trapdoor, the tension *T* in the cable and the force *H* at the hinge.

Which list gives the three forces in increasing order of magnitude?

A *H*, *W*, *T** **B** *H*, *T*, *W** **C** *W*, *H*, *T** **D** *W*, *T*, *H*

11 In a design challenge, a student builds a launcher using an elastic cord of negligible mass and natural length of 1.0 m attached to 2 rigid supports.



Assuming that the elastic cord obeys Hooke's Law with a spring constant of 80 N m^{-1} and that the cord is pulled at its midpoint, what is the minimum draw length *x* needed such that a 200g water balloon may be propelled with a speed of 10 m s^{-1}?

A 0.50 m **B** 0.56 m **C** 0.75 m **D** 1.5 m

12 An airplane flies round the Earth at a constant speed with a period *T*. Standing on the Earth Equator, you observed the plane flying from West to East directly overhead. Exactly 18 hours later, you observed the same plane flying overhead again. Determine *T*.

A 6.5 hours **B** 10.3 hours **C** 18 hours **D** 24 hours

13 A computer is reading data from a rotating circular CD-ROM disc. At a point that is 0.030 m from the centre of the disc, the centripetal acceleration is 120 m s^{-2}. What is the linear speed at a point that is 0.050 m from the center of the disc?

A 1.9 m s^{-1} **B** 2.2 m s^{-1} **C** 3.2 m s^{-1} **D** 6.3 m s^{-1}

14 A spacecraft travels in a circular orbit around the Earth. Its engine is then fired and produces a force on it exactly equal and opposite to that exerted by the Earth's gravitational field. The spacecraft will now move

A along a tangent to the orbit.

B in a circular path with a longer period.

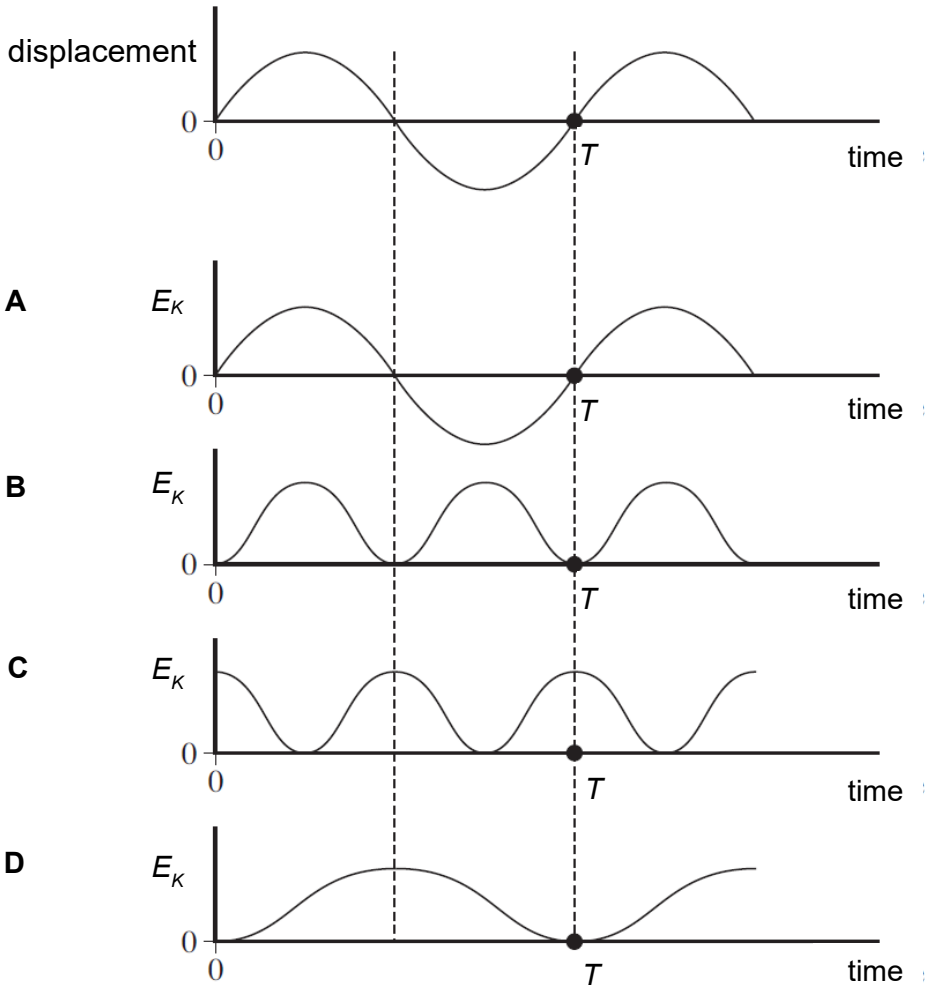
C in a circular path with a shorter period.

D in a spiral towards the Earth's surface.

15 A satellite is orbiting the Earth with a radius of 6610 km at a speed of 7780 m s^{-1}. The satellite is boosted to a higher orbit of radius 6890 km. Given that the mass of the Earth is 6.0 x 10^{24} kg, the speed of the satellite in the new orbit is

A 7460 m s^{-1} **B** 7620 m s^{-1} **C** 7940 m s^{-1} **D** 8110 m s^{-1}

16 An object oscillating in simple harmonic motion as a time period T. The first graph shows how its displacement varies with time. Which subsequent graphs, **A** to **D**, show how the kinetic energy, E_K, of the object varies with time?



17 Which one of the following statements always applies to a damping force acting on a vibrating system?

A It is in the opposite direction to the velocity.

B It is in the same direction as the acceleration.

C It is in the same direction as the displacement.

D It is proportional to the displacement.

18 The frequency of a certain wave is 1000Hz and its speed is 340 m s^{-1}.

What is the phase difference between the motions of two points on the wave 0.17 m apart?

A $\frac{1}{4}\pi$ rad **B** $\frac{1}{2}\pi$ rad **C** π rad **D** 2π rad

19 The angular resolution of a vertical slit for horizontally separated objects is 0.50×10^{-3} rad.

What is the angular resolution if the width of the slit is halved?

A 0.25×10^{-3} rad **B** 0.50×10^{-3} rad **C** 1.0×10^{-3} rad **D** 2.0×10^{-3} rad

20 A diffraction grating has *N* lines per unit length and is placed at 90° to monochromatic light of wavelength λ.

What is the expression for θ, the angle to the normal to the grating at which the second order diffraction peak is observed?

A $\sin\theta = \frac{1}{2N\lambda}$ **B** $\sin\theta = \frac{2\lambda}{N}$ **C** $\sin\theta = \frac{N\lambda}{2}$ **D** $\sin\theta = 2N\lambda$

End of Paper

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