Cambridge Assessment
Admissions Testing

NAZARBAYEV
UNIVERSITY

Foundation Year Programme

Entrance Tests

PHYSICS

SPECIMEN PAPER

For

NUFYP SET 2019

V1.0 October 2018

Cambridge Assessment Admissions Testing

SPECIMEN for NUFYP SET 2019

Physics

SPECIMEN **60 minutes**

Additional materials: Answer Sheet

Instructions to Candidates

Read this page carefully, but do not open the question paper until you are told that you may do so.

A separate answer sheet is provided for this paper. Please check you have one.

You require a soft pencil and an eraser.

Check that the title of the paper you are taking matches the title on the answer sheet.

Complete the top section of the answer sheet in soft pencil with your personal details.

There are 30 questions in this paper. Each question is worth one mark. There are no penalties for incorrect responses, only marks for correct answers, so you should attempt all 30 questions.

Answer in soft pencil on the answer sheet provided. Questions ask you to show your choice between options. Choose the **one** option you consider correct and record your choice on the separate answer sheet. If you make a mistake, erase thoroughly and try again.

You can use the question paper for rough working, but no extra paper is allowed.

Only your responses on the answer sheet will be marked.

Speed as well as accuracy is important in this paper. Work quickly, or you might not finish the paper.

Dictionaries and calculators may NOT be used.

Please wait to be told you may begin before turning this page.

This question paper consists of 27 printed pages and 5 blank pages.

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1 A horse of weight 6000 N gallops at a speed of 16 m / s.

What, in kJ, is the kinetic energy of the horse?

(Take the gravitational field strength g to be 10 N / kg.)

A 4.8 kJ

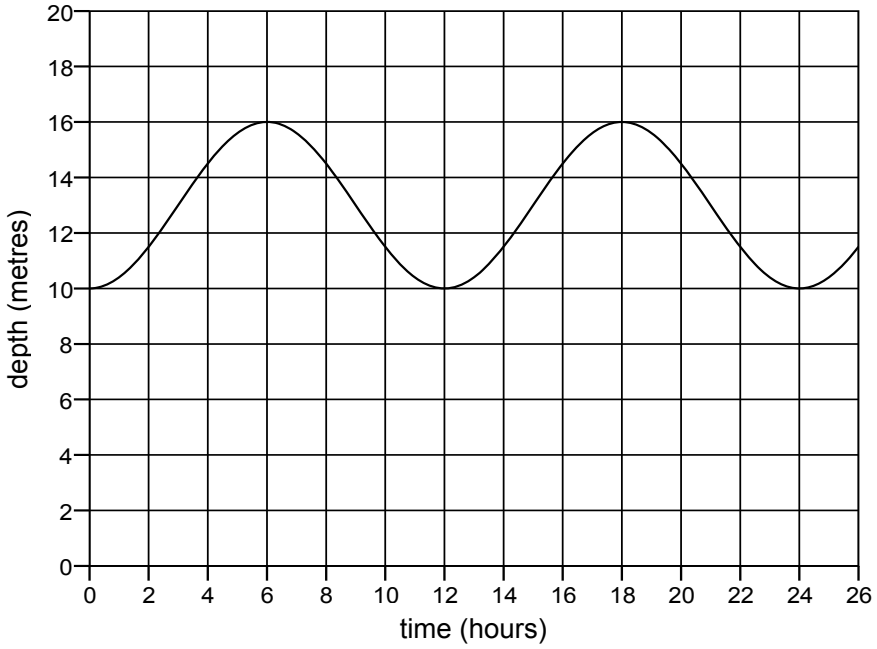
B 9.6 kJ

C 76.8 kJ

D 4800 kJ

E 960 kJ

2 The depth of water in a particular tidal harbour varies with time as shown in the graph:



If the variation in depth caused by the effect of the tide is considered as a wave, what are the amplitude and frequency of this wave?

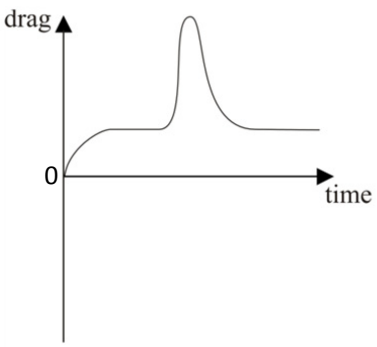
	amplitude / metres	*frequency* / hertz
A	3	$1/(12 \times 3600)$
B	3	3600/12
C	6	$1/(24 \times 3600)$
D	6	3600/24
E	8	$1/(12 \times 3600)$
F	8	3600/12
G	16	$1/(24 \times 3600)$
H	16	3600/24

3 A parachutist falls from an aircraft and reaches a terminal velocity.

After a while they open their parachute and reach a new (lower) terminal velocity.

Which graph shows how the total air resistance (drag) force acting on the parachutist and the parachute varies with time during the fall?

A



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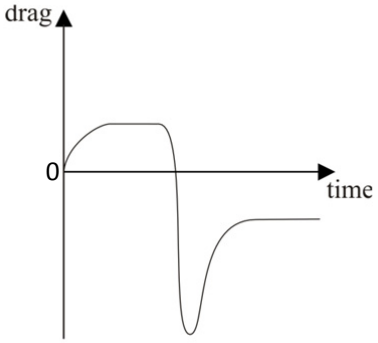

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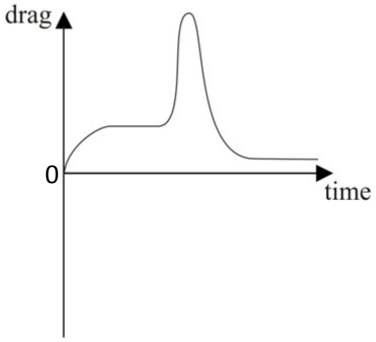

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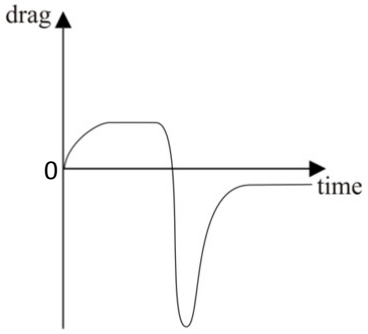

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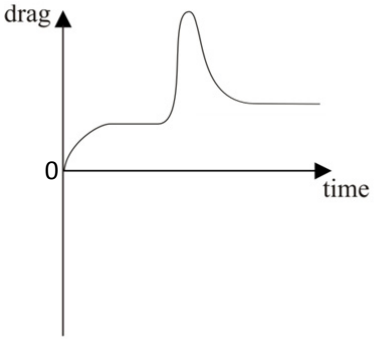


4 A parachutist of total mass 90 kg (including the parachute) is falling at a terminal velocity of 6.0 m / s. Take the force due to gravity on a mass of 1.0 kg to be 10 N.

What is the magnitude of the air resistance force acting on the parachutist?

A 0 N

B 150 N

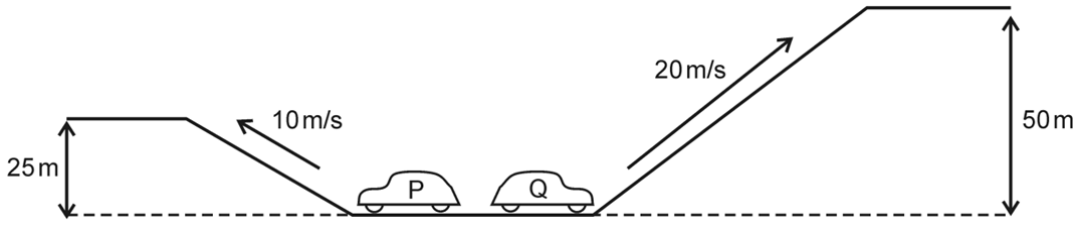
C 540 N

D 900 N

E 5400 N

5 Two identical cars, P and Q, start at the same level. Car P moves at a constant speed of 10 m / s up a hill to a height of 25 m in a time of 20 s.

In the same time car Q moves at a constant speed of 20 m / s up a hill to a height of 50 m.



Which of the following statements are correct for the kinetic energies of the cars while they are travelling up the hills, and for their gravitational potential energies once they are at the top?

	kinetic energy	*gravitational potential energy*
A	car Q has twice as much as car P	car Q has twice as much as car P
B	car Q has twice as much as car P	car Q has four times as much as car P
C	car Q has four times as much as car P	car Q has twice as much as car P
D	car Q has four times as much as car P	car Q has four times as much as car P

6 Students investigate a radioactive source. They place a detector close to a radioactive source and take 5 readings over 5 minutes. They then place a thin sheet of paper between the detector and the source, and again observe the counts over 5 minutes. Lastly, they replace the paper sheet with a piece of aluminium many millimetres thick and observe the counts over 5 minutes. Their results are shown below:

	nothing	*paper*	*aluminium*
reading 1	100	101	30
reading 2	98	102	31
reading 3	99	96	28
reading 4	103	101	33
reading 5	101	103	27

What type(s) of radiation is/are being given off by the source?

(All readings have been corrected for background radiation.)

A alpha only

B beta only

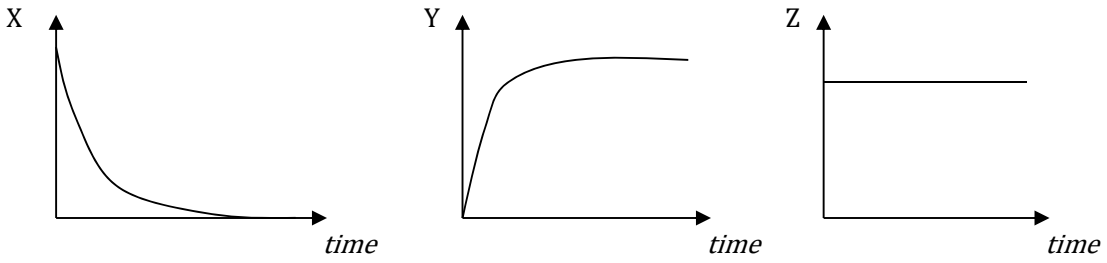
C gamma only

D alpha and beta

E alpha and gamma

F beta and gamma

7 A car is accelerated from rest along a horizontal road by a constant thrust force produced by the engine. The car eventually reaches a terminal velocity, and the graphs below show the variation with time of three quantities (X, Y and Z) for the car:



Which line in the table could correctly identify the quantities X, Y and Z?

	X	Y	Z
A	acceleration	air resistance (drag force)	kinetic energy
B	acceleration	mass of car	weight of car
C	(gravitational) potential energy	velocity	kinetic energy
D	(gravitational) potential energy	air resistance (drag force)	weight of car
E	resultant force	mass of car	kinetic energy
F	resultant force	velocity	weight of car

8 An object of mass 5.0 kg falls from rest and hits the ground at a speed of 20 m / s. Air resistance is negligible.

From what height has the object fallen?

(Take the gravitational field strength g to be 10 N / kg.)

A 10 m

B 20 m

C 50 m

D 100 m

E 200 m

F 1000 m

9 Two radioactive sources, X and Y, have half-lives of 4.8 hours and 8.0 hours respectively. Both decay directly to form only stable isotopes.

The activity of a sample of the source X is measured by a detector as 320 counts per minute, and simultaneously the radioactivity of a sample of the source Y is measured as 480 counts per minute. Immediately after the measurements, the two samples are combined.

What is the count rate when the activity of the combination of X and Y is measured 24 hours later?

(Assume that all readings in this question have been corrected for background radiation.)

A 25 counts per minute

B 50 counts per minute

C 55 counts per minute

D 70 counts per minute

E 100 counts per minute

F 140 counts per minute

10 In a laboratory experiment, protactinium-234 undergoes radioactive decay by beta emission into uranium-234.

The table below describes how the mass of uranium-234 present in the sample varies with time from the start of the experiment:

time / min	*mass of* U-234 / mg
0.0	0.0
1.2	8.0
2.4	12.0
3.6	14.0
4.8	15.0
6.0	15.5
7.2	15.7
8.4	15.9
9.6	15.9
10.8	16.0
12.0	16.0

Using the information in the table, approximately what is the half-life of protactinium-234?

A 1.2 minutes

B 2.4 minutes

C 6.0 minutes

D 9.6 minutes

E 10.8 minutes

F 12.0 minutes

11 A cooling unit in a refrigerator establishes a convection current in the air inside the refrigerator. This ensures that the air throughout the refrigerator is cooled.

Which statement explains this?

A As the air at the bottom of the refrigerator is cooled, it contracts, its density decreases, and the cool air rises.

B As the air at the bottom of the refrigerator is cooled, it expands, its density decreases, and the cool air rises.

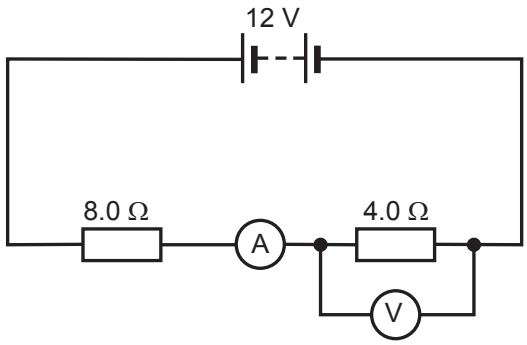
C As the air at the bottom of the refrigerator is cooled, it expands, its density increases, and the cool air rises.

D As the air at the top of the refrigerator is cooled, it contracts, its density decreases, and the cool air sinks.

E As the air at the top of the refrigerator is cooled, it contracts, its density increases, and the cool air sinks.

F As the air at the top of the refrigerator is cooled, it expands, its density increases, and the cool air sinks.

12 The circuit shown contains a battery, two resistors, an ammeter and a voltmeter.



What are the readings on the ammeter and on the voltmeter, and how much charge passes through the 4.0 Ω resistor in 20 s?

	reading on ammeter / A	*reading on voltmeter* / V	*charge passing* / C
A	1.0	4.0	20
B	1.0	4.0	80
C	1.0	12	20
D	1.0	12	240
E	3.0	4.0	60
F	3.0	4.0	80
G	3.0	12	60
H	3.0	12	240

13 A particular radioisotope X with a half-life of 4.0 years decays into the stable isotope Y.

At a particular time, a sample contains 32×10^{20} atoms of nuclide X and 4×10^{20} atoms of nuclide Y.

How many atoms of nuclide Y will be present in the sample 8.0 years later?

A 1×10^{20}

B 4×10^{20}

C 8×10^{20}

D 12×10^{20}

E 24×10^{20}

F 28×10^{20}

14 The diagrams show, not to scale, three different situations in which a force F acts. Also shown in each case is a distance d.

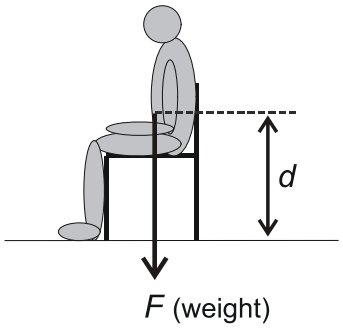


Diagram 1:
Person sitting on a chair

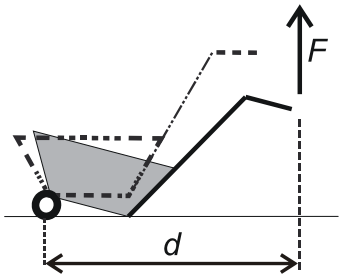


Diagram 2:
Wheelbarrow being lifted

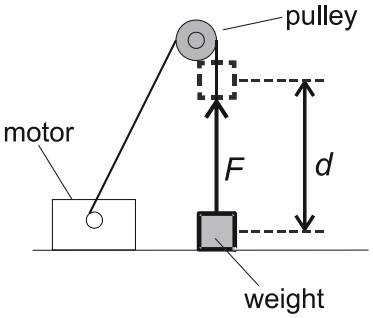


Diagram 3:
Weight being lifted by a motor

Which line in the table shows whether or not work is being done by force F in each situation and, if it is, whether work is equal to $F \times d$?

	work being done by force F?	*work done equal to* $F \times d$?
A	only in diagrams 1 and 2	only in diagram 1
B	only in diagrams 1 and 2	only in diagram 2
C	only in diagrams 2 and 3	only in diagram 2
D	only in diagrams 2 and 3	only in diagram 3
E	in diagrams 1, 2 and 3	only in diagrams 1 and 2
F	in diagrams 1, 2 and 3	only in diagrams 2 and 3
G	only in diagrams 1 and 3	only in diagram 1
H	only in diagrams 1 and 3	only in diagram 3

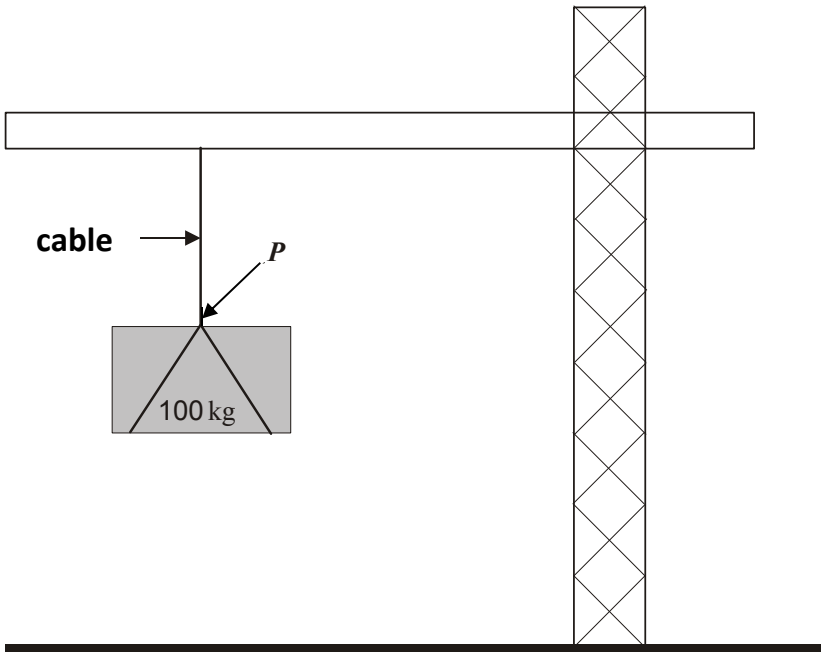
15 When radioactive isotopes decay, they sometimes have to go through a succession of disintegrations to reach a stable isotope. These are called decay chains, and involve the successive emission of numerous alpha and/or beta particles.

One such isotope is radon-219 ($^{219}_{86}$Rn), which goes through a chain in which three alpha particles and two beta particles are emitted before reaching a stable isotope.

What are the atomic and mass numbers of the resulting stable isotope?

	atomic number	*mass number*
A	80	207
B	80	211
C	82	207
D	82	215
E	85	211
F	85	219
G	86	215
H	86	219

16 The diagram shows a crane that lifts a load with a mass of 100 kg at a constant speed of 0.40 m / s for 5.0 seconds.



Which of the following statements about this activity is/are correct:

1 The gain in gravitational potential energy of the load is 2000 J.

2 The tension in the cable at point *P* is 2000 N.

3 The load accelerates at 10 m / s^2.

(Take the gravitational field strength *g* to be 10 N / kg.)

A 1 only

B 2 only

C 3 only

D 1 and 2 only

E 1 and 3 only

F 2 and 3 only

17 A ball is thrown vertically upwards and leaves the thrower's hand with a speed of 12 m / s. You may assume that all of the initial kinetic energy of the ball has been converted into gravitational potential energy when the ball reaches its highest point. Take the value of g to be 10 N / kg.

What is the height to which it rises?

A 7.2 m

B 14.4 m

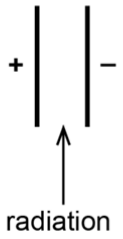
C 24 m

D 60 m

E 120 m

18 A narrow beam of radiation containing alpha particles, beta particles and gamma rays emitted by a radioactive source passes between two electrically charged plates.

The radiation initially travels in the direction shown in the diagram:



What happens to the alpha particles, the beta particles and the gamma rays as they pass between the plates?

	deflected to the left	*not deflected*	*deflected to the right*
A	alpha particles	beta particles	gamma rays
B	alpha particles	gamma rays	beta particles
C	beta particles	alpha particles	gamma rays
D	beta particles	gamma rays	alpha particles
E	gamma rays	alpha particles	beta particles
F	gamma rays	beta particles	alpha particles

19 In an experiment concerning radioactive decay, the count rate of radiation 5.0 cm from a source was measured as 140 counts per minute. 12 minutes later, with the detector and source in the same position, the count rate was measured as 35 counts per minute.

Background radiation was recorded as 20 counts per minute.

What, in minutes, is the half-life of the source?

A 3 minutes

B 4 minutes

C 6 minutes

D 12 minutes

E 24 minutes

F 36 minutes

G 48 minutes

20 Nuclide ${}^{N}_{R}X$ is an unstable isotope which decays in two stages into nuclide Z as shown:

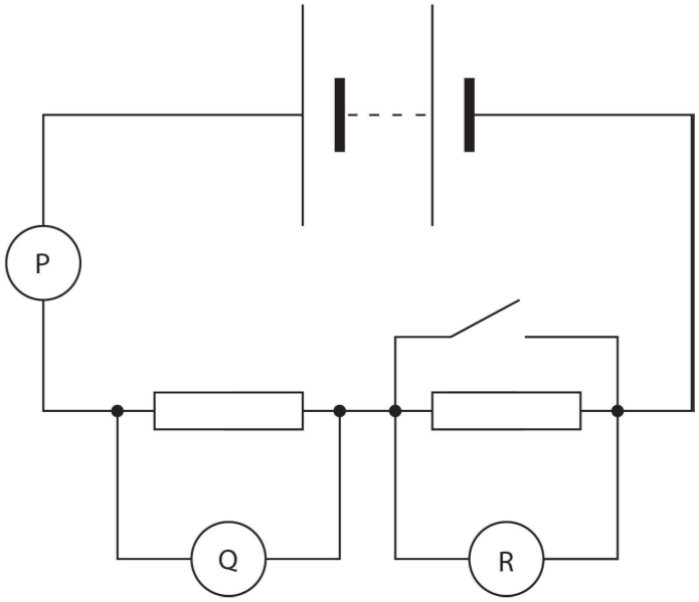
${}^{N}_{R}X \rightarrow {}^{P}_{R-2}Y \rightarrow {}^{P}_{Q}Z$

What are the values of P and Q?

	P	Q
A	$N - 4$	$R + 1$
B	$N - 4$	$R - 1$
C	$N - 4$	$R - 2$
D	N	$R - 1$
E	N	$R - 2$
F	N	$R - 4$

21 The diagram shows three appropriate meters, P, Q and R, connected in a circuit.

The switch is initially open.



The switch is now closed. What happens to the readings on each meter?

A P decreases, Q decreases, R decreases

B P decreases, Q decreases, R increases

C P decreases, Q increases, R decreases

D P decreases, Q increases, R increases

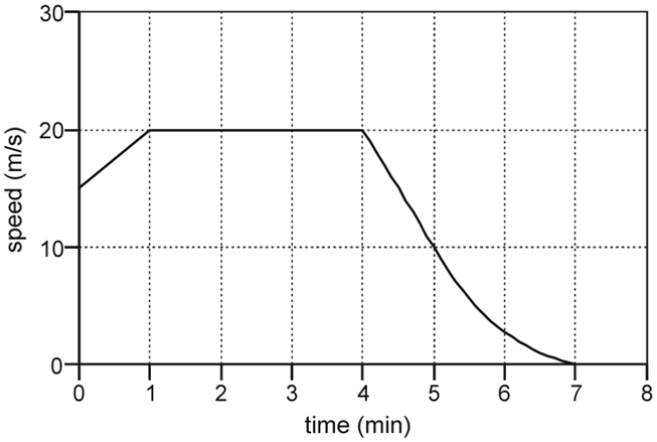
E P increases, Q decreases, R decreases

F P increases, Q increases, R increases

G P increases, Q decreases, R increases

H P increases, Q increases, R decreases

22 The graph represents the motion of a vehicle during part of a journey.



What is the best estimate of the distance travelled during the part of the journey shown?

A 100.00 m

B 107.50 m

C 115.00 m

D 6.00 km

E 6.45 km

F 6.90 km

23 Consider the following three combinations of units:

1 volt / ohm

2 ohm / watt

3 watt / volt

Which of these combinations can be used as the unit of electric current?

A none of them

B 1 only

C 2 only

D 3 only

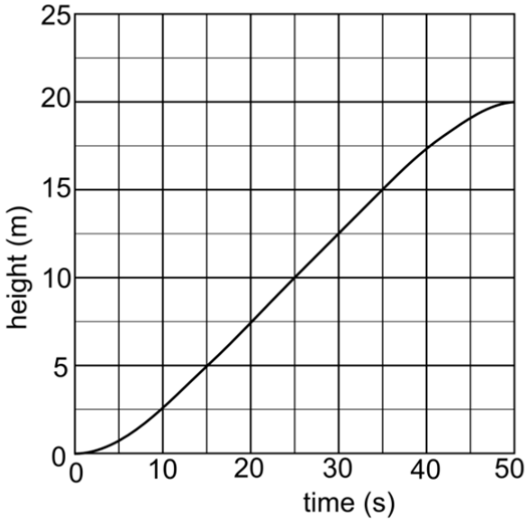
E 1 and 2 only

F 1 and 3 only

G 2 and 3 only

H 1, 2 and 3

24 The graph shows the variation with time of the height through which a crane lifts a mass of 20 kg.



Assume the gravitational field strength g is 10 N / kg, and that the effects of air resistance and friction are negligible.

What is the power output of the crane when the mass is at a height of 10 m?

A 0.1 W

B 10 W

C 40 W

D 100 W

E 400 W

F 4000 W

25 A small metal ball is released from rest just below the surface of a tall column of oil. The ball falls vertically, experiencing a resistive force from the oil. The ball accelerates until it reaches terminal velocity, and stops when it reaches the bottom of the tube containing the oil.

Which of the following statements is a correct application of Newton's third law of motion to this situation?

A As the ball accelerates, its weight is greater than the resistive force.

B The resistive force is always equal and opposite to the weight of the ball.

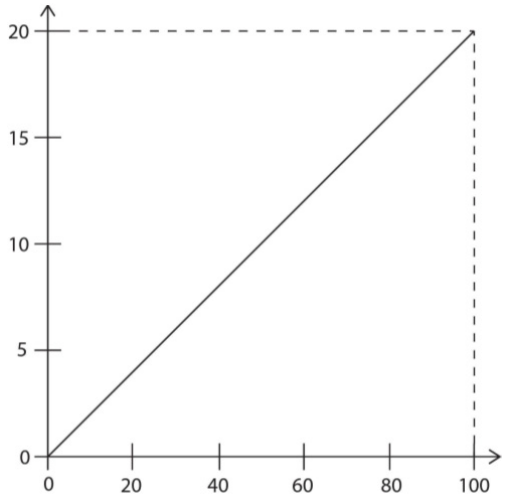
C The weight and resistive force are only equal and opposite when the ball reaches terminal velocity.

D The resistive force is always equal and opposite to the force exerted on the oil by the ball.

E When the ball stops, its weight and the contact force from the bottom of the tube are equal and opposite.

F The resultant force on the ball falls to zero as it reaches terminal velocity.

26 Consider this graph.



Which one of the following could the graph **not** represent if all quantities are in S.I. units?

A The variation of the acceleration (y-axis) of a body of mass 5.0 kg with the resultant force acting on the body (x-axis).

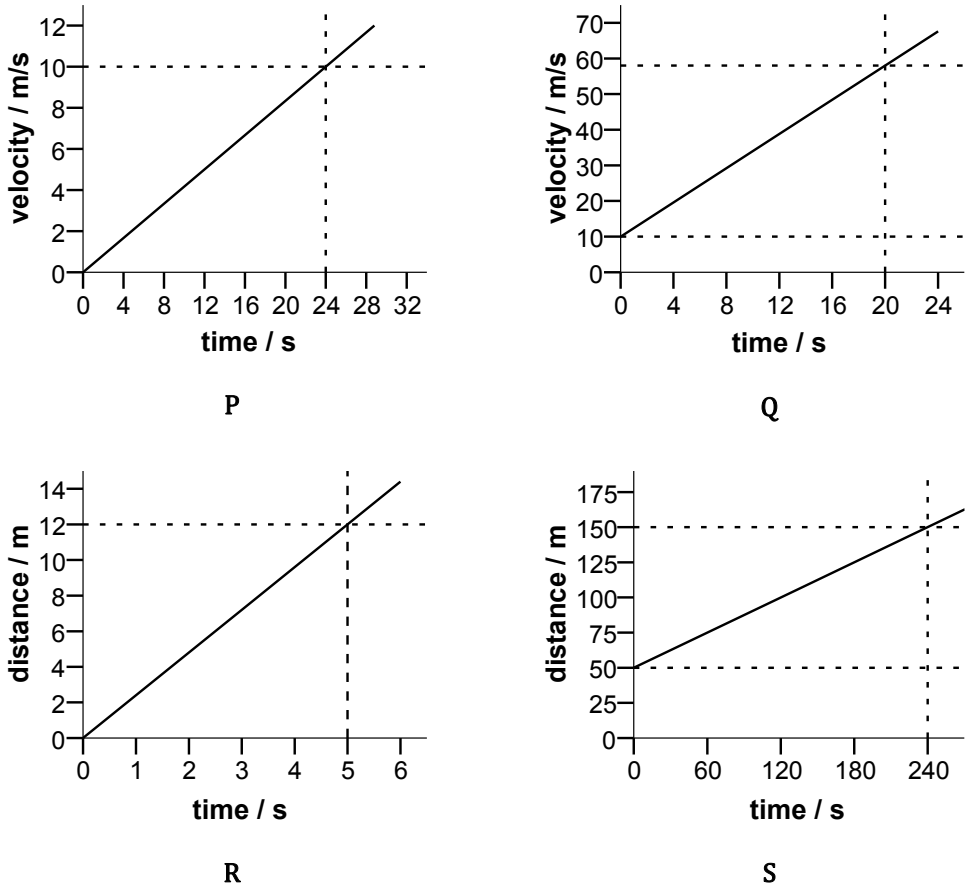
B The variation of the current (y-axis) through a 5.0 Ω resistor with the applied voltage (x-axis).

C The variation of the kinetic energy (y-axis) of a body of mass 0.4 kg with the square of its speed (x-axis).

D The variation of the wavelength (y-axis) of waves with a speed of 0.2 m / s with their frequency (x-axis).

E The variation of the work done (y-axis) by a force of 0.2 N with the distance it moves through (x-axis).

27 The diagrams below show **either** velocity-time **or** distance-time graphs for four different objects, P, Q, R and S.



Which graph(s) show an object accelerating at 2.4 m / s^2?

A P only

B Q only

C R only

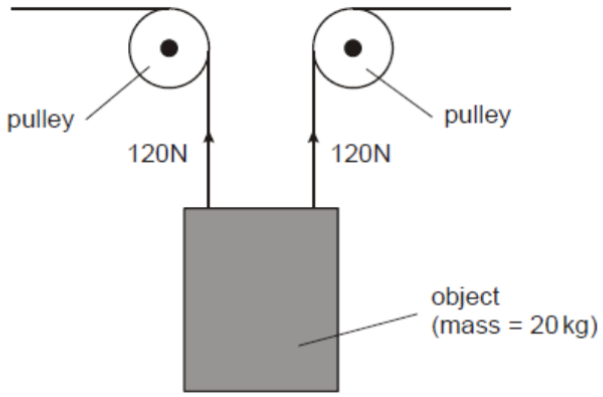
D S only

E P and Q only

F Q and R only

G P and S only

28 An object with a mass of 20 kg is lifted by the arrangement shown in the diagram. Air resistance (drag) can be ignored, and the gravitational field strength (acceleration due to gravity) can be taken as 10 N / kg.



What is the acceleration of the object?

A zero m/s^2

B 2 m/s^2 downwards

C 2 m/s^2 upwards

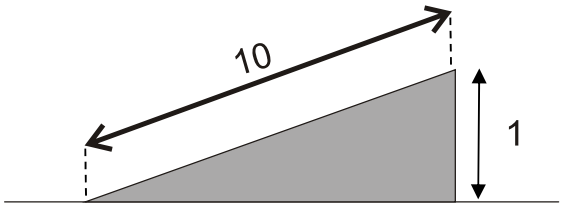
D 4 m/s^2 downwards

E 4 m/s^2 upwards

F 10 m/s^2 downwards

G 10 m/s^2 upwards

29 A cyclist and a bike have a combined mass of 100 kg. The cyclist freewheels (rolls without pedalling) at a constant speed of 0.80 m / s down a 1 in 10 slope. This means that the cyclist descends 1.0 m for each 10 m travelled along the road, as shown in the diagram.

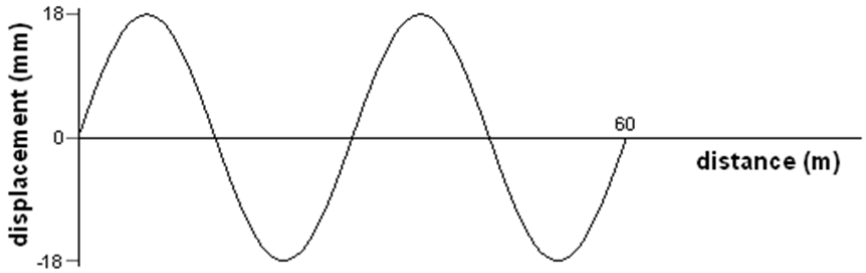


Calculate the loss in gravitational potential energy as the cyclist loses 100 m in vertical height, and hence calculate the total resistive force on the cyclist.

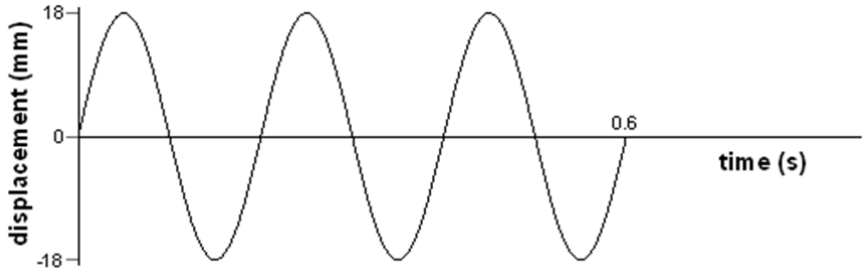
(Take the gravitational field strength g to be 10 N / kg.)

	loss in gravitational potential energy / J	*resistive force* / N
A	3200	3.2
B	3200	$\frac{32}{\sqrt{99}}$
C	3200	$\frac{32}{\sqrt{100}}$
D	100 000	100
E	100 000	$\frac{1000}{\sqrt{99}}$
F	100 000	$\frac{1000}{\sqrt{101}}$

30 The first graph shows the variation of the displacement of particles with distance along a wave at a particular instant in time:



The second graph shows the variation with time of the displacement of a particular particle in this wave:



What is the speed of this wave?

A 30 m / s

B 50 m / s

C 90 m / s

D 100 m / s

E 150 m / s

F 300 m / s

END OF TEST

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