T2-1 *[201 marks]*

1. *[1 mark]*

Markscheme

A

Examiners report

[N/A]

2. *[1 mark]*

Markscheme

C

Examiners report

[N/A]

3. *[1 mark]*

Markscheme

C

Examiners report

[N/A]

4. *[1 mark]*

Markscheme

A

Examiners report

[N/A]

5. *[1 mark]*

Markscheme

C

Examiners report

[N/A]

6.

[1 mark]

Markscheme

A

Examiners report

[N/A]

7.

[1 mark]

Markscheme

C

Examiners report

[N/A]

8.

[1 mark]

Markscheme

C

Examiners report

[N/A]

9.

[1 mark]

Markscheme

B

Examiners report

[N/A]

10.

[1 mark]

Markscheme

A

Examiners report

[N/A]

11.

[1 mark]

Markscheme

A

Examiners report

[N/A]

12.

[1 mark]

Markscheme

B

Examiners report

[N/A]

13.

[1 mark]

Markscheme

C

Examiners report

[N/A]

14.

[1 mark]

Markscheme

B

Examiners report

[N/A]

15a.

[1 mark]

Markscheme

upwards (or away from the Moon) is taken as positive / downwards (or towards the Moon) is taken as negative / towards the Earth is positive;

Examiners report

[N/A]

15b.

[6 marks]

Examiners report

[N/A]

15c. *[4 marks]*

Markscheme

values for masses, distance and correct G substituted into Newton’s law;

see subtraction (*ie* *r* value = $3.84 \times 10^{8} - 1.74 \times 10^{6} = 3.82 \times 10^{8}$ m);

F=5.4 to 5.5 × 10^{-4} N / a=2.7 × 10^{-3} m s^{-2};

comment that it’s insignificant compared with (0.2 × 1.63 =) 0.32 to 0.33 N / 1.63 m s^{-2};

Examiners report

[N/A]

15d. *[1 mark]*

Markscheme

7.7 m s^{-1};

Examiners report

[N/A]

15e.

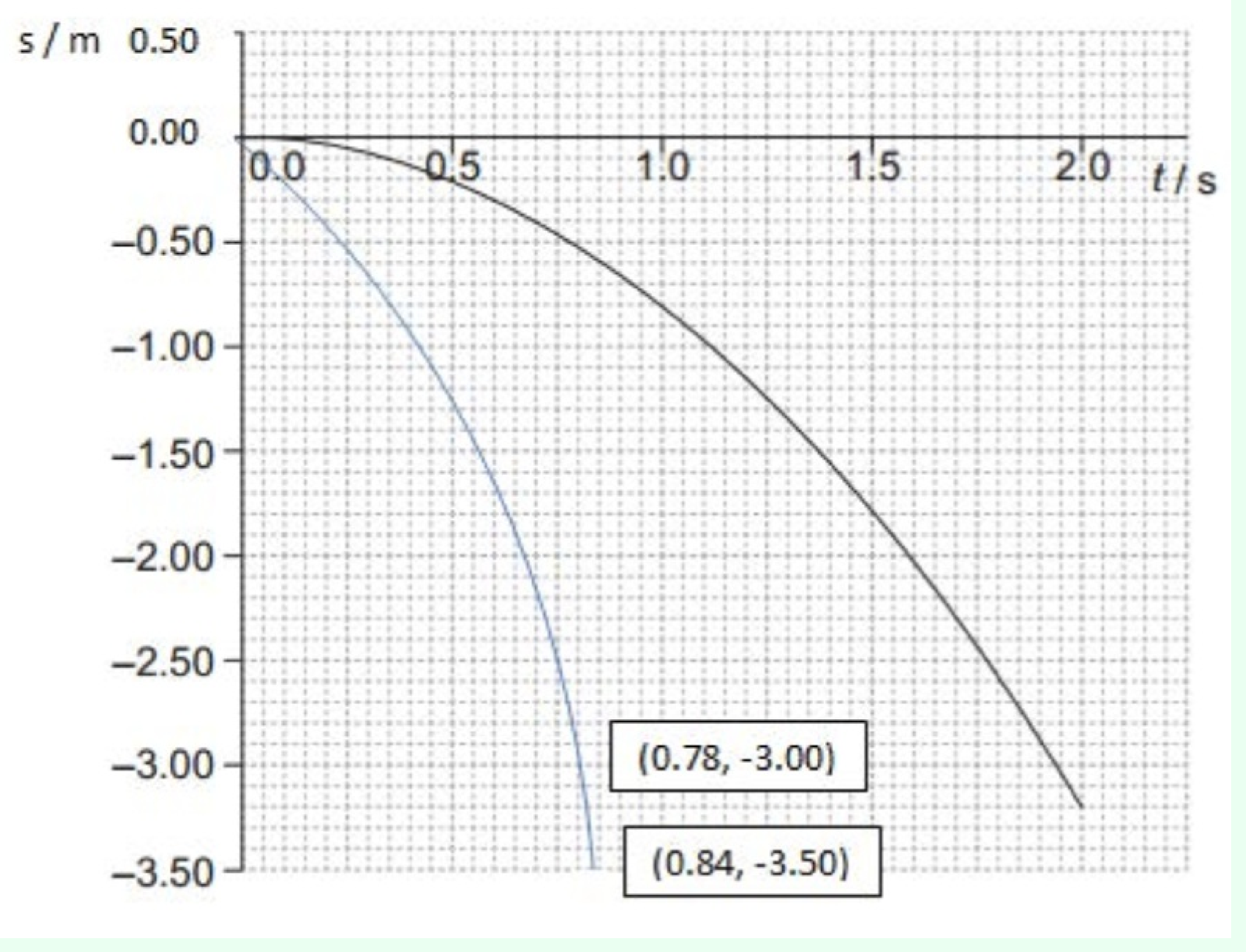
[3 marks]

Markscheme

curve permanently below Moon curve;

smooth parabola; *(judge by eye)*

line passing through s = −3.00 m, t = 0.78 s ***or*** s = −3.50 m, t = 0.84 s (±1mm);



Examiners report

[N/A]

15f.

[3 marks]

Markscheme

six half-lives occurred;

$\left(\left(\frac{1}{2}\right)^6 =\right) 1.6\%$ remaining;

98.4 / 98% decayed;

Examiners report

[N/A]

15g.

[4 marks]

Markscheme

(i)(electron) anti-neutrino /
$\bar{v}$;

(ii) 46.95455 u − (46.95241 u + 0.00055 u) = 0.00159 u;

1.48 MeV;

(iii) does not account for energy of (anti) neutrino/gamma ray photons;

Examiners report

[N/A]

16a.

[3 marks]

Markscheme

(i) (weight) = 85 × 9.81(=834N); *(if 850 (N) seen, award this mark)*
component =(834×sin19=)271 (N);
Allow use of g=10ms^{-2}. Answer is 277 (N).

(ii) component=(834×cos19=) 788 (N);
Allow use of g=10ms^{-2}. Answer is 804 (N).
Allow a bald correct answer.
Do not award ECF if cos used in (a)(i) and sin used in (a)(ii).

Examiners report

[N/A]

16b.

[4 marks]

Markscheme

total decelerating force =271+250(=521N);
acceleration $= (-)\,\frac{521}{85}\left(= -6.13\text{ms}^{-2}\right)$;
$s = \frac{v^2 - u^2}{2a}$;
2.47 (m);} *(signs must be consistent for this mark, ie: if acceleration assumed positive, look for negative distance)*
Allow use of g=10. Answers are 527 N, 6.2ms^{-2}, 2.44 m.

or

total decelerating force =271+250(=521N) ;
initial kinetic energy $= \frac{1}{2}mv^2 = 1290\text{J}$
$\text{distance} = \frac{\text{energylost}}{\text{force}} = \frac{1290}{521}$
2.47 (m);

Examiners report

[N/A]

17a.

[2 marks]

Markscheme

total momentum does not change/is constant; } *(do not allow “momentum is conserved”)*
provided external force is zero / no external forces / isolated system;

Examiners report

[N/A]

17b. *[4 marks]*

Markscheme

impulse is the same/similar in both cases / momentum change is same;
impulse is force × time / force is rate of change of momentum;
time to come to rest is longer for car B;
force experienced by car B is less (so less likely to be damaged);

Examiners report

[N/A]

17c. *[2 marks]*

Markscheme

electric force per unit charge;
acting on a small/point positive (test) charge;

Examiners report

[N/A]

17d.

[8 marks]

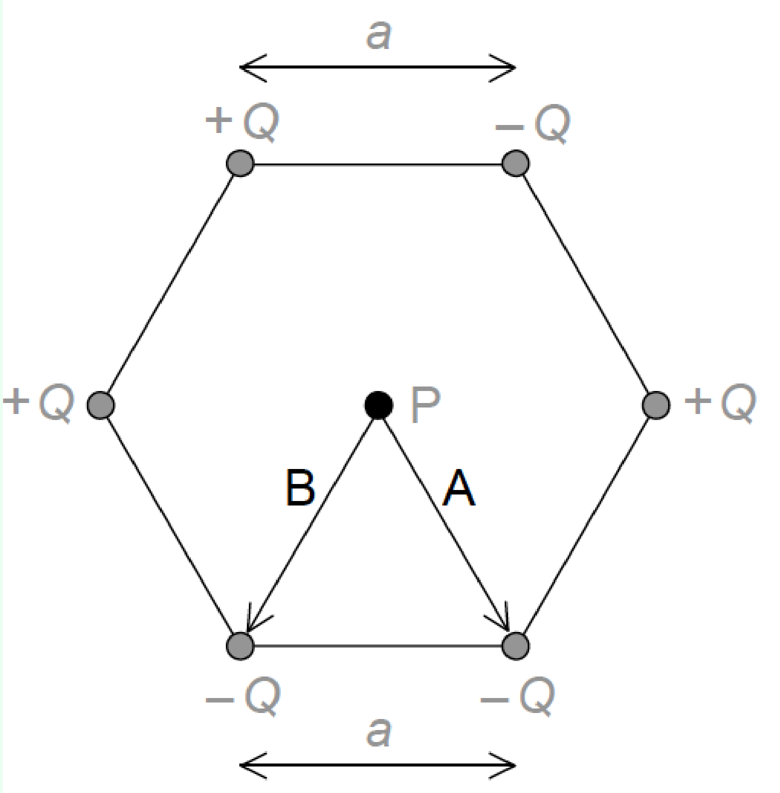
Markscheme

(i) states Coulomb's law as $\frac{kQq}{r^2}$ ***or*** $\frac{F}{q} = \frac{kQ}{r^2}$

states explicitly q=1;

states r=a;

(ii)



arrow labelled A pointing to lower right charge;

arrow labelled B point to lower left charge;

Arrows can be anywhere on diagram.

(iii) overall force is due to +Q top left and -Q bottom right / top right and bottom left and centre charges all cancel; }
(can be seen on diagram)

force is therefore $\frac{2kQ}{a^2}$;

2.6×106 (N C^{-1}) ;

towards bottom right charge; *(allow clear arrow on diagram showing direction)*

Examiners report

[N/A]

18.

[1 mark]

Markscheme

D

Examiners report

Air resistance depends upon speed, so initially, when the body is increasing in speed, the acceleration will be decreasing. Hence A and C can be immediately discounted. Many candidates chose C which indicated that they clearly had not read the question carefully. As the body approaches terminal velocity so its acceleration approaches zero, indicating D as the correct answer. Unfortunately though, D also indicates a sudden decrease in the acceleration initially whereas it should be a gradual decrease (as in C). Both B and D were accepted as correct answers to this question.

19. *[1 mark]*

Markscheme

D

Examiners report

[N/A]

20. *[1 mark]*

Markscheme

D

Examiners report

[N/A]

21. *[1 mark]*

Markscheme

C

Examiners report

A was a popular choice. Candidates should be taught the conceptual difference between momentum and kinetic energy and realise that if the momentum of two moving objects of different mass is the same, then their kinetic energy can never be the same.

22. *[1 mark]*

Markscheme

A

Examiners report

Newton's third law is often poorly understood, so it is pleasing to see so many correct responses to this question. If candidates have been correctly taught that the force of X on Y will be equal and opposite to the force of Y on X, then the only possible answers are A or B.

23. *[1 mark]*

Markscheme

D

Examiners report

[N/A]

24. *[1 mark]*

Markscheme

C

Examiners report

[N/A]

25. *[1 mark]*

Markscheme

B

Examiners report

[N/A]

26. *[1 mark]*

Markscheme

D

Examiners report

Gradient is in ms^{-1} giving a speed, so A and B must be wrong. Most candidates went for C although it is the only one that does not have a non-zero initial velocity.

27. *[1 mark]*

Markscheme

C

Examiners report

The area gives force times distance, that is, energy. This leads directly to C.

28. *[1 mark]*

Markscheme

B

Examiners report

29. *[1 mark]*

Markscheme

C

Examiners report

30.

[1 mark]

Markscheme

C

Examiners report

[N/A]

31.

[1 mark]

Markscheme

D

Examiners report

[N/A]

32.

[1 mark]

Markscheme

C

Examiners report

[N/A]

33.

[1 mark]

Markscheme

B

Examiners report

There were some comments from teachers that candidates should not need to count squares. However, dropping a vertical from the reaction arrow and continuing the friction line backwards would reveal both C and D as incorrect.

34.

[1 mark]

Markscheme

D

Examiners report

Candidates are often under the misapprehension that there are conditions upon Newton’s third law. It should be stressed that it is always true irrespective of energy or momentum considerations; and it does not depend upon the state of motion of the bodies in contact.

35.

[1 mark]

Markscheme

A

Examiners report

[N/A]

36.

[1 mark]

Markscheme

A

Examiners report

[N/A]

37.

[1 mark]

Markscheme

C

Examiners report

[N/A]

38.

[1 mark]

Markscheme

B

Examiners report

Candidates should understand technical language such as ‘dissipated’ even if they are working in a second language.

39.

[1 mark]

Markscheme

A

Examiners report

This is a perfect example of a question that can be ‘seen’ without any calculation. If θ is zero the height will be zero – so it is either A or C. From consideration of the units, C gives a time (in seconds) so must be discounted.

40a.

[2 marks]

Markscheme

(i) 2.0 ***or*** 0(ms^{-1});
(ii) 1.0 ***or*** 0(ms^{-1});

Examiners report

Most were able to identify the relative speeds. The markscheme was amended to also include answers in terms of velocity.

40b. *[6 marks]*

Markscheme

(i) her direction is changing;
hence her velocity is changing;
or
since her direction/velocity is changing;
a resultant/unbalanced/net force must be acting on her (hence she is accelerating);

(ii) arrow from Aibhe towards centre of merry-go-round;
Ignore length of arrow.

(iii) the force of the merry-go-round on Aibhe/her;

(iv) no force is acting on the upper body towards the centre of the circle / no centripetal force acting on the upper body (to maintain circular motion);
upper body (initially) continues to move in a straight line at constant speed/ velocity is tangential to circle;

Examiners report

i) This was well-answered with most identifying a change in direction and a change in velocity.

ii) The majority were able to show the direction of the centripetal acceleration.

iii) Few identified a force that would act on Aibhe. They did not realize that the centripetal force is the resultant of the forces acting.

iv) Few realized from the diagram that it would be difficult provide an inward directed force on Aibhe's upper torso. The consequence of this is that it would tend to continue to move in a direction which is tangential to the circle.

40c. *[2 marks]*

Markscheme

distance travelled by Euan=$4.0 \times 2\pi \times 1.5\,(= 37.70\mathrm{m})$;
$W\,(= F_{av}d = 45 \times 37.70) = 1700\,(\mathrm{J})$;

Examiners report

This was well done by many.

40d. *[5 marks]*

Markscheme

(i) Aibhe's period of revolution is the same as before;
from $v = \frac{2\pi r}{T}$, since *r* is halved, *v* is halved;
v=0.5(ms^{-1});
*Award **[3]** for a bald correct answer.*

(ii) $a\left(= \frac{v^2}{r}\right) = \frac{0.5^2}{0.75}$;
a=0.33(ms^{-2});
Allow ECF from (d)(i).
*Award **[2]** for a bald correct answer.*

Examiners report

i) Many scored three marks here.

ii) Most candidates were able to gain both marks.

41.

[1 mark]

Markscheme

B

Examiners report

Although in an examination, candidates still need to appreciate when they may need to take a little more time to fully understand the question and appreciate the labelling on the axis of the graphs. A sizeable number of candidates opted for A despite this being the only graph which begins with an acceleration of 0. The typical velocity-time graph for objects falling in air would be of this shape and this seems to led to confusion for these candidates.

42.

[1 mark]

Markscheme

D

Examiners report

[N/A]

43.

[1 mark]

Markscheme

A

Examiners report

[N/A]

44.

[1 mark]

Markscheme

A

Examiners report

[N/A]

45.

[1 mark]

Markscheme

C

Examiners report

This question proved to be difficult for candidates with many opting for the distractors B and D. Candidates should know that in calculating work done by a varying force $F_{average}$ needs to be used rather than the initial or final force.

46.

[1 mark]

Markscheme

D

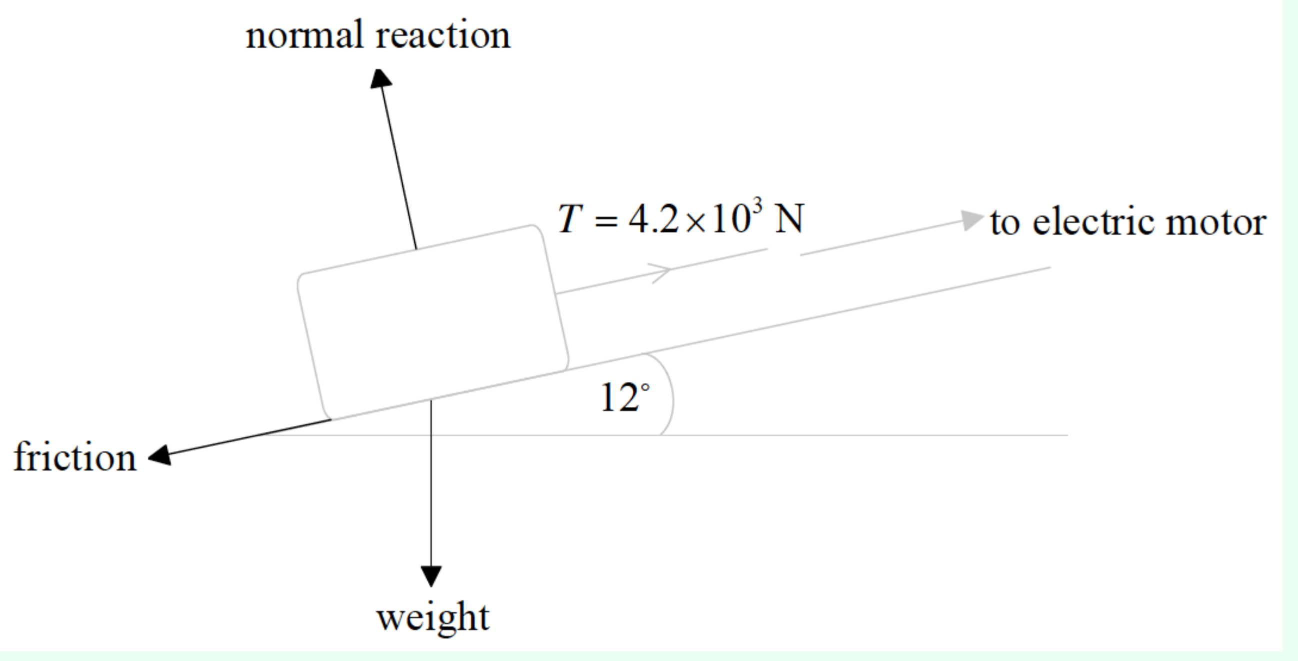
Examiners report

Although the ball is launched with a velocity of *V*, the question refers to the vertical component. Therefore, the initial velocity in the vertical direction must be less than this value. Many candidates failed to pick up on this point.

47a.

[2 marks]

Markscheme



(normal) reaction/*N*/*R* and weight/force of gravity/gravity force/gravitational force/*mg*/*w*/*W* with correct directions;
friction/frictional force/*F*/F_f with arrow pointing down ramp along surface of ramp;
Do not allow "gravity" as label. Do not allow "drag" as label for friction.

Examiners report

[N/A]

47b.

[3 marks]

Markscheme

recognize that friction=T-$W \sin \theta$;
$W \sin \theta = 3.1 \times 10^3$N;
friction=1.1×10^3N;

Examiners report

[N/A]

48a.

[1 mark]

Markscheme

the net (external) force acting on the system is zero / no force acting on system / system is isolated;

Examiners report

[N/A]

48b. *[5 marks]*

Markscheme

(i) no external force/system is isolated so change in momentum is zero; { *(do not accept momentum is conserved/constant)*
force on ball must be equal and opposite to force on the person;
so ball and person/Earth/pond move in opposite directions;

(ii) Newton's second law states that the rate of change of momentum is equal/proportional/directly proportional to the force acting;
the horizontal force acting on the ball is zero therefore the momentum must be constant/the rate of change of momentum is zero;

or

Newton's second law can be expressed as the force acting is equal to the product of mass and acceleration;
the horizontal force acting on the ball is zero therefore the acceleration is zero so velocity is constant (and therefore momentum is constant);

Examiners report

[N/A]

48c. *[2 marks]*

Markscheme

$F = \frac{P}{v}$ ***or*** $\frac{0.75 \times 10^6}{44}$;
17kN;

Examiners report

[N/A]

48d. *[4 marks]*

Markscheme

(i) 3.7×4.0=10×v;
v=1.5ms^{-1};

(ii) KE lost$= \frac{1}{2}\left[3.7 \times 10^3 \times 4.0^2\right] - \frac{1}{2}\left[10 \times 10^3 \times 1.5^2\right]$;
=18kJ;

Examiners report

[N/A]

48e. *[3 marks]*

$= \left(\frac{1}{2}\left[10 \times 10^3 \times 1.5^2\right] =\right) 11250\text{J}$

$= \frac{11250}{40}$

–1

3

Examiners report

[N/A]

48f.

[5 marks]

Markscheme

(i) methane/CH_4, water vapour/H_2O, carbon dioxide/CO_2, nitrous oxide/N_2O;
*Award **[1]** for any two of the above.*

(ii) *mechanism:*
mention of resonance;
natural frequency of (resonating) greenhouse gas molecules is same as that of infrared radiation from Earth;

or

mention of energy level differences;
differences between energy levels of greenhouse gas molecules matches energy of infrared radiation from Earth;

explanation:
less infrared trapped if absorption is reduced;
so more infrared is transmitted through atmosphere;

or

more infrared is trapped if absorption is increased;
so more infrared is re-radiated back to Earth;
Allow only one variant for each alternative.

Examiners report

[N/A]

49.

[1 mark]

Markscheme

A

Examiners report

Response C was the most popular one at both levels. The magnitude of the gradient is the acceleration due to gravity, which of course is constant close to the Earth"s surface.

50.

[1 mark]

Markscheme

D

Examiners report

At SL more candidates thought that there was zero change in momentum (Response A) than the correct 2*mv* (Response D). This was a popular choice at HL too but the majority recognised this standard piece of bookwork.

51.

[1 mark]

Markscheme

C

Examiners report

A clear majority of candidates recognized that both a sine and a cosine would be involved but a high proportion was unable to correctly perform the resolution.

52.

[1 mark]

Markscheme

D

Examiners report

Most candidates recognised that 19N could not be achieved with these three forces but a sizeable proportion at both levels believed that they could not be added to total zero.

53.

[1 mark]

Markscheme

D

Examiners report

B and C proved to be effective distracters here. The ball would be at rest at the highest point after the bounce and with the bounce occurring at ABC (which would be a very steep negative slope on a larger scale). The correct response can only be D.

54.

[1 mark]

Markscheme

A

Examiners report

Looking at the units helps here: with force in N and velocity in ms^{-1} the product will be in Nms^{-1} or Js^{-1} that is, W; so the correct response must be power.

55.

[1 mark]

Markscheme

C

Examiners report

[N/A]

56.

[1 mark]

Markscheme

A

Examiners report

Response B was popular here despite D not being so. This would mean that the accelerating force would be the same on the skier and the boat despite significant difference in mass and both moving together.

57.

[1 mark]

Markscheme

C

Examiners report

[N/A]

58.

[1 mark]

Markscheme

B

Examiners report

No work is done only if there are no forces on the object. So clearly the only possible answer is B.

59.

[1 mark]

Markscheme

B

Examiners report

[N/A]

60a.

[4 marks]

Markscheme

(i) (gravitational) potential energy (of club head) goes to kinetic energy (of club head);

some kinetic energy of club head goes to internal energy of club head/kinetic energy of ball;

(ii) equating mgh to $\frac{1}{2}mv^2$;

v=4.1(ms^{-1});

*Award **[0]** for answers using equation of motion – not uniform acceleration.*

Examiners report

(i) Nearly all candidates gained a mark for recognising the change from kinetic to potential energy in this part. Fewer recognised that the club head would not transfer all of its energy to the ball and therefore retained a significant amount of energy.

(ii) This part was well done by many.

60b. *[2 marks]*

Markscheme

deformation prolongs the contact time;

increased impulse => bigger change of momentum/velocity;
or
(club head) stores (elastic) potential energy on compression;

this energy is passed to the ball;

Examiners report

A minority of candidates became bogged down by the deformation of the ball and club head idea and ventured into elastic potential energy ideas. This had a successful outcome in many cases when there was discussion of the compression providing further kinetic energy to the ball on recovering its shape. The most straightforward solution was to use to principle of impulse being equal to the change in momentum (as shown in the question heading) and simply to recognise that an increased contact time would be expected to give a greater change of momentum for a constant force.

60c. *[5 marks]*

Markscheme

(i) any value of $\frac{\text{mass}\times\text{velocity}}{\text{time}}$;

1.3×10^4 (N);

(ii)-1.3×10^{-4} (N);

Accept statement that force is in the opposite direction to (c)(i).

Allow the negative of any value given in (c)(i).

(iii) clear use of conservation of momentum / impulse = change of momentum;

21(ms^{-1});

or

$a = \left(\frac{F}{m} = \frac{-13000}{0.17} =\right)(-)\,76500\,\left(ms^{-1}\right)$;
$v = (u + at = 38 - 76500 \times 0.00022 =)$ 21(ms^{-1});

*Award **[2]** for a bald correct answer.*

Examiners report

(i) This was well done with the only real problem being deciding which was the speed change of the ball.

(ii) Less candidates than anticipated recognised that the force on the club head was equal and opposite to that acting on the ball (applying Newton’s third law of motion).

(iii) Most made a good attempt at calculating the speed of the club head.

61a. *[2 marks]*

Markscheme

force per unit charge;

on a positive test charge / on a positive small charge;

Examiners report

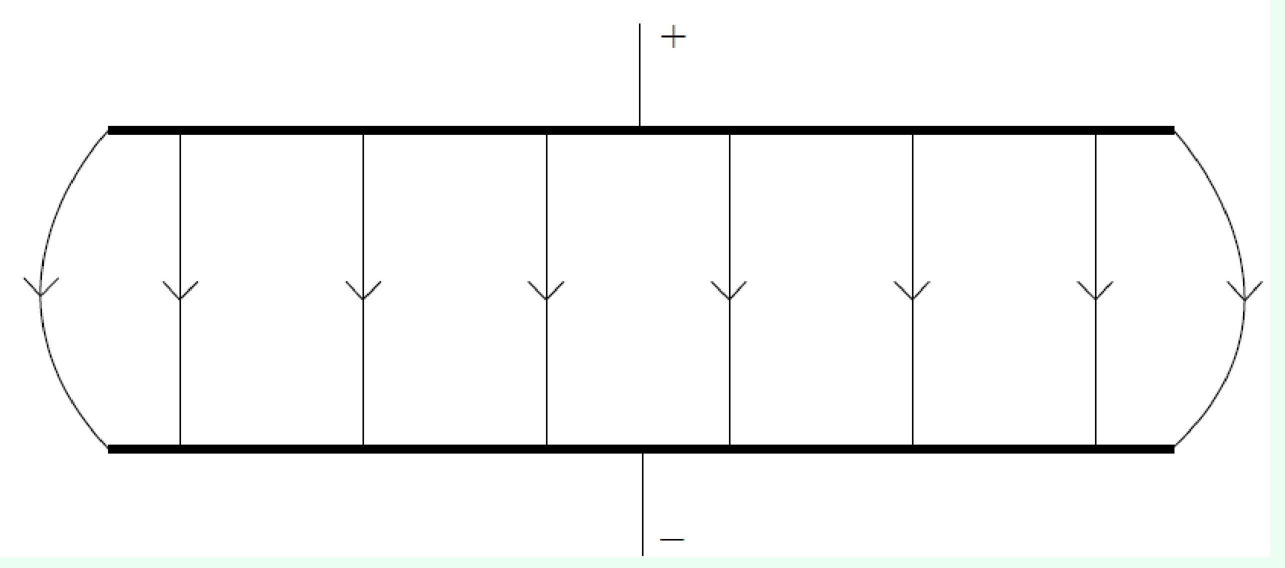
(i) As this is worth two marks, candidates should see the signal that force per unit charge is unlikely to gain full marks; and so it proved. Although a mark was available for saying this there needed to be a reference to the charge being a positive test charge.

61b. *[5 marks]*

Markscheme

(i) top plate positive and bottom negative (or +/- and ground);

(ii)



uniform (by eye) line spacing and edge effect, field lines touching both plates;

downward arrows (minimum of one and none upward);

(iii) $F=2.5\times10^{3}\times1.6\times10^{-19}$
4.0×10^{-16} (N);

*Award **[2]** for a bald correct answer.*

Examiners report

(i) G2 comments that the term ‘polarity’ was confusing to candidates proved to be unfounded and nearly all candidates marked in a positive and negative terminal – although the actual polarity was often incorrect.

(ii) With error carried forwards, the direction of the field was often correct but the drawing often was below an acceptable standard with line of force not bridging the plates, being very unevenly spaced and having no edge effect.

(iii) This calculation was almost invariably very well done.

61c. *[8 marks]*

Markscheme

(i) use of $F = \frac{(1.60\times10^{-19})^2}{4\pi\varepsilon_0(5.0\times10^{-3})^2}$ ***or*** $F = \frac{(1.60\times10^{-19})^2}{(5.0\times10^{-3})^2} \times 8.99 \times 10^9$;

9.2×10^{-24}(N);

(ii) 1.0×10^7 (ms^{-2}) (9.9×10^6 (ms^{-2}) if 9×10^{-24} (N) used);

(iii) electron will continue to accelerate;
speed increases with acceleration;
acceleration reduces with separation;
when outside the field no further acceleration/constant speed;
any reference to accelerated charge radiating and losing (kinetic) energy;

(iv) minimum of two concentric circles centred on Y;
anti-clockwise;

Examiners report

(i) In another 'show that' question it was expected that candidates would use Coulombs law and the data value for the electronic charge to give a value of more than one digit; often this was not the case but otherwise this was generally well done

(ii) Most candidates used their value for the force (or 9 x 10-24 N) and the mass of the electron on the data sheet to calculate a correct value for the acceleration.

(iii) This was an unusual opportunity for candidates to use Newton's laws and many did say that the acceleration would decrease with distance. Too often they incorrectly believed that this meant that the electron would slow down – it continues to accelerate but at an ever decreasing rate.

(iv) Clearly, this part represented a simplification of a complex situation but as set up was not beyond the skills of most of the candidates. The electron represents an instant in which a conventional current would leave the page and the field at this instant would be that of concentric circles with an anti-clockwise (counter-clockwise) direction. Many candidates did draw this but diagrams were too frequently hurriedly drawn and of a poor standard.

62a. *[3 marks]*

Markscheme

(i) s=12.5/12.6 (m);
Allow g =10ms^{-2} , answer is 12.8.

(ii) $v = \sqrt{2gs}$ ***or*** *gt; (allow any use of suvat equations)*
$= \left(\sqrt{2 \times 9.8 \times 12.5} =\right) 15.7 \left(\mathrm{ms}^{-1}\right)$;
*Award **[2]** for a bald correct answer.*
Allow g = 10ms^{-2} answer is 16.0 ms^{-1}.
Allow ECF from (a)(i)

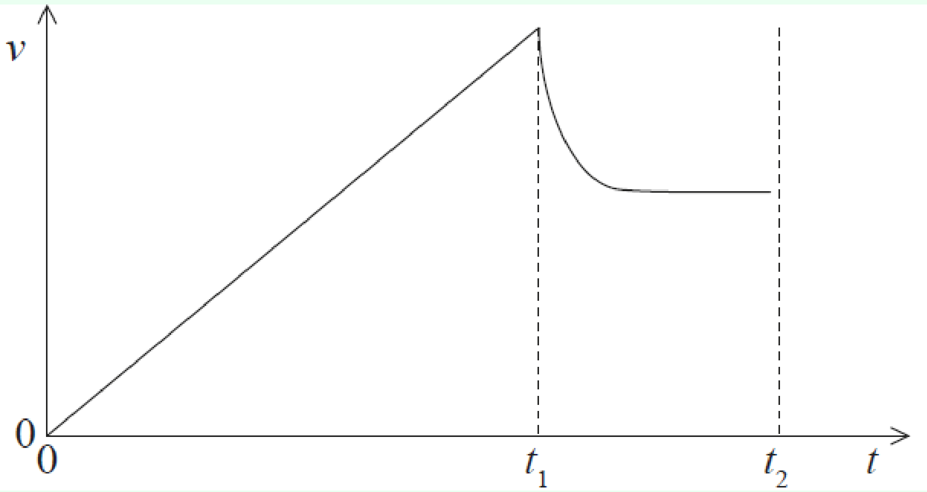
Examiners report

(i) and (ii) These were high scoring questions with a substantial number of correct solutions. Even those who could not answer (i) were able to take their incorrect value and use it correctly in (ii).

62b.

[3 marks]

Markscheme



straight line to water surface; *(allow a slight curve within 10 % of t_1)* clear decrease after hitting surface; (*allow straight line or concave curve as shown, do not allow convex curve*)

constant non-zero speed reached smaller than maximum; (*speed must be less than maximum velocity*)

Do not penalize answers where a curve is drawn to the dotted lines as there should not be a discontinuity at the two lines. Do not penalize if the line continues to t_2 or zero velocity shown at t_2.

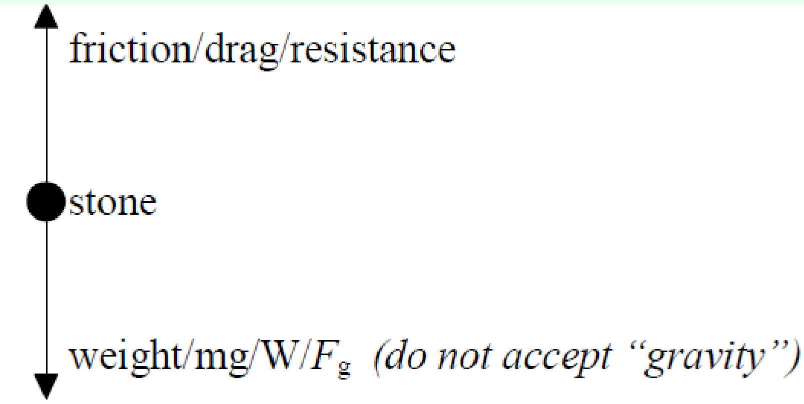
Examiners report

This part was not straightforward and demands some thought by candidates – ideally before they put pen to paper. A number of candidates achieved two marks. Common faults included: setting the final speed in the water at higher than the final speed in air; a significantly curved first section before t_1; incorrect curvature between t_1 and t_2 and lack of a final constant speed or a zero final speed.

62c.

[2 marks]

Markscheme



correctly labelled forces;

correct direction and equal lengths; *(judge by eye)*

Accept co-linear/vector arrows that do not begin at the stone.

Accept arrow heads finalizing at the stone.

Treat mention of upthrust as neutral.

Examiners report

This straightforward question was not well done. Many candidates did not draw two clear lines of appropriate length with a ruler – crude, free-hand sketches were very common. The question asks for labelling and this should be done with words, not symbols. Mention of up thrust was not required in the answer, although its inclusion was treated as neutral.

63a.

[2 marks]

Markscheme

if the net external force acting on a system is zero;
the momentum of the system remains constant/unchanged/the same;

or

for a closed system;
the momentum remains constant/unchanged/the same;
*Award **[1]** for "momentum before collision equals momentum after collision".*
Do not accept "momentum is conserved".

Examiners report

A common error re-emerged in this examination. If asked to state a law of conservation a candidate must *not* simply say that the "quantity is conserved". This tells the examiner nothing (other than that the candidate has read the question) and will never attract marks. This is a simple examination skill that many candidates continue to fail to learn.

63b.

[3 marks]

Markscheme

identifies the system as rocket + exhaust gases / total momentum of rocket and gas is equal before and after; (*it must be clear that this is the system, a mention of rocket and gases is not enough)*

no external forces act on this system / closed system;

increase/change in momentum of the gases is equal and opposite to the increase/change of momentum of the rocket;

Examiners report

Few were able to give adequate discussions of the how momentum conservation applies to one of the most common cases discussed in teaching at this level, that of a rocket in free space. There was no clear recognition that the system is closed or even what the system is or that the important factor is the *change* in momentum of the fuel and therefore the rocket. These are difficult ideas for candidates to grasp but examiners expected better attempts from the most able.

63c.

[4 marks]

Markscheme

(i) attempts to use conservation of momentum, *eg* $8.0\times1.3=52\times v$;
$v=0.20(\text{ms}^{-1})$;
*Award **[2]** for a bald correct answer.*

(ii) identifies new mass as 75.3(kg);
$V=0.14(\text{ms}^{-1})$;

Examiners report

(i) This was well done.

(ii) About one-third of candidates failed to recognise that the mass of Joe needs to have the mass of the ball added to it for a correct solution of the problem

64. *[1 mark]*

Markscheme

C

Examiners report

[N/A]

65. *[1 mark]*

Markscheme

B

Examiners report

The most popular response was A. It can only be guessed that perhaps the candidates were confusing the gravitational field strength with the acceleration of the body despite the clear reference to terminal speed in the stem.

66. *[1 mark]*

Markscheme

A

Examiners report

The statistics indicate that a good number of candidates overlooked the fact that velocity is a vector quantity. So its change, in this question is 8.0 ms^{-1}, not 2.0 ms^{-1}.

67. *[1 mark]*

Markscheme

C

Examiners report

The candidates were clear that the acceleration was decreasing – so had linked this conceptually with the decreasing force. Around half of candidates perhaps confused acceleration with velocity and decided the kinetic energy must also be decreasing.

This question is modelling what happens when an arrow is fired and as such it will be obvious that the speed is increasing while the arrow is in contact with the string.

68. *[1 mark]*

Markscheme

D

Examiners report

[N/A]

69.

[1 mark]

Markscheme

C

Examiners report

[N/A]

70.

[1 mark]

Markscheme

A

Examiners report

On the surface of a planet the gravitational field strength can be taken as invariant. This did not confuse the candidates although there were a number of teachers who wondered how high the crater was and whether this would affect the acceleration.

71a.

[2 marks]

Markscheme

if no external forces act / isolated system;
momentum is constant / (total) momentum before=(total) momentum after;

Examiners report

[N/A]

71b.

[7 marks]

Markscheme

(i) use of $v = \sqrt{2gh}$;
6.11ms^{-1}; *(must show calculation to better than 1 sf)*

(ii) rate of change of vertical momentum=13×6.11;
79N; *(accept answers in the range of 78N to 80N)*

(iii) mass accrued=5.0×13=65kg;
weight of this mass (=65×9.8)=637N; *(650 from g=10ms^{-2})*
total force (637+79=)716N; } *(allow ECF from (b)(ii) and from incorrect weight)*

Examiners report

[N/A]

71c.

[4 marks]

Markscheme

(i) 14.6Js^{-1};

(ii) horizontal momentum gain per second =13×1.5(=19.5kgms^{-1});
power required=29.3W;

(iii) additional energy/power required to accelerate gravel (through friction at the surface of the belt) / the gravel has to slip to gain horizontal speed / *OWTTE*;

Examiners report

[N/A]