## Current School:



## SHREWSBURY SCHOOL

## SIXTH FORM ENTRANCE EXAMINATION 202I

## PHYSICS

(Time: I Hour)

## Instructions to candidates:

- Attempt all questions.
- Spend about 40 minutes on section $A$ and 20 minutes on section $B$.
- Assume g= $9.8 \mathrm{~m} / \mathrm{s}^{2}$
- Circle your multiple choice answers on the answer sheet provided on page 3.
- Please answer section B on the exam paper.

| Equation number | Word equation | Symbol equation |
| :---: | :---: | :---: |
| 1 | weight $=$ mass $\times$ gravitational field strength $(\mathrm{g})$ | $W=m g$ |
| 2 | work done $=$ force $\times$ distance (along the line of action of the force) | $W=F s$ |
| 3 | force applied to a spring $=$ spring constant $\times$ extension | $F=k e$ |
| 4 | moment of a force $=$ force $\times$ distance (normal to direction of force) | $M=F d$ |
| 5 | $\text { pressure }=\frac{\text { force normal to a surface }}{\text { area of that surface }}$ | $p=\frac{F}{A}$ |
| 6 | distance travelled $=$ speed $\times$ time | $s=v t$ |
| 7 | $\text { acceleration }=\frac{\text { change in velocty }}{\text { time taken }}$ | $a=\frac{\Delta v}{t}$ |
| 8 | resultant force $=$ mass $\times$ acceleration | $F=m a$ |
| 9 HT | momentum $=$ mass $\times$ velocity | $p=m v$ |
| 10 | kinetic energy $=0.5 \times$ mass $\times(\text { speed })^{2}$ | $E_{k}=\frac{1}{2} m v^{2}$ |
| 11 | gravitational potential energy $=$ mass $\times$ gravitational field strength $(\mathrm{g}) \times$ height | $E_{p}=m g h$ |
| 12 | $\text { power }=\frac{\text { energy transterred }}{\text { time }}$ | $P=\frac{E}{t}$ |
| 13 | $\text { power }=\frac{\text { work done }}{\text { time }}$ | $P=\frac{W}{t}$ |
| 14 | $\text { efficiency }=\frac{\text { useful output energy transfer }}{\text { total input energy transfer }}$ |  |
| 15 | $\text { efficiency }=\frac{\text { useful power output }}{\text { total power input }}$ |  |
| 16 | wave speed $=$ frequency $\times$ wavelength | $v=f \lambda$ |
| 17 | charge flow $=$ current $\times$ time | $Q=I t$ |
| 18 | potential difference $=$ current $\times$ resistance | $V=I R$ |
| 19 | power $=$ potential difference $\times$ current | $P=V I$ |
| 20 | power $=(\text { current })^{2} \times$ resistance | $P=I^{2} R$ |
| 21 | energy transferred $=$ power $\times$ time | $E=P t$ |
| 22 | energy transferred $=$ charge flow $\times$ potential difference | $E=Q V$ |
| 23 | $\text { density }=\frac{\text { mass }}{\text { volume }}$ | $\rho=\frac{m}{V}$ |

## NAME:

Multiple Choice Answer Sheet for Section A
For each question circle just one answer.

| O <br>  |
| :---: |
| $\triangle \ggg \ggg \ggg \ggg \ggg \ggg \ggg \ggg \ggg \ggg$ |
|  |
| $\bigcirc \cap \cap \cap \cap \cap \cap \cap \cap \cap \cap \cap \cap \cap \cap \cap \cap \cap \cap \cap \cap \cap \cap \cap \cap \cap \cap \cap \cap \cap$ |
|  |

## Section A: Multiple-choice Questions.

## Total marks available for section: $\mathbf{3 0}$

The diagram shows an enlarged drawing of the end of a metre rule. It is being used to measure the length of a small feather.


What is the length of the feather?
A 19 mm
B 29 mm
C 19 cm
D 29 cm

Which option contains only apparatus that could be used to determine the volume of a small block of unknown material?

A measuring cylinder, metre rule
B measuring cylinder, stopwatch
C metre rule, balance
D metre rule, stopwatch

Two runners take part in a race.
The graph shows how the speed of each runner changes with time.


What does the graph show about the runners at time $t$ ?
A. Both runners are moving at the same speed.
B. Runner 1 has zero acceleration.

C Runner 1 is overtaking runner 2.
D Runner 2 is slowing down.

A large stone is dropped from a bridge into a river. Air resistance can be ignored.
Which row describes the acceleration and the speed of the stone as it falls?

|  | acceleration <br> of the stone | speed of <br> the stone |
| :---: | :---: | :---: |
| A | constant | constant |
| B | constant | increasing |
| C | increasing | constant |
| D | increasing | increasing |

A car travels 100 km . The journey takes two hours. The highest speed of the car is $80 \mathrm{~km} / \mathrm{h}$, and the lowest speed is $40 \mathrm{~km} / \mathrm{h}$.

What is the average speed for the journey?
A $40 \mathrm{~km} / \mathrm{h}$
B $50 \mathrm{~km} / \mathrm{h}$
C $60 \mathrm{~km} / \mathrm{h}$
D $120 \mathrm{~km} / \mathrm{h}$

The speed-time graph shows the motion of a car.


Which row describes the motion?

|  | between $P$ and $Q$ | between Q and R |
| :---: | :---: | :---: |
| A | accelerating | moving at constant speed |
| B | accelerating | not moving |
| C | moving at constant speed | decelerating |
| D | moving at constant speed | not moving |

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The diagram shows a balance being used to find the weight of a baby. The weight of the basket can be ignored.

At equilibrium, the pivot is nearer to the 40 N balancing weight than to the baby.


What is the weight of the baby?
A less than 40 N
B 40 N
C more than 40 N
D impossible to tell without a scale on the beam

A ball is dropped on to a hard surface and bounces. It does not bounce all the way back to where it started, and so has not regained all of its original gravitational potential energy.


Which statement accounts for the loss of gravitational potential energy?
A Energy was destroyed as the ball hit the ground.
B Energy was destroyed as the ball travelled through the air.
C The chemical energy and elastic energy of the ball have increased.
D The internal (heat) energy of the ball and its surroundings has increased.
Which energy resource is used to boil water to generate electricity?
A hydroelectric
B nuclear fission
C tides
D waves

An engineer wants to fix a steel washer on to a steel rod. The rod is just too big to fit into the of the washer.


How can the engineer fit the washer on to the rod?
A Cool the washer and then place it over the rod.
B Cool the washer and rod to the same temperature and then push them together.
C Heat the rod and then place it in the hole in the washer.
D Heat the washer and then place it over the rod.

Which list contains only transverse waves?
A infra-red waves, light waves, sound waves
B infra-red waves, light waves, ultraviolet waves
C infra-red waves, sound waves, ultraviolet waves
D light waves, sound waves, ultraviolet waves

The diagram shows a wave.
Which labelled distance is the wavelength?


Which is an example of a force?
A energy
B power
C pressure
D weight

A skier walks from the bottom of a ski slope to the top and gains 10000 J of gravitational potential energy.

She skis down the slope. At the bottom of the slope, her kinetic energy is 2000 J .


How much energy is dissipated in overcoming friction and air resistance as the skier moves down the slope?
A 2000 J
B 8000 J
C 10000 J
D 12000 J

Four different children run up the same set of stairs.
For which child is the useful power to climb the stairs the greatest?

|  | mass of child $/ \mathrm{kg}$ | time taken/s |
| :---: | :---: | :---: |
| A | 40 | 15 |
| B | 50 | 25 |
| C | 60 | 25 |
| D | 70 | 15 |

The circuit shown includes two meters X and Y , connected correctly.


Which row gives the unit of the quantity measured by $X$ and the unit of the quantity measured by Y ?

|  | meter X | meter Y |
| :---: | :---: | :---: |
| A | ampere | ampere |
| B | ampere | volt |
| C | volt | ampere |
| D | volt | volt |

The circuit shown contains three ammeters $\mathrm{X}, \mathrm{Y}$ and Z .


Which ammeter has the largest reading?
A X
B Y
C Z
D They all have the same reading.
A reading is taken every 10 minutes of the number of emissions per second from a radioactive source. The table shows the readings.

| time/min | number of <br> emissions <br> per second |
| :---: | :---: |
| 0 | 800 |
| 10 | 560 |
| 20 | 400 |
| 30 | 280 |
| 40 | 200 |
| 50 | 140 |
| 60 | 100 |

What is the half-life of the source?
A 10 min
B 20 min
C 40 min
D 60 min

Which statement about $\alpha$-radiation is correct?
A It is a stream of fast-moving electrons.
B It is a form of electromagnetic radiation.
C It is more highly ionising than $\gamma$-radiation.
D It is more penetrating than $\beta$-radiation.

A nuclide has the symbol ${ }_{10}^{22} \mathrm{Ne}$.

What is the proton number of a nucleus of this nuclide?
A 10
B 12
C 22
D 32

A woman of weight 600 N sits 1.5 m away from the pivot point of a see-saw. Her son weighs 400 N . How far from the pivot must he sit on the other side to balance the see-saw?

A $\quad 0.75 \mathrm{~m}$

B $\quad 2.25 \mathrm{~m}$

C $\quad 1.75 \mathrm{~m}$

D $\quad 2.50 \mathrm{~m}$

Molecules sometimes escape from the surface of a liquid and become gas molecules. What is this process called?

A Condensation

B Convection

C Evaporation

D Diffusion

What is the output power of a machine which can do 30 kJ of work in one minute?

A $\quad 0.5 \mathrm{~W}$

B $\quad 500 \mathrm{~W}$

C 1800 W

D $\quad 30$ kW

A cyclist and his bike have a mass of 100 kg . He is cycling at a speed of $20 \mathrm{~m} / \mathrm{s}$. What is his kinetic energy?

A 1000 J

B 2000 J

C $\quad 10000 \mathrm{~J}$

D 20000 J

The diagram shows four objects standing on a flat surface.
The centre of mass of each object is marked M .
Which object will fall over?


Which of the following statements about forces and motion is true?
A If there are no forces acting on an object it must be at rest.
B If an object is moving forwards there must be an unbalanced forward force.
C If the forces on an object are balanced it must be at rest.
D If an object moves at constant velocity the forces acting on it must balance.
A lamp is connected in four circuits in turn, each using identical batteries.
The resistors are all identical.
In which circuit will the lamp be brightest?


C


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A fuse is a safety device for use in an electrical appliance.
How does a fuse affect a circuit when the current in it becomes higher than the correct value for the appliance?

A It completely stops the current.
B It reduces the current to the correct value for the appliance.
C It sends the current to the outer case of the appliance.
D It sends the excess current to the earth wire.
29
The diagram shows radiation from a lamp passing through a prism.


Which type of radiation is found at $P$ ?
A $\gamma$-rays
B infra-red
C ultraviolet
D X-rays
30 This information was attached to an electric washing machine :

|  |  |
| :--- | :--- | :---: |
| The correct size of fuse which should be fitted is | 230 V |
| A | 3 A |
| B | 5 A |
| C | 10 A |
| D | 13 A |

## Section B: Structured Questions.

## Total marks available for section = $\mathbf{2 0}$ marks

Q1.
The diagram shows an electrical circuit.

(a) The 6 V battery shown in the diagram is made up of a number of identical 1.5 V cells.

Calculate the minimum number of cells needed to make the battery.
$\qquad$
$\qquad$

Number of cells $=$ $\qquad$
(b) The switch in the diagram is shown in the open position. Closing the switch completes the circuit.

Charge flows through the completed circuit and a reading is shown on both the ammeter and the voltmeter.
(i) In 10 seconds, 20 coulombs of charge flows through the circuit.

Calculate the current reading shown on the ammeter.
$\qquad$ A
(ii) For 20 coulombs of charge to flow through the resistor R, 100 joules of work must be done.

Calculate the potential difference reading given by the voltmeter.


Q2.
A student investigated the insulating properties of newspaper.
Figure 1 shows the apparatus the student used.
Figure 1


The student's results are shown in Figure 2.
Figure 2

(a) Describe a method the student could have used to obtain the results shown in Figure 2.
$\qquad$
$\qquad$
$\qquad$
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$\qquad$
(b) The student could have used a datalogger with a temperature probe instead of the digital thermometer.

Figure 3 shows the readings on the digital thermometer and the datalogger.

Figure 3


The datalogger records 10 readings every second.
The student considered using a temperature probe and datalogger.
Explain why it was not necessary to use a temperature probe and datalogger for this investigation.
$\qquad$
$\qquad$
$\qquad$
$\qquad$
$\qquad$
$\qquad$

## Q3.

Figure 1 shows a person sliding down a zip wire.
Figure 1

(a) As the person slides down the zip wire, the change in the gravitational potential energy of the person is 1.47 kJ

The mass of the person is 60 kg
gravitational field strength $=9.8 \mathrm{~N} / \mathrm{kg}$

Calculate the change in vertical height of the person.
$\qquad$
$\qquad$
$\qquad$
$\qquad$
$\qquad$
Change in vertical height $=$ $\qquad$ m
(b) As the person moves down the zip wire her increase in kinetic energy is less than her decrease in gravitational potential energy.

Explain why.
$\qquad$
$\qquad$
$\qquad$
$\qquad$
$\qquad$
(c) Different people have different speeds at the end of the zip wire.

Explain why.
$\qquad$
$\qquad$
$\qquad$
$\qquad$
$\qquad$
$\qquad$
$\qquad$

End of Questions

