ST. ANDREW'S JUNIOR COLLEGE
JC 2 2016
Preliminary Examination Paper 1

PHYSICS, Higher 1   **8866/01**

20th Sept 2016   **1 hour**

Instructions to students:

There are **thirty** questions in this paper. Answer **all** the questions. For each question there are four possible answers **A, B, C, D.**

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Optical Mark Sheet (OMS).

Each correct answer will score one mark. Double entry of choices will be considered as a wrong answer. A mark will not be deducted for a wrong answer.

This question paper consists of <u>12</u> printed pages including this page.

DATA AND FORMULAE

Data

speed of light in free space	c =	$3.00 \times 10^8 \, \text{m s}^{-1}$
elementary charge	e =	$1.60 \times 10^{-19} \, \text{C}$
the Planck constant	h =	$6.63 \times 10^{-34} \, \text{Js}$
unified atomic mass constant	u =	$1.66 \times 10^{-27} \, \text{kg}$
rest mass of electron	m_e =	$9.11 \times 10^{-31} \, \text{kg}$
rest mass of proton	m_p =	$1.67 \times 10^{-27} \, \text{kg}$
acceleration of free fall	g =	$9.81 \, \text{m s}^{-2}$

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 =	$\rho g h$
resistors in series	R =	$R_1 + R_2 + ...$
resistors in parallel	$1/R$ =	$1/R_1 + 1/R_2 + ...$

1 Three pairs of physical quantities are listed below:

   I.   momentum and moment of a force
   II.   moment of a force and energy
   III. power and moment of a force

   In which of the pairs do the quantities listed below have the same base units?

   A   I only
   B   II only
   C   II and III only
   D   None of the pairs

2 A student carries out an experiment to determine the gravitational acceleration, using a pendulum, and obtains a value 9.81 m s^{-2}. The uncertainties in the measurements are shown.

   Uncertainty in length L of pendulum = 0.7 %
   Uncertainty in period T of pendulum = 0.1 %

   The equation for the period T of pendulum is $T = 2\pi\sqrt{\dfrac{L}{g}}$

   How should the answer for gravitational acceleration be stated?

   A (9.8 ± 0.1) m s^{-2} **B** (9.81 ± 0.09) m s^{-2}
   C (10 ± 8) m s^{-2} **D** (10 ± 9) m s^{-2}

3 For which quantity is the magnitude a reasonable estimate?

| **A**	frequency of radio wave	500 pHz
B	mass of an atom	500 μg
C	wavelength of green light	500 μm
D	de Broglie's wavelength of an electron	500 pm

4 A ball, after having fallen from rest under the influence of gravity for 5 s, crashes onto a horizontal glass plate, thereby losing one-third of its velocity. If it then reaches the ground in 3 s, find the height of the plate above the ground.

   A   93 m   **B**   123 m   **C**   142 m   **D**   265 m

5 A particle **P** is projected with velocity u_1 at an angle of 30° with the horizontal. At the same time, another particle **Q** is thrown vertically upwards with velocity u_2 from a point vertically below the highest point of path of **P**. The necessary condition for the two particles to collide at the highest point is
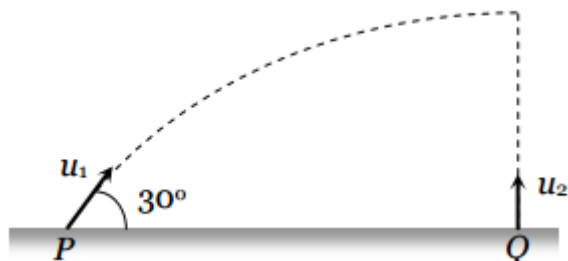

A $u_1 = u_2$ **B** $u_1 = 2u_2$ **C** $u_1 = \dfrac{u_2}{2}$ **D** $u_1 = 4u_2$

6 A ball is released from rest above a horizontal surface and bounces several times. The graph shows how y varies with time t
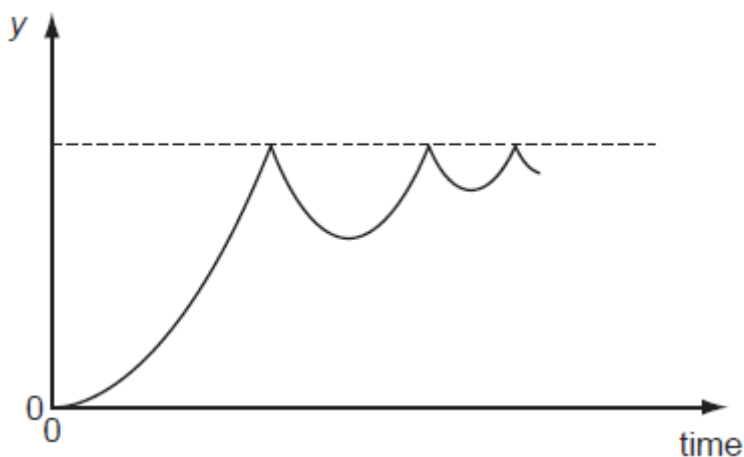

What is the quantity y?

A vertical velocity   **B** horizontal velocity
C vertical displacement   **D** horizontal displacement

7   A large sandbag of mass m is lifted by a rope attached to a crane. The variation of its velocity with time is as shown below.
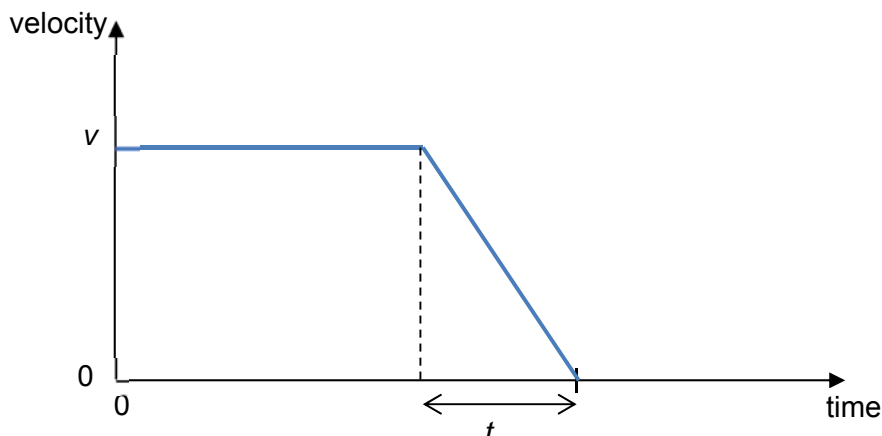
What is the difference of tension in the rope supporting the sandbag between the time when the sandbag is moving at uniform speed v and the time when the sandbag is decelerating?

A $\dfrac{mv}{t}$ **B** $\dfrac{mg}{t}$ **C** $m\left(g - \dfrac{v}{t}\right)$ **D** $m\left(\dfrac{v}{t} - g\right)$

8   Two masses m_1 and m_2 are connected by a cord. The tensions, T_1 and T_2 act on m_1 and m_2 respectively. The mass m_1 rests on a horizontal rough surface which exerts a normal force N and friction f on it. The masses remain stationary. Which pair of forces are equal because of Newton's 1st Law and which pair have equal magnitudes?
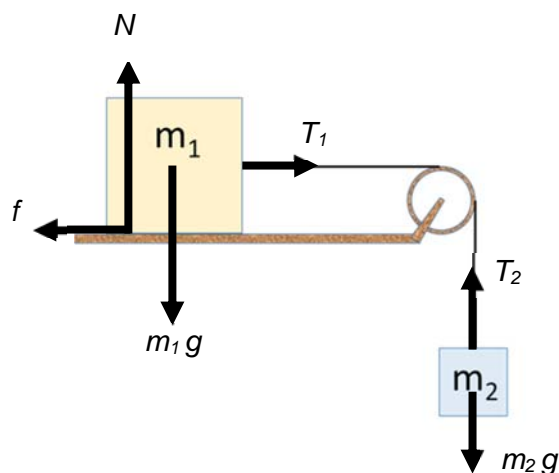
|	Newton's 1st Law	Forces of equal magnitude
A	T_1 and T_2	N and $m_1 g$
B	T_2 and $m_2 g$	f and $m_1 g$
C	$m_1 g$ and $m_2 g$	T_1 and T_2
D	f and T_1	T_1 and T_2

9 Two spheres of different masses travel along the same line with velocities u_1 and u_2. They collide and after collision their velocities are v_1 and v_2.

before collision u_1

after collision v_1

before collision u_2

after collision v_2

Which collision is not elastic?

	u_1 / m s^{-1}	u_2 / m s^{-1}	v_1 / m s^{-1}	v_2 / m s^{-1}
A	2	-5	-5	-2
B	3	-3	0	6
C	3	-2	1	6
D	5	2	3	6

10 Forces act along the edges of a square as shown below :

4 N

2 N   **2 N**

4 N
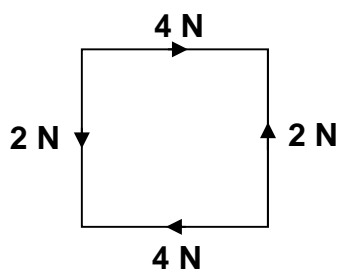
The simplest system to which these forces are equivalent is

A a single force.
B a single couple.
C a resultant force and a couple.
**D** two couples.

11 A wooden block rests on a rough board. The end of the board is then raised until the block slides down the plane of the board at a constant velocity.
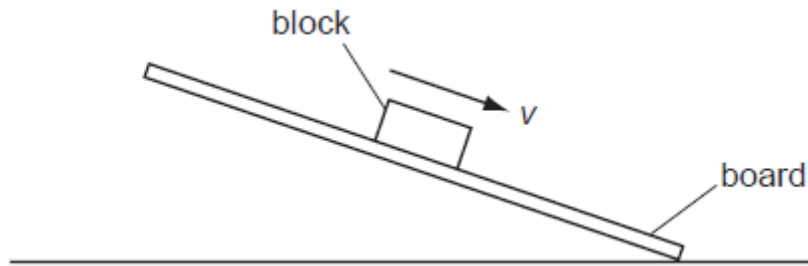
Which row describes the forces acting on the block when sliding with constant velocity?

	Frictional force on block	Net force on block
A	down the plane	down the plane
B	down the plane	zero
C	up the plane	down the plane
D	up the plane	Zero

12 A spring of original length 100 mm is compressed by a force. The graph shows the variation of the length L of the spring with the compressing force F.
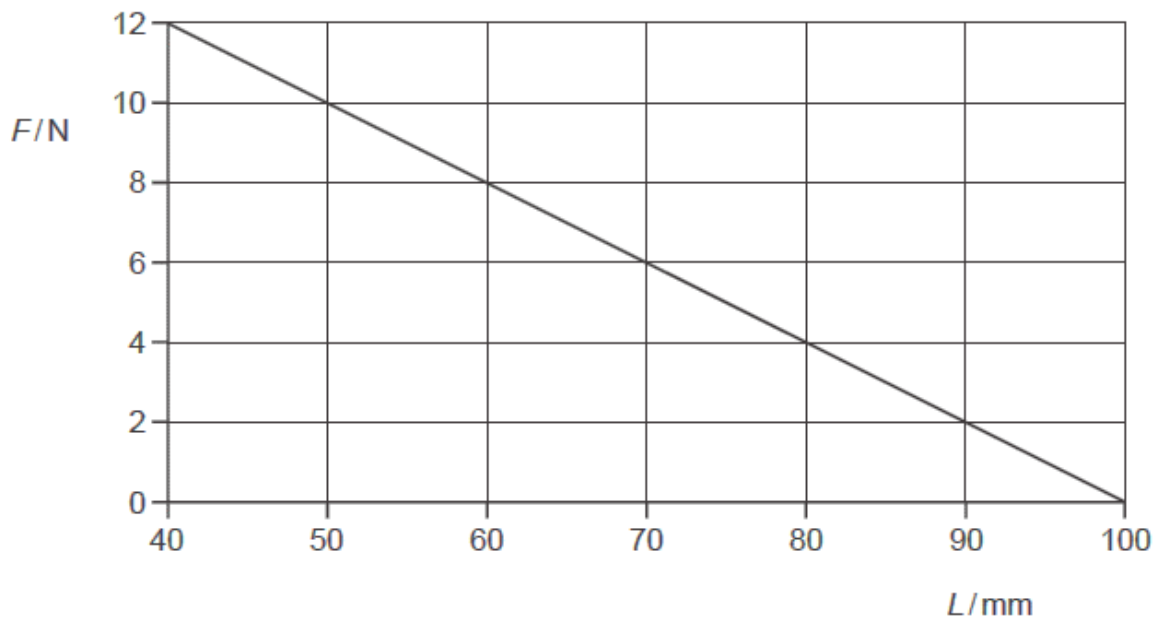
What is the energy stored in the spring when the length is 70 mm?

A   0.09 J   **B**   0.21 J   **C**   0.27 J   **D**   0.63 J

13 A projectile is launched at 45° to the horizontal with initial kinetic energy E. Assuming air resistance to be negligible, what will be the kinetic energy of the projectile when it reaches its highest point?

A   0.50E **B**   0.71E **C**   0.87E **D** E

14 When a horizontal force F is applied to a frictionless trolley over a distance s, the kinetic energy of the trolley increases from 5 J to 10 J.

If a force of $2F$ is applied to the trolley over a distance of $2s$, what will be the final kinetic energy of the trolley if it has started with 5 J?

A	20 J	**B**	25 J	**C**	40 J	**D**	80 J

15 A car of mass 1200 kg travels along a horizontal road at a speed of 10 m s^{-1}. At the time it begins to accelerate at 0.2 m s^{-2}, the total resistive force acting on the car is 160 N. What is the total output power developed by the car as it begins the acceleration?

A	0.80 kW	**B**	1.6 kW	**C**	2.4 kW	**D**	4.0 kW

16 The diagram below shows an instantaneous position of a string as a transverse progressive wave travels along it from right to left.

direction of travel
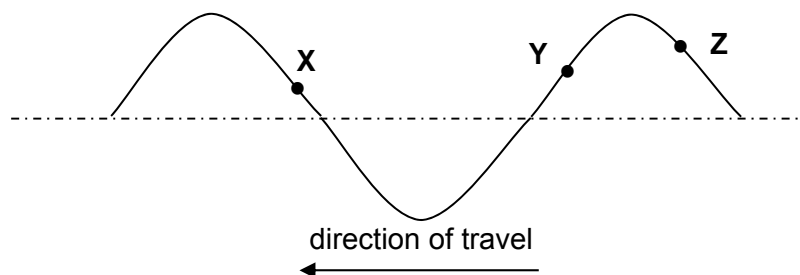
Which of the following correctly shows the directions of the velocities of the points **X**, **Y** and **Z** on the string?

	X	**Y**	**Z**
A	Left	left	left
B	Left	right	left
C	down	up	down
D	Up	down	up

17 A plane wave of amplitude A is incident on a surface of area S placed so that it is perpendicular to the direction of travel. The energy per unit time reaching the surface is E. The amplitude of the wave is increase to $2A$ and the area of the surface is reduced to $\frac{1}{2}S$.

How much energy per unit time reaches this smaller surface?

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

18 A taut wire is clamped at two points 1.0 m apart. It is plucked near one end. Which are the three longest wavelengths present on the vibrating wire when stationary waves are created?

    A   1.0 m, 0.50 m and 0.25 m
    B   1.0 m, 0.67 m and 0.50 m
    C   2.0 m, 1.0 m and 0.50 m
    D   2.0 m, 1.0 m and 0.67 m

19 Which observation indicates that sound waves are longitudinal?

    A   Sound wave can be reflected from a solid surface
    B   Sound cannot be polarized
    C   Sound can be diffracted around corners.
    D   Sounds can superpose to create observable interference patterns.

20 What is the equivalent resistance of the circuit shown in the figure below between points **P** and **S**? Each resistor has a similar resistance of 10 Ω.

    A   10 Ω **B**   20 Ω **C**   30 Ω **D**   40 Ω
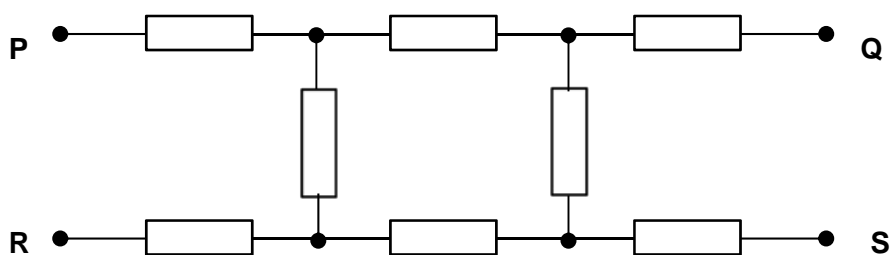
21 Under what circumstances will the resistance of a resistor always be equal to the reciprocal of the gradient of its I-V characteristics graph?

    A   When the graph is a straight line.
    B   When the graph cuts through the origin.
   **C**   When the graph obeys Ohm's Law.
    D   Never.

22 In the following circuit, the voltmeter reading is
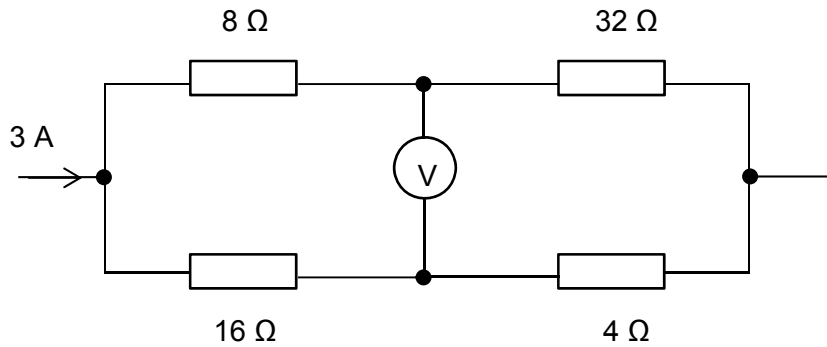
A	0 V	B	8 V	C	12 V	D	24 V

23 A variable resistor is connected across the terminals of a cell which has internal resistance. As the resistance of the variable resistor is gradually increased, what are the effects on the terminal potential difference as well as the power wasted in the internal resistance of the cell?

	Terminal potential difference	Power wasted in the cell
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

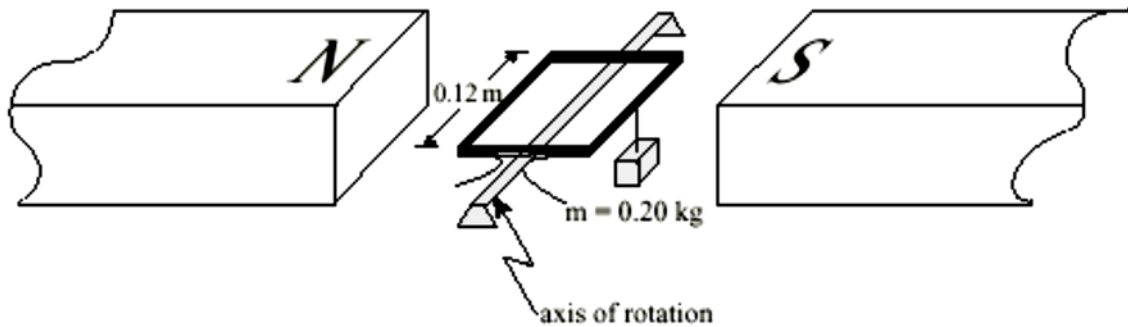**24** The diagram shows an incorrectly connected circuit. The ammeter has a resistance of 0.1 Ω and the voltmeter has a resistance of 1 MΩ.
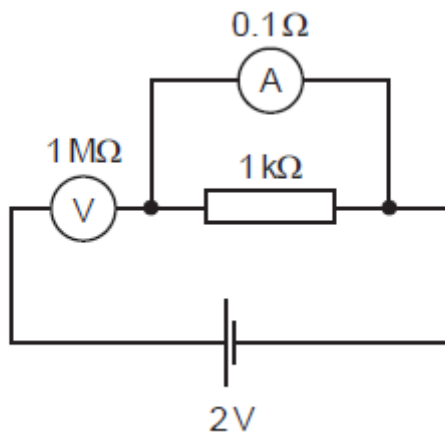

Estimate the reading on the ammeter.

A	2×10^{-6} A	B	2×10^{-3} A	C	2 A	D	20 A

25 A 35 loop square coil 0.12 m on a side is positioned in a 0.050 T magnetic field. A 0.20 kg mass is suspended from one side of the coil as shown in the diagram below.


How much current must pass through the coil in order for the coil to remain horizontal?

A   2.3 A **B**   4.7 A **C**   9.3 A **D**   330 A

26 Two wires carry current as shown below. One wire is slightly above the other. Which region has the strongest magnetic field pointing out of the page?
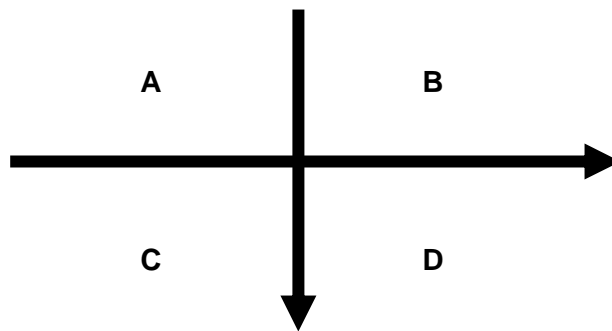
27 Current-carrying wires **A** and **B** are placed perpendicularly to each other with position of **A** above **B** as shown.
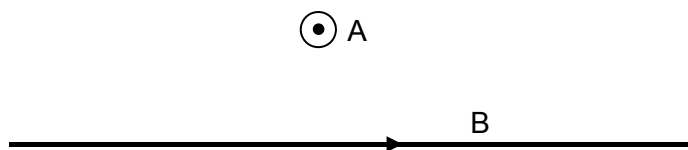
What is the initial effect on the wire **B** due to the magnetic field produced by wire **A**?

A   Move up
B   Move down
C   Rotate
D   None

28   What is the de Broglie wavelength associated with a proton having kinetic energy 2.1×10^{-16} J?

   A 3.2×10^{-18} m
   B 7.9×10^{-13} m
   C 1.3×10^{12} m
   D 3.1×10^{17} m

29   When a parallel beam of white light passes through a metal vapour, dark lines appear in the spectrum of the emergent light. This is primarily because energy is

   A   permanently absorbed by the vapour
   B   re-radiated as electromagnetic radiation in the invisible spectrum
   C   re-radiated uniformly in all directions
   D   re-radiated gradually over a long period of time

30   Light quanta of energy 3.50×10^{-19} J falls onto the cathode of a photocell. The current through the cell is just reduced to zero by applying a stopping potential of 0.25 V.

   What is the work function energy of the cathode?

   A 2.9×10^{-19} J
   B 3.1×10^{-19} J
   C 3.5×10^{-19} J
   D 3.9×10^{-19} J

-- End of Paper --

JC2 Preliminary Exam 2016 (H1 Physics)

Paper 1 Solutions

Qn	1	2	3	4	5	6	7	8	9	10
Ans	B	B	D	C	B	C	A	D	A	B
% correct										

Qn	11	12	13	14	15	16	17	18	19	20
Ans	D	A	A	B	D	C	B	D	B	C
% correct										

Qn	21	22	23	24	25	26	27	28	29	30
Ans	C	D	C	A	B	B	C	B	C	B
% correct										

End of solutions