Name:		Index Number:		Class:	

DUNMAN HIGH SCHOOL
Promotional Examination
Year 5

H2 PHYSICS

9749/01
6 October 2021
40 minutes

Paper 1 Multiple Choice Questions
Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

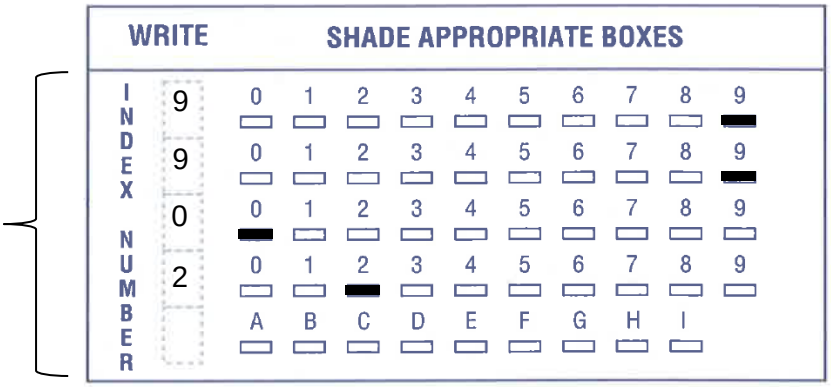
Write your class, index number and name at the top of this page.
Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.

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.
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
The use of an approved scientific calculator is expected, where appropriate.

Write your name and class on the Multiple Choice Answer Sheet. Write and shade the Index Number as follows.

For illustration only:

A student from class 5C99, with index number 02, should shade "9902".



This document consists of **12** printed pages.

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}

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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	=	$-Gm/r$
temperature,	T/K	=	$T/^{o}$C + 273.15
pressure of an ideal gas,	p	=	$\frac{1}{3}\frac{Nm}{V}<c^2>$
mean translational kinetic energy of an ideal gas molecule,	E	=	$\frac{3}{2}kT$
displacement of particle in s.h.m.,	x	=	$x_0 \sin \omega t$
velocity of particle in s.h.m.,	v	=	$v_0 \cos \omega t$
		=	$\pm\omega\sqrt{x_o^2 - x^2}$
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	=	$x_0 \sin \omega t$
magnetic flux density due to a long straight wire,	B	=	$\frac{\mu_0 I}{2\pi d}$
magnetic flux denxity due to a flat circular coil,	B	=	$\frac{\mu_0 NI}{2r}$
magnetic flux density due to a long solenoid,	B	=	$\mu_0 nI$
radioactive decay,	x	=	$x_0 \exp(-\lambda t)$
decay constant,	λ	=	$\frac{\ln 2}{t_{\frac{1}{2}}}$

1 The table shows some measurable quantities.

Which row gives the correct order of magnitude of the measurable quantity in the stated unit?

	Measurable quantity	Order of magnitude	unit
A	mass of a coin	10^{-4}	kg
B	thickness of a sheet of paper	10^{-2}	m
C	weight of an apple	10^{0}	N
D	temperature of a person's body	10^{1}	K

2 The frequency f of vibration of a mass m supported by a spring with spring constant k is given by the equation

$$f = Cm^p k^q$$

where C is a constant with no units.

What are the values of p and q?

	p	q
A	$-\frac{1}{2}$	$-\frac{1}{2}$
B	$-\frac{1}{2}$	$\frac{1}{2}$
C	$\frac{1}{2}$	$-\frac{1}{2}$
D	$\frac{1}{2}$	$\frac{1}{2}$

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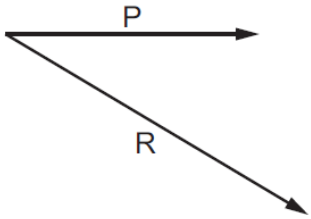
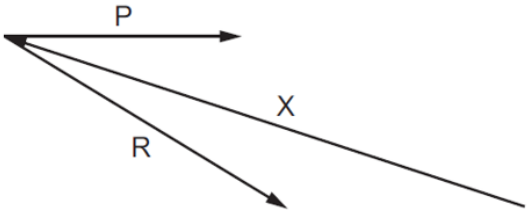
3 P and R are coplanar vectors.

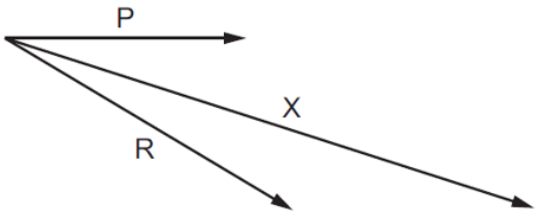


If X = P – R, which diagram best represents vector X?

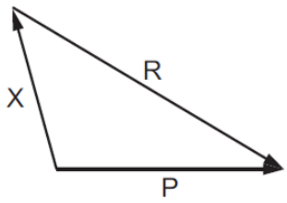
A



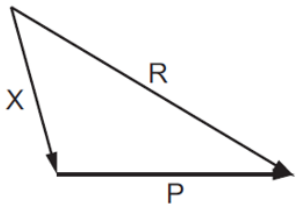
B



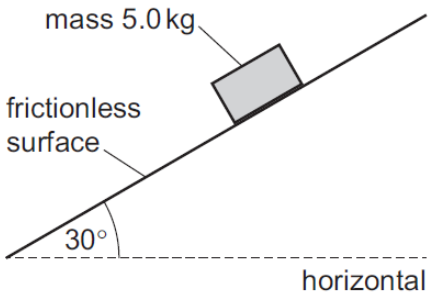
C



D



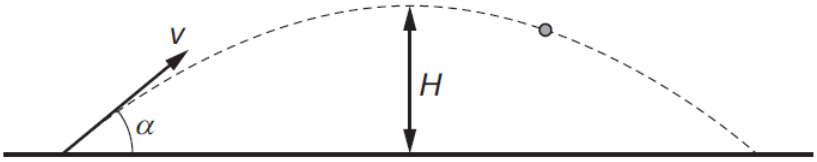
4 A mass of 5.0 kg is released from rest on a frictionless surface inclined at 30° to the horizontal. Air resistance is negligible.



How far does the mass travel in a time of 0.80 s?

A 1.6 m **B** 2.0 m **C** 2.7 m **D** 3.1 m

5 A cannon fires a cannonball with an initial speed v at an angle α to the horizontal.



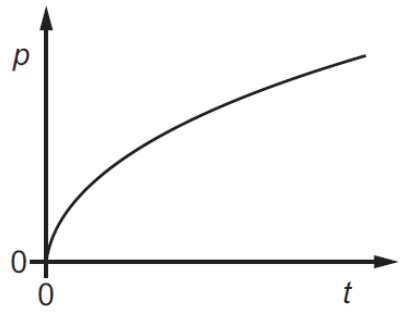
Which equation is correct for the maximum height H reached?

A $H = \dfrac{v \sin \alpha}{2g}$ **B** $H = \dfrac{g \sin \alpha}{2v}$ **C** $H = \dfrac{(v \sin \alpha)^2}{2g}$ **D** $H = \dfrac{g^2 \sin \alpha}{2v}$

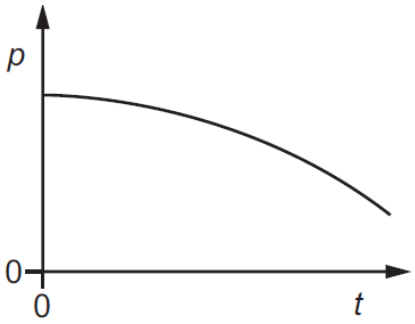
6 The resultant force acting on an object is slowly increased.

Which graph could show the variation with time t of the momentum p of the object?

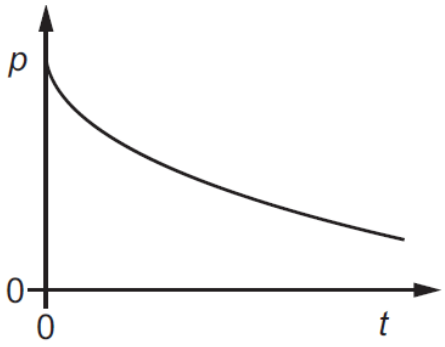
A



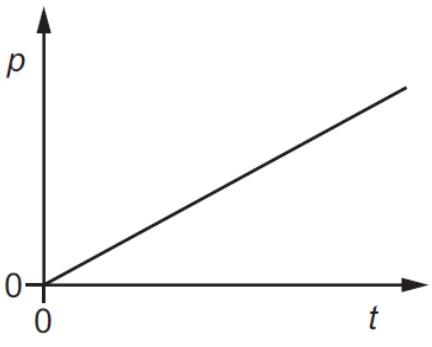
B



C

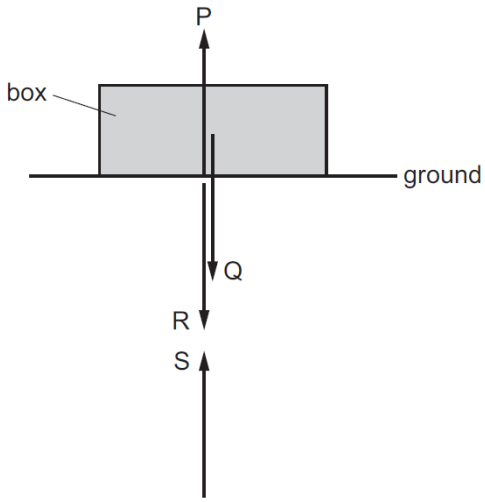


D



7 A box is shown resting on the ground. Newton's third law of motion implies that four forces of equal magnitude are involved. These forces are labelled P, Q, R and S.

Forces P and Q act on the box. Forces R and S act on the Earth. For clarity, the forces are shown slightly separated.



Which statement about the forces is correct?

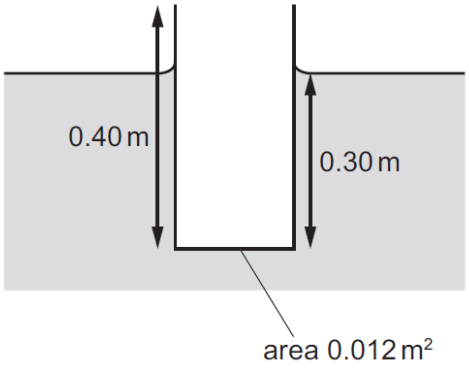
A P is the equal and opposite force to Q and both are forces of contact.

B Q is the equal and opposite force to P and both are gravitational forces.

C R is the equal and opposite force to S and both are forces of contact.

D S is the equal and opposite force to Q and both are gravitational forces.

8 A pipe, open at one end, floats in a liquid as shown.



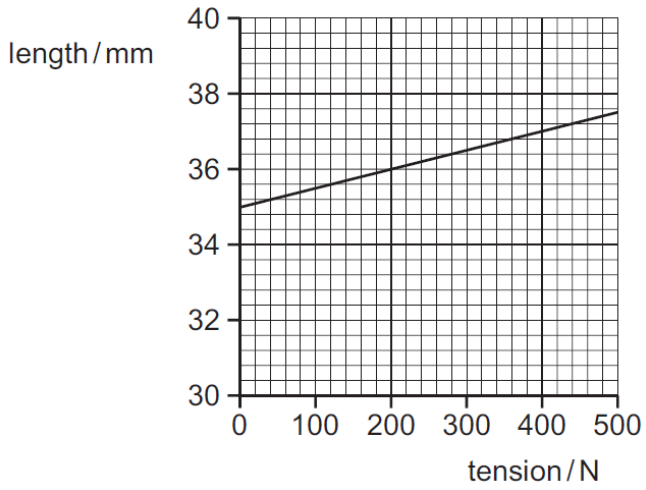
The cross-sectional area of the pipe is 0.012 m^2. The weight of the pipe is 32 N.

What is the density of the liquid?

A 680 kg m^{-3} **B** 910 kg m^{-3} **C** 6700 kg m^{-3} **D** 8900 kg m^{-3}

9 The Achilles tendon in a rabbit's leg is stretched when the rabbit jumps.

The graph shows the variation with tension of the length of the tendon.



What is the elastic potential energy in the tendon when the tension is 400 N?

A 0.40 J **B** 0.80 J **C** 2.4 J **D** 7.4 J

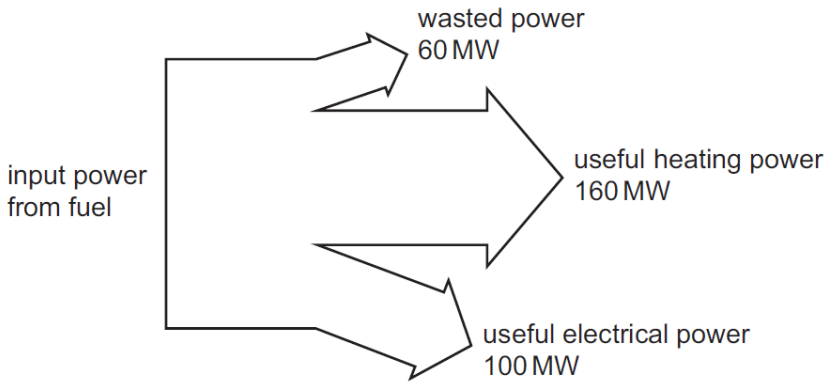
10 The kinetic energy E_k of an object of mass m moving at speed v is given by the equation

$$E_k = \frac{1}{2}mv^2$$

Which equation is **not** used in the derivation of this equation?

A $F = ma$ **B** $W = Fs$ **C** $v^2 = u^2 + 2as$ **D** $s = vt$

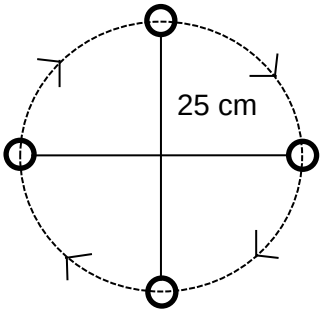
11 A combined heat and power (CHP) station generates electrical power and useful heat. The diagram shows the input and output powers for a CHP station.



What is the efficiency of the CHP station for producing useful power?

A 31% **B** 38% **C** 50% **D** 81%

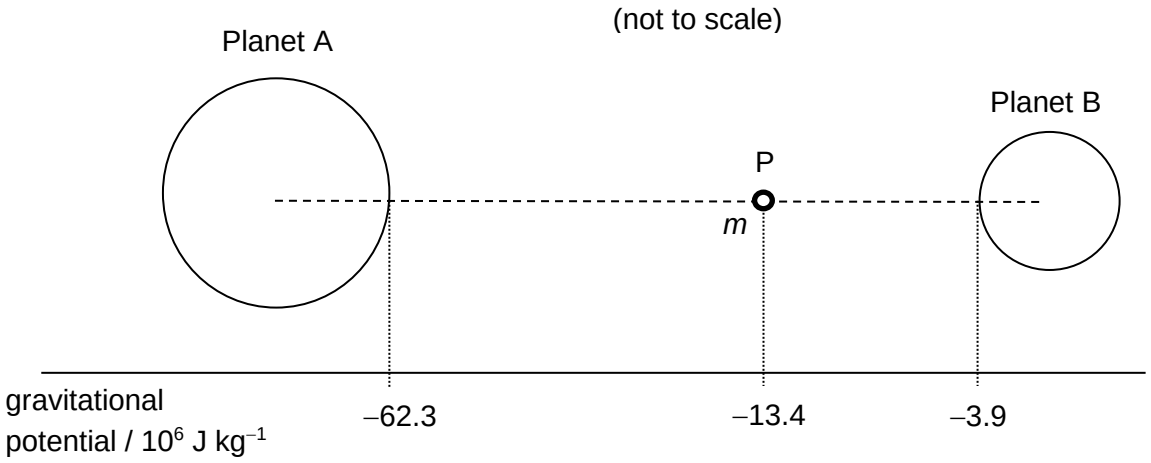
12 An object tied to the end of a light inextensible string of length 25 cm is swung in a vertical circle as shown.



Determine the minimum speed of the object in order that the string remains straight throughout the motion.

A 1.6 m s^{-1} **B** 2.2 m s^{-1} **C** 2.5 m s^{-1} **D** 3.1 m s^{-1}

13 A stationary object of mass *m* is released at a point *P* on the line joining the centres of the two planets A and B. The gravitational potential at several points along the line joining the centres of the two planets are shown in the figure below. The object will accelerate towards one of the planets.



What is the speed of the object just before it hits the surface of the planet?

A 4.36 x 10^3 m s^{-1}

B 5.18 x 10^3 m s^{-1}

C 9.89 x 10^3 m s^{-1}

D 1.08 x 10^4 m s^{-1}

14 An Earth satellite is moved from one stable circular orbit to another stable circular orbit at a greater distance from the Earth. Which of the following correctly describes the energy of the satellite?

	total energy	gravitational potential energy	kinetic energy
A	stays the same	decreases	increases
B	stays the same	increases	decreases
C	increases	decreases	increases
D	increases	increases	decreases

15 An ideal gas expands at constant temperature by absorbing heat Q. It then returns to its original volume without any heat exchange with the surrounding.

The net change in internal energy of the gas as a result of the two processes is

A zero.

B smaller than Q.

C equal to Q.

D larger than Q.

16 The temperature of a hot liquid in a container of negligible heat capacity falls at a rate of 4.0 K per minute just before it begins to solidify. The temperature then remains steady for 25 minutes by which the liquid has all solidified.

What is the value of the ratio

$$\frac{\text{specific heat capacity of liquid}}{\text{specific latent heat of fusion}} \ ?$$

A 0.01 **B** 0.04 **C** 25 **D** 100

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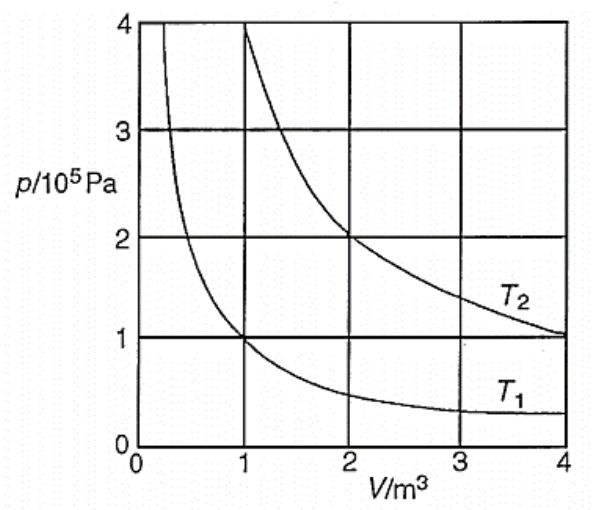
17 The two curves shown below connect points that have the same temperature for a fixed mass of an ideal gas.

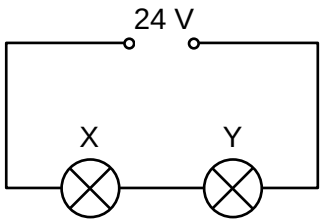


What is the ratio

$$\frac{\text{r.m.s. speed of the molecules at temperature } T_2}{\text{r.m.s. speed of the molecules at temperature } T_1} \ ?$$

A 1 **B** 2 **C** $\sqrt{2}$ **D** 4

18 Two filament lamps X and Y are connected in series with a 24 V power supply. Lamps X and Y dissipate power of 1.0 W and 3.0 W respectively.

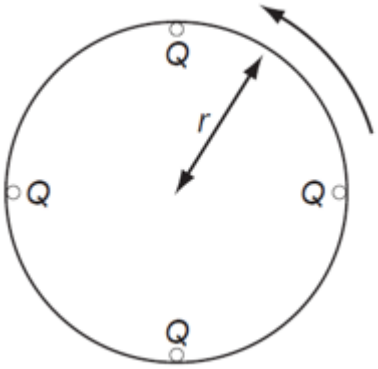


What is the potential difference across lamp X?

A 6.0 V **B** 8.0 V **C** 16 V **D** 18 V

19 Four point charges, each of charge Q, are placed at the edge of an insulating disc of radius r.

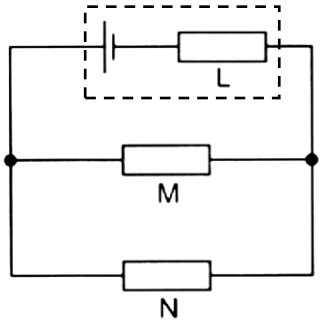
The frequency of rotation of the disc is f.



What is the equivalent electric current at the edge of the disc?

A $8\pi rQf$ **B** $\frac{4Q}{f}$ **C** $4Qf$ **D** $\frac{2Qf}{\pi r}$

20 A battery supplies a current of 0.025 A for 80 s. During this time it produces 18.0 J of electrical energy while resistor M receives 11.0 J and resistor N receives 4.0 J.



What is the e.m.f. of the battery and its internal resistance L?

	e.m.f. of battery / V	internal resistance L of battery / Ω
A	1.5	60
B	9.0	60
C	9.0	360
D	16.5	360